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**Design Discipline and Issuing Authority (IA)**

Documents have been prepared and issued by each Issuing Authority as follows:  
Architect (A), Professional Engineer – Structural (S), Professional Engineer –  
Mechanical (M), Professional Engineer – Electrical (E), Vertical Transportation (VT),  
Landscape Architect (L), Hardware (H), Professional Engineer – Civil (C), Security  
Consultant (SE), Audio-Visual Consultant (AV), Communications Consultant (COMM).

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**1. GENERAL**

**1.1 AVAILABLE INFORMATION AVAILABLE TO BIDDERS \***

- 1.1.1 Investigation documents are available for review in Owner's purchasing documents.
- 1.1.2 Following Report(s) and document(s) are for information only. Neither Consultant nor Owner assumes any liability for items extracted from documents. These documents do not form part of Contract Documents

**1.2 REPORTS \***

- 1.2.1 Geotechnical Investigation Report:
  - .1 A copy of a geotechnical investigation report and related letters prepared by Owner's consultant for the Place of the Work are available for review. Refer to following:
    - .1 "Geotechnical Engineering Report – Dixie and Dockstader Road, Brampton, Ontario", dated 4 December, 2023, prepared by Grounded Engineering Inc.
- 1.2.2 Hydrogeological Report:
  - .1 A copy of a hydrogeological report and related letters prepared by Owner's consultant for the Place of the Work are available for review. Refer to following:
    - .1 "Hydrogeological Review Report – Dixie and Dockstader Road, Brampton, Ontario", dated 11 October, 2023, prepared by Grounded Engineering Inc.
- 1.2.3 Excess Soil Plan:
  - .1 A copy of a excess soil plan and related letters prepared by Owner's consultant for the Place of the Work are available for review. Refer to following:
    - .1 "Excess Soil Implementation Plan – Peel Region Paramedic Services Reporting Station, Brampton, Ontario", dated 31 August, 2023, prepared by Grounded Engineering Inc.
- 1.2.4 Building Code Report:
  - .1 A copy of a building code report and related letters prepared by Owner's consultant for the Place of the Work are available for review. Refer to following:

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- .1 “Building Code Outline Report – Paramedic Services Reporting Station, Brampton, Ontario”, dated 24 May, 2024, prepared by LMDG.
  - 1.2.5 Hydrant Flow Test Report:
    - .1 A copy of a hydrant flow test report and related letters prepared by Owner's consultant for the Place of the Work are available for review. Refer to following:
      - .1 “Hydrant Flow Test Report – Dixie and Dockstader, Brampton, Ontario”, dated 12 October, 2023, prepared by BA Fire Safety.
  - 1.2.6 Acoustic Report:
    - .1 A copy of an acoustic report and related letters prepared by Owner's consultant for the Place of the Work are available for review. Refer to following:
      - .1 “Acoustic, Noise and Vibration Control Basis of Design Report – Part of Block 5, Plan 43M-1907, Brampton, Ontario”, dated 26 March, 2024, prepared by Thornton Tomasetti.
  - 1.2.7 Storm Water Management Report:
    - .1 A copy of a storm water management report and related letters prepared by Owner's consultant for the Place of the Work are available for review. Refer to following:
      - .1 “SWM Pond Drawing, Employment Lands, Countryside Village”, dated August, 2012 (revised October, 2012), prepared by Schaeffers Consulting Engineers.
  - 1.2.8 OTTSWMM Analysis Report:
    - .1 A copy of a OTTSWMM analysis report and related letters prepared by Owner's consultant for the Place of the Work are available for review. Refer to following:
      - .1 “OTTSWMM Analysis Report, Countryside Villages Employment Block, City of Brampton”, dated December, 2011 (revised October, 2012), prepared by Schaeffers Consulting Engineers.
  - 1.2.9 LCA Report:
    - .1 A copy of an LCA report and related letters prepared by Owner's consultant for the Place of the Work are available for review. Refer to following:
      - .1 “Life Cycle Assessment Report – PRPS Reporting Station, Dockstader”, dated 9 September, 2024, prepared by Introba.

**LEGEND**

*\* - Documents provided by the Owner have been prefixed by an asterisk and are not included under, nor governed by Diamond Schmitt Architects Inc.'s seal.*

END OF SECTION

**1. GENERAL**

**1.1 Work Covered By Contract Documents**

- 1.1.1 Work of this Contract identified as Dockstader PRPS - 221033 includes furnishing labour, materials, equipment, services and other related expenses to complete requirements specified under Contract Documents.
- 1.1.2 General Project Description: The project consists of new construction for an EMS Station situated on a greenfield site, in compliance with the Ontario Building Code, 2012. The primary structures will include essential EMS facilities and support spaces with associated infrastructure. Project is to be designed and constructed as a post-disaster building.
- 1.1.3 Project is located at 6 Dockstader Road, Brampton, ON
- 1.1.4 Contract Type: Project is to be governed by a CCDC 2-2020 contract.
- 1.1.5 Without limiting generality of foregoing, Contractor is responsible for coordination of various parts of the Work so that no part is left in an unfinished or incomplete condition.

**1.2 Work By Owner Or Under Other Contracts**

- 1.2.1 Ensure full cooperation with separate contractors to enable smooth execution of such contracts without interference or delay to Work of this Contract. Coordinate Work of this Contract with work under separate contracts.
- 1.2.2 Immediately report defects, which affect quality and performance of the Work, in writing to Consultant. Commencement of parts of the Work of this Contract, in existing areas and in areas provided by other contractors, will be deemed to signify Contractor's acknowledgment and acceptance of those parts of the Work.
- 1.2.3 NIC Work: "NIC" refers to Work not performed or provided under this Contract. "NIC" signifies "Not In this Contract" or "Not a Part of Work by Contractor". NIC Work may be shown on Drawings and in scheduling amount of time and materials necessary for completion of Contract.

**1.3 Owner-Supplied / Contractor-Installed Products**

- 1.3.1 Owner Responsibilities:
  - .1 Order and pay for Owner-supplied Products not already in Owner's possession.

- 
- .2 Arrange and pay for delivery of Owner-supplied Products F.O.B. the site, within time frames required by Contractor's progress schedule. If delivered sooner than required by Contractor's latest progress schedule submitted to Owner, arrange and pay for delivery to a temporary storage location and subsequent delivery to the site.
  - .3 Advise Contractor in writing of the value of Owner-supplied Products for Contractor's insurance purposes.
  - .4 Arrange and pay for delivery to Contractor of reviewed Shop Drawings, Product data, samples, and manufacturer's installation instructions.
  - .5 Inspect deliveries jointly with Contractor.
  - .6 Submit claims for transportation damage.
  - .7 Arrange for replacement of damaged, defective or missing items identified at time of delivery.
  - .8 Arrange for manufacturer's field services.
  - .9 Arrange for delivery of manufacturer's warranties to Contractor for inclusion in operation and maintenance manual.
- 1.3.2 Contractor Responsibilities:
- .1 Designate in progress schedule, time frames for delivery of Owner-supplied Products to the site and for receipt of related submittals. If the site is not ready to receive delivery of Owner-supplied Products within the time frame indicated in the latest progress schedule submitted to Owner, arrange and pay for delivery to a temporary storage location and subsequent delivery to the site.
  - .2 Review all required submittals and notify Consultant of any observed discrepancies or anticipated problems.
  - .3 Ensure that course of construction insurance is adequate to cover Owner-supplied Products.
  - .4 Receive and unload Owner-supplied Products at the site.
  - .5 Inspect deliveries jointly with Owner. Record and notify Owner and Consultant of shortages and visibly damaged or defective items.
  - .6 Handle Owner-supplied Products at site, including uncrating and storage. Dispose of waste materials and debris.
  - .7 Take appropriate precautions to protect Owner-supplied Products from loss or damage.
  - .8 Repair or replace items damaged on site.
  - .9 Assemble, install, connect, adjust, and finish Owner-supplied Products as specified.

- .10 Arrange for inspections required by authorities having jurisdiction as specified.
- .11 Arrange for or perform testing as specified.
- .12 Workmanship warranty for installation.
- 1.3.3 The following Products will be supplied by Owner and installed by Contractor:
  - .1 Refer to Drawings and Equipment Schedules.

#### **1.4 Sustainability Targets**

- 1.4.1 Project is targeting CaGBC Zero Carbon Building Standard Version 3 and Region of Peel's Net Zero Emissions Standard.
- 1.4.2 Refer to Section 01 35 69 for additional requirements.

#### **1.5 Specifications Language, Style And Conventions**

- 1.5.1 Imperative Mood: Specifications are written in imperative mood and in streamlined form. Imperative language is directed to Contractor, unless stated otherwise.
  - .1 Complete sentences by reading "shall", " Contractor shall", "shall be", and similar phrases by inference. Where a colon (:) is used within sentences and phrases, read the words "shall be" by inference.
  - .2 Fulfill and perform all indicated requirements whether stated imperatively or otherwise.
  - .3 When used in the context of a Product, read the word "provide" to mean "supply and install to result in a complete installation ready for its intended use".
- 1.5.2 Specification Structure: Specifications are arranged using a modified CSI/CSC 3-part SectionFormat® structure in 3 broad "Parts": 1. General, 2. Products and 3. Execution.
  - .1 Installation Requirements: Specifications are not intended as detailed description of installation methods but serve to indicate particular requirements in completing the Work. Where Contract Documents do not Provide sufficient information for complete installation of item, then as supplement, comply with manufacturer's written instructions for quality of Work.
- 1.5.3 Singular and Gender References: Where items in Contract Documents are referred to in singular, provide as many as required to complete the Work. Words used in one gender only are intended to be inclusive.
- 1.5.4 Drawings and Schedules: Use for scope and arrangement understanding; refer to them for item locations unless otherwise stated in Specifications.

- 1.5.5 Text Characteristics: No implied emphasis for text colour or hyperlink features.
- 1.5.6 Hyperlinks: May lead to external information, not part of Contract Documents unless specifically indicated.
- 1.5.7 Division 00 and Division 01 Requirements: General provisions of the Contract, including General Conditions and Supplementary Conditions, apply to all sections of the Specifications. Similarly, requirements of Sections in Division 01 are applicable to the Work of all sections of the Specifications.

**1.6 Project Coordination And Division Of Work**

- 1.6.1 Division of the Work among Trade Contractors, Subcontractors, and Sub-sub-contractors is solely Contractor's responsibility. Consultant and Owner assume no responsibility to act as an arbiter to establish subcontract limits between Sections or Divisions of the Work.
- 1.6.2 Scope and Extent Coordination:
  - .1 Analyze Contract Documents to define the extent of the Work. Coordinate scope and extent of work for each trade. Coordinate work of all trades including construction sequence, schedule and interfacing of all work. Coordinate work of each trade as required for satisfactory and expeditious completion of The Work. Ensure components to be built in are supplied in time with setting Drawings and other related information.
  - .2 Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of The Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
  - .3 Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation. Make adequate provisions to accommodate items scheduled for later installation.
- 1.6.3 Specifications and Drawings Organization: Organization of Specifications into CSI/CSC MasterFormat® Divisions or into 3-part SectionFormat® is solely for Contractor's convenience. This organization is not intended to determine subcontract limits between Sections or Divisions of the Work.
  - .1 Arrangement of Specifications, Drawings or schedules, must not affect Contractor's control or responsibility for dividing the Work or establishing each trade's scope of work.



- .2 Claims for additional compensation due to disputes between trades resulting from Contractor's lack of coordination will not be permitted.

**1.7 Contract Documents For Construction Purposes**

- 1.7.1 Electronic Documents: Owner will supply Contractor with complete set of Contract Documents in PDF format prior to commencement of The Work. Contractor is permitted to print hard copies for construction purposes.
- 1.7.2 "IFC" Documents: Contractor acknowledges that Drawings and Specifications labeled as "Issued for Construction" or "IFC" represent Consultant's best effort at incorporating revisions issued during addenda and bidding or negotiation phase. In case of discrepancies, omission or conflict between "Issued for Construction" documents and Contract Documents, Contractor must promptly notify Consultant.

**1.8 Original Data Files**

- 1.8.1 Files Provided Consultant: Consultant will provide data files in their original format for Contractor's use during construction process and for preparation of as-built or record drawings upon receipt of signed disclaimer. Files will be provided in two stages:
  - .1 Initial Files: One set of files will be provided at start of construction to assist in preparing coordination and interference drawings, Shop Drawings, and documenting actual site conditions.
  - .2 Updated Files: Updated files will be provided before Substantial Performance of the Work, intended to aid in the finalization of as-built or record drawings.
- 1.8.2 Data Accuracy Disclaimer: Consultant makes no representations as to accuracy or completeness of files as they relate to Contract Drawings.
  - .1 Copy of Contract Documents for the purpose of creating As-Built Drawings and other documentation may not include changes issued as Addenda, Supplementary Instructions, or Change Orders.
- 1.8.3 Format: Consultant will provide the Contractor with complete set of data files in "Revit" format and as available from respective Subconsultants.
- 1.8.4 Licensing Agreements for Use of Digital Files:
  - .1 Contractor's Data Licensing Agreement: Contractor must execute a data licensing agreement in a form acceptable to both the Owner and Consultant. A copy of Consultant's typical agreement is provided in Appendix A.

- .2 Subcontractors and Third Parties' Agreement: Subcontractors and other parties granted access by Contractor to Consultant's original data files must also execute a data licensing agreement in a form acceptable to both the Owner and Consultant.
- .3 Refer to Consultant's BIM Data Disclaimer document appended to this Section for additional information.
- 1.8.5 Fee: One set of original data files may be obtained at no cost from Consultant.

**1.9 Documents At The Site**

- 1.9.1 Keep the following documents at Place of the Work, stored securely and in good order and available to Owner and Consultant in hard copy and digital form:
  - .1 Current Contract Documents, including Drawings, Specifications and addenda.
  - .2 Change Orders, Change Directives, and Supplementary Instructions.
  - .3 Reviewed Shop Drawings, Product data and samples.
  - .4 Field test reports and records.
  - .5 Construction progress schedule.
  - .6 Meeting minutes.
  - .7 Manufacturer's certifications.
  - .8 Permits, inspection certificates, and other documents required by authorities having jurisdiction.
  - .9 Current as-built drawings.
  - .10 Safety Data Sheets (SDS) for all controlled Products.

**1.10 Contractor's Use Of Premises**

- 1.10.1 Except as otherwise specified, Contractor has unrestricted use of Place of the Work from time of Contract award until Ready-for-Takeover.
- 1.10.2 Confine Construction Equipment, Temporary Work, storage of Products, waste products and debris, and all other construction operations to limits required by laws, ordinances, permits, and Contract Documents, whichever is most restrictive. Do not unreasonably encumber Place of the Work.
- 1.10.3 Refer to Section 01 14 00 for additional requirements.

**1.11 Discrepancies/Conflicts/Omissions**

- 1.11.1 If discrepancies, conflicts, or omissions in Drawings, Specifications, or other Contract Documents are suspected or if there is uncertainty

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about their meaning or intent, such uncertainties must immediately be reported to Consultant.

- 1.11.2 Resolving Conflicting Specifications: In cases where Specifications require compliance with multiple requirements that establish different or conflicting quantities or quality levels, Contractor must adhere to most stringent requirement. Where requirements are stated differently, but have apparently equal effects, immediately notify Consultant and obtain instructions before proceeding.
- 1.11.3 Resolving Conflicting Reference Standards: If compliance with multiple reference standards is specified and such standards establish different or conflicting requirements for minimum quantities or quality levels, comply with most stringent requirement. Where requirements are stated differently, but have apparently equal effects, immediately notify Consultant and obtain instructions before proceeding.
- 1.11.4 Minimum Quantity or Quality Levels: Specified or illustrated quantities or quality levels represent minimum that must be provided or performed. Actual installation may meet minimum specified levels or exceed them within reasonable limits. Numeric values indicated are to be interpreted as minimum or maximum as appropriate. Uncertainties must be referred to the Consultant for clarification.
- 1.11.5 Comply with Consultant's written instructions or explanations and proceed accordingly. If Changes to the Work are suspected or required, refer to Section 01 26 00, for appropriate procedures to follow.

## **2 . PRODUCTS**

### **2.1 Not used**

## **3 . EXECUTION**

### **3.1 Not used**

END OF SECTION



384 Adelaide Street West, Suite 100  
Toronto, ON M5V 1R7

t: 416 862 8800

1050 West Pender Street, Suite 2010  
Vancouver, BC V6E 3S7

t: 604 674 0866

1776 Broadway, Suite 2200  
New York, NY 10019

t: 212 710 4329

www.dsai.ca  
info@dsai.ca

Project Name: Dockstader PRPS

Project No: 221033

File Format(s): RVT, DWG

No. of Files:

File Name(s): (See table at the end of disclaimer)

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- 1.0** This Building Information Model (BIM) data is being provided at the request of and for the convenience of the recipient only. It may be incomplete, contain unintentional inaccuracies, or be partially obsolete. The user is further warned that, while all digital BIM data appears to be extremely accurate, this apparent accuracy is an artifact of the techniques used to generate it and is in no way intended to imply actual accuracy.
- 2.0** The drawings remain the contract documents. In the event of a discrepancy between model elements or between the model elements and the drawings, the model element author shall be notified. The user of this data takes full responsibility for the accuracy and correctness of all measurements, areas, inventories, etc. extracted from this data either manually or with the use of a computer.
- 3.0** The user is advised that any translation of BIM data from one computer system or environment to another can and often does result in the loss of important data. This loss can include but may not be limited to portions of text and dimensions, the existence, location or scale of symbols or other elements of graphics; the internal structure of data, including layers and data attributes; and the style or weight of lines. Diamond Schmitt Architects Incorporated makes no representations as to the usability of this BIM data on any system.
- 4.0** Users of the BIM data are advised to review all current versions, as well as subsequent versions, of project documentation for inconsistencies and revisions. It is the responsibility of the user to identify and make all required revisions or corrections to this data. Diamond and Schmitt Architects Incorporated will not routinely issue updates to BIM data.
- 5.0** By acceptance of this electronic media and the files it contains, the user agrees, to the fullest extent of the law, to indemnify and hold Diamond Schmitt Architects harmless from any damage, cost or liability, including but not limited to reasonable attorney's fees and cost of defense, arising from any changes made to these files by anyone other than Diamond Schmitt Architects Incorporated or from reuse of files and data without the prior written consent of Diamond Schmitt Architects Incorporated.

- 6.0** While reasonable care has been used to ensure that the transfer medium and the material are free of computer viruses, Diamond Schmitt Architects Incorporated accepts no responsibility for any loss or damage that might result from the transmission of computer viruses in this process.
- 7.0** The copyright of this BIM data belongs to Diamond Schmitt Architects Incorporated and it may not be altered, modified, copied, or transferred to another company or individual, either in part or whole, without express written permission from Diamond Schmitt Architects Incorporated. Diamond Schmitt Architects Incorporated grants the recipient non-exclusive license to use the BIM for construction purpose for this project only. The license includes the right to create a derivative model. Alterations are at the sole risk of the recipient making the alterations, and Diamond Schmitt Architects Incorporated shall have no responsibility for any alterations made.
- 8.0** Elements included in the BIM data such as, but not limited to, families, components, shared parameters, view templates, family templates and project templates are property of Diamond Schmitt Architects Incorporated and are protected by intellectual property laws including copyright laws. The recipient of the BIM data agrees to be bound by any such intellectual property and copyright laws and other than using it specifically for the above-mentioned project, shall not sell, transfer, modify, use, or otherwise incorporate these elements into its own office standards or it will be in violation of such laws.
- 9.0** If shop drawings are issued by the Contractor which appears to have made unaltered use of the BIM files issued by Diamond Schmitt Architects Incorporated, they will be returned without review. Under no circumstances can it be assumed that Diamond Schmitt Architects Incorporated working drawings are sufficiently detailed to become documents for final manufacturing (shop drawings).
- 10** The terms of this disclaimer are effective immediately upon the User's receipt of digital information.



Full Name: \_\_\_\_\_

Signature: \_\_\_\_\_

Company: \_\_\_\_\_

Date: \_\_\_\_\_

List of project files associated with provisions outlined in this BIM Data Disclaimer.

<b>File Name</b>	<b>Date</b>
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**1. GENERAL**

- 1.1.1 Use of Site: Contractor is granted unrestricted use of Place of the Work for construction purposes, as defined by Contract boundaries. Owner retains right to enter the Place of the Work, to perform work using their own forces, or engage other contractors to perform work of Project in accordance with General Conditions and Supplementary Conditions of the Contract.
- 1.1.2 Construction Activities and Boundaries: Confine construction activities and materials to area indicated on Drawings and within property lines. Where temporary extension of boundaries is required by Contractor to perform work of this Contract, obtain permission from Owner, and perform such work at no additional cost to Owner.
  - .1 Additional Storage or Work Areas: Obtain and pay for use of additional storage or work areas needed for operations under Contract.
- 1.1.3 Restoration of Paving and Landscaping: Restore paving, sidewalks, curbs, landscaping, and grass damaged during construction to conditions existing before construction operations began.
- 1.1.4 Work on Public or Municipal Property: comply with regulations of municipality and authorities having jurisdiction including associated fees, permits, insurance or bonding required.
- 1.1.5 Prohibition on Smoking and Controlled Substances: A strict no-tobacco, no-vaping, no-alcohol and no-controlled substances policy is to be enforced on project site and on Owner's property.
- 1.1.6 Construction of Temporary Access and Egress:
  - .1 Design and maintain temporary access and egress routes, including stairs, runways, ramps or ladders and scaffolding, independent of finished surfaces; comply with safety and regulatory standards of Authorities Having Jurisdiction. Maintain temporary entrances to building(s) including enclosed hoardings as required.
  - .2 Bridge excavations with construction to safely support loads that could be imposed and provide personnel to assist in deliveries to building(s) as required.
- 1.1.7 Restriction of Site Access to Non-Construction Personnel: Limit site access strictly to authorized individuals, except for visitors authorized by Contractor.
- 1.1.8 Temporary Vehicular Access and Parking: Refer to Section 01 50 00.

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2 . PRODUCTS

2.1 Not Used

3 . EXECUTION

3.1 Not Used

END OF SECTION



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**1. GENERAL**

**1.1 Cash Allowances**

- 1.1.1 Include in Contract Price specified cash allowances.
- 1.1.2 Cash allowances, unless otherwise specified, cover net cost to Contractor of services, products, construction machinery and equipment, freight, handling, unloading, storage, installation and other authorized expenses incurred in performing Work.
- 1.1.3 Contract Price, and not cash allowance, includes Contractor's overhead and profit in connection with such cash allowance.
- 1.1.4 Disbursements from Cash Allowances shall be authorized by Consultant in writing and by Change Order.
- 1.1.5 Contract Price will be adjusted by written order to provide for excess or deficit to each cash allowance.
  - .1 Where costs under a cash allowance exceed the amount of the allowance, unexpended amounts from other cash allowances may be reallocated to cover the shortfall.
- 1.1.6 Extend to Owner refunds, trade and quantity discounts which may be received in purchasing under Cash Allowances, except cash discounts for prompt payment.
- 1.1.7 Include progress payments on accounts of work authorized under cash allowances in Consultant's monthly certificate for payment.
- 1.1.8 Prepare schedule jointly with Consultant and Contractor to show when items called for under cash allowances must be authorized by Consultant for ordering purposes so that progress of Work will not be delayed.
- 1.1.9 At Consultant's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- 1.1.10 Purchase products and systems selected by Consultant from the designated supplier.
- 1.1.11 Submit invoices, summary statements or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- 1.1.12 Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.
- 1.1.13 Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

- 1.1.14 Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
- .1 If requested by Consultant, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.
- 1.1.15 Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.
- 1.1.16 Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.
- 1.1.17 Schedule of Cash Allowances: Provide cash allowances as follows:

No.	Cash Allowance Description	Amount
	<b>FF&amp;E</b> Cafeteria / Served Appliances: - Two (2) Traulsen G-Series Solid Door, 2 Section Refrigerators - Two (2) Miele G5006 U Active Dishwashers  Laundry Equipment - 1 x Tumble Dryer, UNIMAC Model# UT075NDNONBA3W0000. - 1 x Washer Extractor, UNIMAC Model# UWNO65T3LXU4001. - 1 x Firefighters PPE drying cabinet, UNIMAC, Model# UTGC6EDG4501W01. - 1x Georgia Steel & Chemical Co., Inc, Respirator washer, Model# GS5000.  Two (2) Ceiling Fans - Big Ass Fans Powerfoil X4	\$600,000.00

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No.	Cash Allowance Description	Amount
	<b>Forklift Equipment - Raymond</b> - Two (2) Raymond Universal Stance Deep-Reach Trucks, Model 7500 DR32TT with two (2) Energys 18-E125D-15 batteries, two (2) FLT-KBP18Y & PSI-829157 battery accessories and two (2) Energys NIP3-HL-4CI chargers for each truck. - Two (2) Bravi Sprint Man-up Orderpickers - One (1) Raymond 8210 Pallet Truck Model 8210-TF45L 48`x 27`, with Bilingual Decals, Standard Warranty Coverage and one (1) Stryten PalletPro Maintenance-Free Battery-Pack (Model M900004S24ELEG)	\$200,000.00
	<b>Racking/Spider Shelving – Metric Storage Systems</b> - Sixty-Four (64) Bays Closed Spider Shelving 48"W X 24"D X 147"H - Each bay of racking has 13 shelves and base delivery and installation	\$55,000.00

No.	Cash Allowance Description	Amount
	<b>Pick Stations – Metric Storage Systems</b> - four (4) wb1 cabinets - 144"w x 30"d Rousseau cabinets w/ 2" s/s base , top leveling glides, 2 x 60"w cabinets w 2 x 12"h drawers & painted plastic bin panels - four (4) wb1 garbage cabinets - 84"w x 40"d x 52"h garbage cabinet with custom 12" Hole is s/s top with 1 garbage drawer, systems: - five (5) wb1 cabinets - 60"w x 40"d x 52"h cabinets with 2" s/s base, top leveling glides, 2 x 60"w x 12"h drawers & painted plastic bin panels - three (3) wb2 cabinets - 108"w x 40"d x 81"h cabinet with s/s top , 2 x 4" 1 x 10", 1 x 12" drawers - power fee - one (1) wb2 cabinet + leg - 108"wide x40"dx76"high cabinets w/ 2" s/s base, top Leveling glides, 2 x 60"w , 2 x 4", 1 x 10" , 1 x 12`` drawers & 1 x powerfeed and plastic bin panels - one (1) wb3 garbage cabinet - 84"w x 40"d x 56"h cabinet with custom 12" hole in s/s top with 1 garbage drawer, 1 x open leg and painted plastci bin panel, 3 x power feed - one (1) wb3 cabinet - 60"w x 40"d Rousseau cabinets w/ 2" s/s base, top leveling glides, 1 x 60"w cabinet with 2 x 12" drawers, 1 x open leg , 2 x power feed, painted Plastic bin panel. Over head cabinets - delivery and installation	\$105,000.00

No.	Cash Allowance Description	Amount
	<b>(PALETTE PICK) Palette Racking - Metric Storage Systems</b> - 65 bays of pallet racking as per design, 100" wide x 37' tall with 5 beam levels per bay with wire mesh decks in all skid locations. - Included safety fencing between double deep bays and single bay. 54 x 12" high floor mounted post guards, 8 x cross aisle guards for single run of racking on east wall, all hardware - Engineered stamped drawings for building permitting - Delivery and installation - Delivery, rental and pickup of scissor lifts and forklifts	\$170,000.00
	<b>Refueling Station Canopy above grade - Refer to drawings for details.</b>	\$400,000.00
	<b>Signage + Wayfinding</b>	\$200,000.00
	<b>Cardboard Baler - MDA Compaction Bullpak 1050 Vertical Baler</b> - 600-208v, 3 phase, 10hp motor - Bale full light - Bale ties (1 bundle) - Auto eject and wire guides - Electrical disconnect on panel - Delivered and installation At Region of Peel - 1 year warranty labour, 2 year on parts, 3 year on structure - (6) semi-annual PM's included with purchase	\$35,000.00
	<b>Inspection and Testing, Including Tab Balancing</b>	\$500,000.00
	<b>AV Equipment and Implementation</b>	\$500,000.00
	<b>TOTAL OF CASH ALLOWANCES</b>	<b>\$2,415,000.00</b>

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2 . PRODUCTS

2.1 Not Used

3 . EXECUTION

3.1 Not Used

END OF SECTION

## **1. GENERAL**

### **1.1 Definitions**

- 1.1.1 Substitution: In this Section “Substitution” means a Product, a manufacturer, or both, not originally specified in Contract Documents by proprietary name but proposed for use by Contractor in place of a Product, a manufacturer, or both, specified by proprietary name.
- 1.1.2 Substitutions for Cause: Substitution proposed due to altered Project conditions like product unavailability, regulatory changes, or warranty issues. Owner will consider cases where Contractor’s proposed products can demonstratively improve Project’s embodied carbon targets over specified baselines.
- 1.1.3 Substitutions for Convenience: Substitution proposed due to perceived benefits, that may not necessarily be required for fulfill Project requirements.

### **1.2 Restrictions On Substitutions**

- 1.2.1 Adherence to Specifications: Use specified materials and manufacturers unless otherwise stated.
- 1.2.2 Bidding Period:
  - .1 Where the bid documents specify particular Products by proprietary name, the Consultant may consider substitutions during the bidding period, provided such requests are received, in writing, at least 10 Working Days before the bid closing time and are in accordance with requirements specified in this Section. If, upon review with the Owner, a substitution is reviewed without objections, the substitute Product will be named in an addendum. Otherwise, bidders must consider the substitution request rejected.
- 1.2.3 Substitutions for Convenience: Generally not permitted.
- 1.2.4 Substitutions for Cause: Substitutions for Cause during construction period may be proposed by Contractor when the terms "or approved equivalent", "or approved equal" or similar terms are used. Do not construe such language as invitation to unilaterally provide a Substitution without Consultant’s prior acceptance in writing. Do not order or install Substitutions without Supplemental Instruction or Change Order.
- 1.2.5 Review Process: Consultant will promptly review a proposed Substitution for Cause, provided submission includes all information specified in this Section under Submission Requirements For Proposed Substitutions.

- 1.2.6 Acceptance Criteria: Consultant may accept a Substitution if it can be satisfied that:
  - .1 the proposed substitute Product is the same type as, is capable of performing the same functions as, interfaces with adjacent work the same as, and meets or exceeds the standard of quality, performance and, if applicable, appearance and maintenance considerations, of the specified Product,
  - .2 the proposed substitute manufacturer has capabilities comparable to the specified manufacturer, and
  - .3 the Substitution provides a benefit to Owner.
- 1.2.7 Invalid Reasons for Substitutions: Delay in ordering specified Product in adequate time to meet construction schedule is not a valid reason for Consultant to accept a Substitution.
- 1.2.8 Documentation of Changes: Accepted Substitutions will be documented through a Supplemental Instruction or Change Order. Refer to Section 01 26 00.
- 1.2.9 Reversion Restrictions: Do not revert to original specified Product or manufacturer without Consultant's prior written acceptance.

### **1.3 Submission Requirements For Proposed Substitutions**

- 1.3.1 Substitution Request Form: Use form appended to this Section for all Substitution requests. Failure to use specified form will result in Consultant rejecting Substitution.
- 1.3.2 Include with each proposed Substitution the following information:
  - .1 Identification of the Substitution, including product name and manufacturer's name, address, telephone numbers, and web site.
  - .2 Reason(s) for proposing the Substitution.
  - .3 A statement verifying that the Substitution will not affect the Contract Price and Contract Time or, if applicable, the amount and extent of a proposed increase or decrease in Contract Price and Contract Time on account of the Substitution.
  - .4 A statement verifying that the Substitution will not affect the performance or warranty of other parts of the Work.
  - .5 Manufacturer's Product literature for the Substitution, including material descriptions, compliance with applicable codes and reference standards, performance and test data, compatibility with contiguous materials and systems, and environmental considerations.
  - .6 Product samples as applicable.
  - .7 For items identified with specific embodied carbon targets or transparency documentation such as EPDs, demonstrate that



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such items are below specified thresholds and have the required documentation.

- .8 A summarized comparison of the physical properties and performance characteristics of the specified Product and the Substitution, with any significant variations clearly highlighted.
- .9 Availability of maintenance services and sources of replacement materials and parts for the Substitution, as applicable, including associated costs and time frames.
- .10 If applicable, estimated life cycle cost savings resulting from the Substitution.
- .11 Details of other projects and applications where the Substitution has been used.
- .12 Identification of any consequential changes in the Work to accommodate the Substitution and any consequential effects on the performance of the Work as a whole. A later claim for an increase to the Contract Price or Contract Time for other changes in the Work attributable to the Substitution will not be considered.

## **2 . PRODUCTS**

### **2.1 Not Used**

## **3 . EXECUTION**

### **3.1 Not Used**

END OF SECTION

**1. GENERAL**

**1.1 Project Information**

1.1.1

1.1.2 Project: \_\_\_\_\_

1.1.3 From: \_\_\_\_\_

1.1.4 Date: \_\_\_\_\_

**1.2 Proposed Substitution**

**REFERENCE INFORMATION**

Specification Section Number and Title:

\_\_\_\_\_

Drawing Reference (if applicable):

\_\_\_\_\_

Page: \_\_\_\_\_ Article/Paragraph:

\_\_\_\_\_

Specified Product:

\_\_\_\_\_

**SUBSTITUTION INFORMATION**

Proposed Substitution (Product Name):

\_\_\_\_\_

Product Description:

\_\_\_\_\_

Product History: ☐ New Product ☐ 2-5 years old ☐ 5-10 years old ☐ > 10 years old

Manufacturer:

\_\_\_\_\_

Standard Warranty Offered: \_\_\_\_\_ Extended Warranty Available? ☐

Yes ☐ No

Address:

\_\_\_\_\_

Name of Technical Representative (TR):

\_\_\_\_\_

Technical Representative's Contact

Phone\_\_\_\_\_

Email:\_\_\_\_\_

Trade Name:

\_\_\_\_\_

Differences between proposed substitution and specified product:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Reason for not providing specified item:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Will proposed substitution affect other parts of Work? ☐ No ☐ Yes;  
explain\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

---

Cost Implications of Proposed Substitutions: ☐ None ☐ Savings/Credit; ☐ Extra Costs  
(explain below)

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Embodied Carbon Impact (GWP) of Proposed Substitutions: ☐ None ☐ Reduced; ☐  
Increase (explain below)

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---

## REFERENCE INSTALLATIONS

*List below installations that reference the product installed in projects that are similar  
in scope and size. Provide at least 3 pertinent reference installations*

### PROJECT NO.1

Project Title:

---

Project Description: ☐ Commercial ☐ Residential ☐ Retail ☐ Healthcare ☐ Other:

---

Date Installed: \_\_\_\_\_ Location:

---

Reference Contact (if known): Phone: \_\_\_\_\_ Email:

---

### PROJECT NO.2

Project Title:

---

Project Description: ☐ Commercial ☐ Residential ☐ Retail ☐ Healthcare ☐ Other:

---

---

Date Installed: \_\_\_\_\_ Location: \_\_\_\_\_

Reference Contact (if known): Phone: \_\_\_\_\_ Email: \_\_\_\_\_

### PROJECT NO.3

Project Title: \_\_\_\_\_

Project Description: ☐ Commercial ☐ Residential ☐ Retail ☐ Healthcare ☐ Other: \_\_\_\_\_

Date Installed: \_\_\_\_\_ Location: \_\_\_\_\_

Reference Contact (if known): Phone: \_\_\_\_\_ Email: \_\_\_\_\_

### SUSTAINABLE INFORMATION

*Indicate below sustainable information that apply to this Product.*

#### MANUFACTURING LOCATION

What is the location of the manufacturing plant for this particular product?

#### ENVIRONMENTAL PRODUCT DECLARATION (EPD)

Does the product have a compliant environmental product declaration (EPD)? ☐ Yes  
☐ No

EPD Type: ☐ Industry Wide EPD ☐ Product Specific EPD

Indicate EPD expiry date: \_\_\_\_\_

#### MATERIALS AND RESOURCES

Does the product contain wood Products? ☐ Yes ☐ No

If yes, Indicate percentage of FSC Certified wood in product: \_\_\_\_\_

---

Indicate wood product low-emitting characteristics:

☐ No Added Urea Formaldehyde (NAUF) ☐ Ultra-low Emitting Formaldehyde (ULEF)

Does the product contain post-consumer or pre-consumer recycled content? ☐ Yes ☐ No

If yes, Indicate percentage of pre-consumer recycled content:

\_\_\_\_\_

If yes, Indicate percentage of post-consumer recycled content:

\_\_\_\_\_

#### **DISCLOSURE AND TRANSPARENCY**

Does the product participate in extended producer responsibility program? ☐ Yes ☐ No

Does the product have a "Declare" label with ingredient disclosure greater than 1000 ppm? ☐ Yes ☐ No

Does the product have a Fully Declare Health Product Declaration? ☐ Yes ☐ No

Is this product CDPH Emissions testing compliant? ☐ Yes ☐ No

Indicate product VOC content (g/l):

\_\_\_\_\_

#### **SUPPORTING DATA**

*Attached data includes product description, specifications, drawings, photographs, and performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.*

Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Test Reports

#### **FOR INTERNAL USE ONLY**

Substitution approved - Make submittals in accordance with Section 01 25 00.  
Substitution approved as noted - Make submittals in accordance with Section 01 25 00.

Substitution rejected - Use specified materials.

---

**1.3     DECLARATIONS**

- 1.3.1 I/We the undersigned agree that the Owner reserves the right to accept or reject any or all the proposed substitution/alternatives and may request that materials specified in the Bidding and Contracting Documents be used.
- 1.3.2 I/We the undersigned understand that by submitting this Substitution Request, I/We assume full responsibility for ensuring that all requirements are considered.
- 1.3.3 I/We hereby certify that:
- .1 Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
  - .2 Same warranty will be supplied for proposed substitution as for specified product.
  - .3 Same maintenance service and source of replacement parts, as applicable, is available.
  - .4 Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
  - .5 Proposed substitution does not affect dimensions and functional clearances.
    - .1 Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

SUBMITTED BY: \_\_\_\_\_

Signature of

Duly Authorized

Signing Officer \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Affix Seal Here

Position:

\_\_\_\_\_

Firm:

\_\_\_\_\_

Street Address:

\_\_\_\_\_

City, Province, Postal  
Code

\_\_\_\_\_

Phone:

\_\_\_\_\_

Respectfully submitted  
this

\_\_\_\_ day of \_\_\_\_\_, 20\_\_ at  
\_\_\_\_\_.

END OF FORM



**1. GENERAL**

**1.1 Summary**

- 1.1.1 Purpose of Section: Section specifies administrative procedures related to modifying Contract by means of Change Orders, Change Directives, and Supplemental Instructions.
- 1.1.2 Read in conjunction with: CCDC 2-2020, Part 6, Changes in the Work and Supplementary Conditions.

**1.2 Schedule Of Labour Rates**

- 1.2.1 Prior to the first application for payment, submit for the Consultant's review a schedule of labour rates for all trades and classifications of trades, such as journeymen, apprentices, and foremen that will be employed in the Work. Provide a breakdown of payroll burden component of labour rates.
- 1.2.2 Labour rates shall reflect the salaries, wages, and benefits paid to personnel in the direct employ of the Contractor, Subcontractors, and sub-Subcontractors, stated as hourly rates, that will be used when:
  - .1 preparing price quotations for Change Orders, and
  - .2 determining the cost of work attributable to Change Directives.
- 1.2.3 Labour rates stated in the schedule of labour rates shall be consistent with rates that will actually be paid, and payroll burden costs that will actually be incurred, in the normal performance of the Work, during regular working hours. Labour rates shall not include any additional overhead and profit component.
- 1.2.4 Where collective agreements apply, the labour rates shall not exceed those established by collective agreement.
- 1.2.5 Obtain the Owner's written acceptance of the schedule of labour rates before submitting the first Change Order quotation.
- 1.2.6 Accepted schedule of labour rates will be used solely for evaluating Change Order quotations and cost of performing work attributable to Change Directives.
- 1.2.7 The Contractor may request amendments to the accepted schedule of labour rates if changes in the labour rates that will actually be paid, or payroll burden cost that will actually be incurred, in the normal performance of the Work can be demonstrated. Obtain the Owner's written acceptance of such changes.

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**1.3 Schedule Of Equipment Rates**

- 1.3.1 Prior to the first application for payment, submit for the Consultant's review a schedule of equipment rates for Contractor owned Construction Equipment.
- 1.3.2 Equipment rates shall reflect the rates that will be used when:
  - .1 preparing price quotations for Change Orders, and
  - .2 determining the cost of work attributable to Change Directives.
- 1.3.3 Equipment rates stated in the schedule shall be consistent with local equipment rental market rates and shall not include any additional overhead and profit component.
- 1.3.4 Obtain the Owner's written acceptance of the schedule of equipment rates before submitting the first Change Order quotation.
- 1.3.5 Accepted schedule of equipment rates will be used solely for evaluating Change Order quotations and cost of performing work attributable to Change Directives.
- 1.3.6 The Contractor may request amendments to the accepted schedule of equipment rates if changes in local equipment rental market rates can be demonstrated. Obtain the Owner's written acceptance of such changes.

**1.4 Valuation Of Changes Based On Agreed Unit Prices**

- 1.4.1 The Consultant may, at the outset of the Contract or at any other time, request the Contractor to submit unit prices anticipated to be required in valuing changes in the Work.
- 1.4.2 The Contractor shall submit such unit prices promptly upon request.
- 1.4.3 The unit prices shall be valid for a specified duration agreed upon by Owner and Contractor.
- 1.4.4 The unit prices shall exclude all fees for overhead and profit and shall be subject to the percentage fees as noted in Supplementary Conditions.
- 1.4.5 The Consultant will evaluate the Contractor's quoted unit prices and, if accepted by the Owner in writing, the agreed unit prices shall be used to value subsequent proposed changes in the Work wherever they are applicable.

**1.5 Method Of Contract Price Adjustment - Change Orders**

- 1.5.1 Unless otherwise agreed, the adjustment of the Contract Price on account of a proposed change in the Work shall be based on a quotation for a fixed price increase or decrease to the Contract Price regardless of the Contractor's actual expenditures and savings.

- 1.5.2 If unit prices included in the stipulated price contract are applicable to the proposed change, the adjustment of the Contract Price shall be based on those unit prices, to the extent they apply.
- 1.5.3 Unless otherwise agreed, the adjustment of Unit Prices affected by a proposed change in the Work shall be based on a quotation for an increase or decrease to existing Unit Prices, or new Unit Prices, as applicable, regardless of the Contractor's actual expenditures and savings.

## **1.6 Change Order Procedures**

- 1.6.1 Any variation in the Contract involving a change in total amount of Contract Price or in Contract Time shall be initiated through Consultant in form of a proposed change in the Work (Contemplated Change Order / Contemplate Change Notice or CCO/CCN) describing work proposed under variation and requesting a quotation from contractor.
- 1.6.2 Upon issuance by the Consultant to the Contractor of a proposed change in the Work, and unless otherwise requested in the proposed change or unless otherwise agreed:
  - .1 Submit to the Consultant a fixed price quotation for the proposed change in the Work within 5 days after receipt of the proposed change in the Work.
  - .2 If requested in the proposed change, provide a detailed breakdown of the price quotation including the following to the extent applicable, with appropriate supporting documentation:
    - .1 Estimated labour costs, including hours and applicable hourly rates based on the accepted schedule of labour rates.
    - .2 Estimated Product costs, including Supplier quotations, estimated quantities and unit prices.
    - .3 Estimated Construction Equipment costs.
    - .4 Enumeration of all other estimated costs included in the price quotation.
    - .5 Estimated credit amounts for labour and Products not required on account of the proposed change.
    - .6 Fees, not exceeding the applicable percentages for overhead and profit as specified in this Section.
    - .7 Where applicable, Subcontractor quotations, also including a detailed breakdown of all of the above.
  - .3 Include in the quotation the increase or decrease to the Contract Time, if any, for the proposed change, stated in number of days.

- .4 Include in the quotation the number of days for which the quotation is valid.
- .5 The quotation will be evaluated by the Consultant and the Owner and, if accepted by the Owner, be documented in the form of a signed Change Order.

**1.7 Method Of Contract Price Adjustment - Change Directives**

- 1.7.1 Unless the Owner and the Contractor reach an earlier agreement on the adjustment to the Contract Price by means of a Change Order that cancels the Change Directive, the adjustment in the Contract Price for change carried out by way of a Change Directive shall be determined as specified in the General Conditions of Contract after the change in the Work is completed.

**1.8 Change Directive Procedures**

- 1.8.1 Change Directives (CD) are instructions for Contractor to carry out change in the Work, which will be included in a subsequent Change Order. Owner will issue Change Directives through the Consultant, providing a complete description of the required changes.
- 1.8.2 If a Change Directive is issued for a change in the Work for which a proposed change was previously issued, but no Change Order has yet been signed, the Change Directive shall cancel the proposed change and any Contractor quotations related to that change in the Work.
- 1.8.3 When proceeding with a change in the Work under a Change Directive, keep accurate records of daily time sheets for labour and Construction Equipment, and invoices for Product and Construction Equipment costs. Submit such records to the Consultant daily, until the Change Order superseding the Change Directive is issued.

**1.9 Supplemental Instructions**

- 1.9.1 The Consultant may issue Supplemental Instructions to provide clarifications to the Contract Documents, provide additional information, or make minor variations in the Work not involving adjustment in the Contract Price or Contract Time.
- 1.9.2 If the Contractor considers a Supplemental Instruction to require an adjustment in Contract Price or Contract Time, the Contractor shall promptly notify the Consultant and the Owner in writing and shall not proceed with any work related to the Supplemental Instruction pending receipt of a Change Order, a Change Directive, or, in accordance with the dispute resolution provisions of the General Conditions of Contract, a Notice in Writing of a dispute and instructions to proceed.

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2 . **PRODUCTS**

2.1 **Not Used**

3 . **EXECUTION**

3.1 **Not Used**

END OF SECTION

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**1. GENERAL**

**1.1 Summary**

- 1.1.1 Purpose of Section: Section specifies administrative procedures related to progress payments and final payment for The Work.
- 1.1.2 Read in conjunction with: CCDC 2-2020, Part 5, Payment and Supplementary Conditions.

**1.2 Schedule Of Values**

- 1.2.1 Initial Submission and Review: Prior to the first application for payment, submit for Consultant's review an initial schedule of values. Modify the initial schedule of values if and as requested by Consultant. Obtain Consultant's written acceptance of the initial schedule of values prior to the first application for payment.
- 1.2.2 Updated Schedule with Applications for Payment: Together with the first and all subsequent applications for payment, submit updated versions of the schedule of values to indicate the values, to the date of application for payment, of work performed and Products delivered to Place of the Work.
- 1.2.3 Format and Content: Provide the schedule of values in an electronic spreadsheet format based on format provided and content described in latest edition of CCDC 24 – A Guide to Model Forms and Support Documents or a format acceptable to Consultant and Owner.
- 1.2.4 Required Information in Schedule: Provide the schedule of values in an electronic spreadsheet format that provides for inclusion of the following information:
  - .1 Identifying information including title and location of the Work, name of Contractor, number and date of application for payment, and period covered by the application for payment.
  - .2 A work breakdown structure based on Contractor, Subcontractor and sub-Subcontractor work according to each Specification section, and material and labour breakdown. Include separate line items for closeout procedures including closeout submittals, demonstration and training, start-up and testing, and commissioning collectively valued at minimum 0.5% of Contract Price.
  - .3 Provisions for approved Change Orders, allowances, and unit price work so that the breakdown amounts indicated in the schedule of values aggregate to the current total Contract Price. Also provide for indicating the estimated value of Change

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Directives within the schedule of values, separately from the current total Contract Price.

- .4 For each item in the work breakdown structure, provide as a minimum the following information, under headings as indicated:
  - .1 Breakdown Amount: A dollar amount, including an appropriate pro rata portion of Contactor's overhead and profit.
  - .2 Performed to Date: The value of Work performed and Products delivered to Place of the Work up to the date of the application for payment, stated as a percentage of the Contract Price and in dollars.
  - .3 Previously Performed: The value of Work performed and Products delivered to the Place of the Work for which payment has been previously certified, stated in dollars.
  - .4 Current Period: The value of Work performed and Products delivered to Place of the Work for which Contractor is currently applying for payment, stated in dollars.
  - .5 Balance to Complete: The value of Work not yet performed and Products not yet delivered to Place of the Work, stated in dollars.

### **1.3 Cash Flow Projection**

- 1.3.1 Prior to the first application for payment submit, for Consultant's review, a forecast of approximate monthly progress payments for each month of the Contract Time.
- 1.3.2 Submit revised cash flow forecasts at least monthly. Consultant may also require revised cash flow forecasts when required due to significant changes in rate of progress of the Work or significant changes in the Contract Price.

### **1.4 Workers' Compensation Clearance**

- 1.4.1 Submit proof of workers' compensation clearance (i.e. Workplace Safety and Insurance Board (WSIB)) with each application for payment.

### **1.5 Statutory Declarations**

- 1.5.1 Submit a statutory declaration in the form of CCDC 9A – Statutory Declaration of Progress Payment Distribution by Contractor with each application for payment except the first.

**1.6     Release Of Holdback**

- 1.6.1   Read in conjunction with: CCDC 2, 2020 GC 5.4 and Supplementary Conditions
- 1.6.2   In accordance, with requirements of Construction Act and General Conditions and Supplementary Conditions of the Contact, Owner may consider possibility of releasing holdback annually or on a phased basis, provided that requisite conditions have been satisfied.

**2 .     PRODUCTS**

**2.1     Not Used**

**3 .     EXECUTION**

**3.1     Not Used**

END OF SECTION



## **1. GENERAL**

### **1.1 Summary**

- 1.1.1 Purpose of Section: Section specifies administrative procedures related to project management, project coordination and project meetings.
- 1.1.2 Read in conjunction with: CCDC 2-2020, Part 3, Execution of the Work and Supplementary Conditions.

### **1.2 Contractor's List Of Personnel And Subcontractors**

- 1.2.1 Preparation and Submission: Prepare and submit a complete written list of individuals or firms proposed for each portion of the Work complete with Name, address, telephone number, and email address of entity. In addition, submit list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, telephone numbers, and e-mail addresses.
- 1.2.2 Displaying List: Display copies of list in Project meeting room, temporary field office, and in a prominent location. Maintain list up-to-date at all times.
- 1.2.3 Compatibility of Construction Team: Ensure compatibility within Project team, especially between Subcontractors. Owner takes no responsibility for incompatibility (labour and otherwise) among Subcontractors and Suppliers employed on the Project.
- 1.2.4 Superintendent Appointment: Appoint a senior member of staff as full-time superintendent, with full authority to commit Contractor to methods and construction schedules. Full-time superintendent shall actively participate in administration and maintenance of construction schedule. Do not replace superintendent without Owner's or Consultant's approval.

### **1.3 Contractor's Administrative Responsibilities For Meetings**

- 1.3.1 Unless otherwise indicated, Contractor's responsibilities for all project meetings are as follows:
  - .1 Schedule and conduct meetings throughout the course of The Work, including those requested at the call of Consultant or Owner, at Project site unless otherwise indicated.
  - .2 Prepare agenda for meetings. Distribute the agenda to all invited attendees.
  - .3 Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify

Owner and Consultant of scheduled meeting dates and times a minimum of 5 working days prior to scheduled meeting dates and times.

- .4 Provide physical space and make arrangements for meetings.
- .5 Preside at meetings.
- .6 Record meeting minutes. Include significant proceedings and decisions. Identify actions by parties.
- .7 Distribute copies of minutes within three working days of meetings and transmit to meeting participants and, affected parties not in attendance.

#### **1.4 Construction Start-Up Meeting**

- 1.4.1 After award of Contract, but no later than 15 calendar days after award of Contract, request meeting of parties in Contract to discuss and resolve administrative procedures and responsibilities.
- 1.4.2 Distribute meeting agenda including relevant items pertaining to administrative, financial, scheduling, health and safety requirements.
- 1.4.3 Attendees:
  - .1 Authorized representative of Consultant, Subconsultants, Owner, Contractor, including superintendent, major Subcontractors, major Suppliers, and other concerned parties must be in attendance.
  - .2 Participants at the meeting must be familiar with Project and authorized to conclude matters relating to the Work.
- 1.4.4 Agenda: Discuss items of significance that could affect progress, including but not limited to the following:
  - .1 Tentative construction schedule and progress schedule.
  - .2 Building permit status.
  - .3 Bonds and insurance certificates.
  - .4 Critical work sequencing, and long-lead items.
  - .5 Designation of key personnel and their duties.
  - .6 Lines of communications.
  - .7 Procedures for processing field decisions and contract modifications including, but not limited to proposed changes (contemplated change orders), change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, and other administrative requirements.
  - .8 Procedures for RFIs.
  - .9 Procedures for testing and inspecting.

- .10 Procedures for processing applications for progress payment including, monthly progress claims, administrative procedures, photographs, and holdbacks.
- .11 Distribution of the Contract Documents.
- .12 Submittal procedures, including schedule of submission of shop drawings, samples, colour chips.
- .13 Preparation of closeout documents including, As-Builts, maintenance manuals, take-over procedures, and warranties.
- .14 Zero Carbon Building Standard requirements.
- .15 RoP Net Zero Emissions Standards
- .16 Climate resiliency requirements during construction
- .17 Mockups
- .18 Working hours.
- .19 Responsibility for temporary facilities and controls including but not limited to, site signage, offices, storage sheds, utilities, hoarding and similar temporary construction.
- .20 Procedures for moisture and mould control.
- .21 Construction waste management and recycling.
- .22 Office, work, and storage areas.
- .23 Equipment deliveries and priorities.
- .24 Health and Safety.
- .25 Security.
- .26 Progress cleaning and housekeeping procedures.
- .27 Owner-supplied products, where applicable.
- .28 Appointment of inspection and testing agencies or firms.
- .29 Insurances, and transcripts of policies.

## **1.5 Construction Progress Meetings**

- 1.5.1 Schedule regular bi-weekly construction progress meetings for the duration of the Work. Contractor shall prepare meeting agendas, chair the meetings, and record and distribute the minutes.
- 1.5.2 Arrange for and provide physical space for meetings, sufficient in size to allow seating for all meeting attendees.
- 1.5.3 Contractor shall record in the meeting minutes significant decisions and identify action items and action dates by attendees or the parties they represent.
- 1.5.4 Contractor shall distribute copies of minutes within three Working Days after each meeting to meeting attendees and any affected parties who may not be in attendance.
- 1.5.5 Ensure that Subcontractors attend as and when appropriate to the progress of the Work.

1.5.6 Agenda for each meeting shall include the following, as a minimum:

- .1 Approval of minutes of previous meeting.
- .2 Work progress since previous meeting.
- .3 Field observations, including any problems, difficulties, or concerns.
- .4 Construction progress schedule.
- .5 Submittals schedule.
- .6 Proposed changes in the Work.
- .7 Requests for information.
- .8 Site safety issues.
- .9 Other business.

**1.6 Preinstallation Meetings**

1.6.1 Conduct a preinstallation meeting at Project site before each construction activity when required by Specifications Sections and when required for coordination with other construction.

1.6.2 Attendees:

- .1 Invite Subcontractor and representatives of manufacturers and fabricators involved in, or affected, by the work of the trade involved and its coordination or integration with other materials and installations that have preceded or will follow.
- .2 Invite Consultant, Owner and inspection and testing company's representative who may elect to attend.

1.6.3 Agenda: Discuss following items as a minimum:

- .1 Work included.
- .2 Materials to be used.
- .3 Storage and handling of materials.
- .4 Installation procedures.
- .5 Sequence and quality control.
- .6 Project staffing.
- .7 Review of mockups.
- .8 Possible conflicts.
- .9 Compatibility requirements.
- .10 Time schedules.
- .11 Weather limitations.
- .12 Manufacturer's written instructions.
- .13 Warranty requirements.
- .14 Acceptability of substrates.
- .15 Temporary facilities and controls.

- 
- .16 Restrictions on areas of work and other matters affecting construction including space and access limitations.
  - .17 Regulations of authorities having jurisdiction.
  - .18 Testing and inspecting requirements.
  - .19 Coordination with other work.
  - .20 Required performance results.
  - .21 Protection of adjacent work.
  - .22 Protection of construction and personnel.
- 1.6.4 Reporting: Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
- .1 Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of The Work and reconvene the conference at earliest feasible date.

## **2 . PRODUCTS**

### **2.1 Not Used**

## **3 . EXECUTION**

### **3.1 Not Used**

END OF SECTION

## **1. GENERAL**

### **1.1 Summary**

- 1.1.1 Purpose of Section: Section specifies Contractor's responsibilities for preparation and submission of schedules and other documentation related to tracking construction progress.
  - .1 Schedules inform Owner and Consultant of actual progress versus planned progress and provide assurance that scheduling issues are being proactively identified and addressed in a timely manner, and that planned progress is being maintained as closely as possible.
- 1.1.2 Read in conjunction with: CCDC 2-2020, Part 3, Execution of the Work and Supplementary Conditions.

### **1.2 Construction Schedule**

- 1.2.1 Refer to CCDC 2, 2020, GC. 3.4 and Supplementary Conditions.
- 1.2.2 Format and Content:
  - .1 Submit a comprehensive, fully developed, detailed horizontal bar chart (GANTT) construction schedule with activities itemized to enable Owner and Consultant to monitor progress of The Work.
  - .2 Prepare schedule in the form of a Critical Path Method (CPM) Gantt chart using appropriate scheduling software (MS Project or similar)
  - .3 Provide a work breakdown structure identifying key activities, work packages, and major milestones, including long delivery Products, inspection and testing activities, preparation and review of mock-ups, Owner decisions for cash allowances, shutdown or closure activities, delivery of Owner supplied Products, Owner performed work, demonstration and training activities, and similar items, at a sufficient level of detail to effectively manage construction progress.
  - .4 Indicate milestone dates for Ready-for-Takeover and Substantial Performance of the Work as applicable.
  - .5 Constraints: Include constraints and work restrictions indicated in the Contract Documents including, but not limited to, phasing, work by Owner and Owner-supplied Products (if any), and work restrictions, and show how the sequence of the Work is affected.
- 1.2.3 Submission:

- 
- .1 Submit initial schedule to Owner and Consultant within 15 Working Days after Contract award.
  - .2 Submit schedule via e-mail as .pdf file.
  - .3 Consultant will review format and content of initial schedule and request necessary changes, if any, within 5 Working Days after receipt.
  - .4 If changes are required, resubmit finalized initial schedule within 5 Working Days after return of reviewed copy.
  - .5 Submit updated progress schedule monthly to Owner and Consultant, indicating actual and projected start and finish dates with report date line and progress, activity relationships, critical path, float, and baseline comparison to current progress.
    - .1 Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule.
    - .2 Determine how construction behind schedule will be expedited and secure commitments from parties involved to do so.
  - .6 At progress meeting, discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
  - .7 Discuss construction schedule at progress site meetings, and identify activities that are behind schedule and provide measures to regain slippage.
  - .8 Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the minutes of each such meeting.
  - .9 As the Work progresses, indicate completion percentage for each activity.
  - .10 Distribute copies of approved schedule to Consultant, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

### **1.3 Schedule Of Submittals**

#### **1.3.1 Format and Content:**

- .1 Prepare schedule identifying all required Shop Drawing, Product data, and sample submissions, including samples required for testing and including those for Owner supplied Products (if any).
- .2 Prepare schedule in electronic format.

- .3 Provide a separate line for each required submittal, organized by Specifications section names and numbers, and further broken down by individual Products and systems as required.
- .4 For each required submittal, show planned earliest date for return of reviewed submittal by Consultant and latest date for return of reviewed submittal without causing delay.
- .5 Allow time in schedule for resubmission of submittals, should resubmission be necessary.

1.3.2 Submission:

- .1 Submit initial schedule to Consultant within 20 Working Days after Contract award.
- .2 Submit schedule via e-mail as .pdf file.
- .3 Consultant will review format and content of initial schedule and request necessary changes, if any, within 5 Working Days after receipt.
- .4 If changes are required, resubmit finalized schedule within 5 Working Days after return of review copy.
- .5 Submit updated submittals schedule monthly to Owner and Consultant.

**1.4 Schedule Management**

- 1.4.1 A schedule submitted as specified and accepted by Consultant shall become the baseline schedule and shall be used as the baseline for updates.
- 1.4.2 At each regular progress meeting, review and discuss current construction progress and submittals schedules with Consultant and Owner, including activities that are behind schedule and planned measures to regain schedule slippage in key areas on or near the critical path.
- 1.4.3 Activities considered behind schedule are those with start or completion dates later than the dates shown on the baseline schedule.

**1.5 Recording Actual Site Conditions On As-Built Drawings**

- 1.5.1 For the purposes of this Section, the following definitions as defined by the Ontario Association of Architects Practice Tip – PT.14 Version 1.1 apply:
  - .1 As-built drawings: drawings usually prepared by Contractor as it constructs the project and upon which it documents the actual locations of building components and changes to the original contract documents. These, or a copy of same, are typically turned over to the Consultant or Owner at completion of the project.



- 
- .2 Record drawings: drawings usually prepared by the Consultant when contracted to do so. These are usually a composite of the original drawings, changes known to the Consultant and information taken from the Contractor's as-built drawings. Responsibility for preparation of record drawings may be delegated to Contractor if indicated as such in Contract Documents.
  - 1.5.2 Clearly label each drawing as "AS-BUILT DRAWING". Record information concurrently with construction progress. Do not conceal Work until required information is recorded.
  - 1.5.3 Accurately and neatly record deviations from Contract Documents, including addenda, Supplementary Instructions and Change Orders, caused by site conditions.
  - 1.5.4 Annotate with coloured felt tip marking pens, maintaining separate colours for each major system, for recording changed information. Digital annotation of as-built data is permitted.
  - 1.5.5 Clearly and legibly mark each item to record the actual construction, including but not limited to:
    - .1 Measured depths of foundation elements in relation to finished first floor datum.
    - .2 Measured horizontal and vertical locations of underground utilities and related components, referenced to permanent surface improvements.
    - .3 Measured locations of pipes, ducts, conduits, outlets, fixtures, access panels, and related components, referenced to visible and accessible features of the construction.
    - .4 Measured locations of interior utilities and related components, referenced to visible and accessible features of the construction.
    - .5 Field changes of dimensions and details.
    - .6 Changes made by Change Orders and Supplemental Instructions.
    - .7 References to Shop Drawings, where Shop Drawings show more detail.
    - .8 Field changes of dimension and detail.
    - .9 Details not shown on original Contract Drawings.
    - .10 Life Safety elements including, but not limited to:
      - .1 Smoke compartmentalization.
      - .2 Exit signage.
      - .3 Fire extinguishers.
      - .4 Fire alarm devices.

- .5 Pull stations.
- .6 Sprinkled areas.
- .11 Refer to Divisions 21, 22, 23 and Division 26 for supplementary requirements.
- 1.5.6 Maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.
- 1.5.7 Store As-Built Drawings and other documentation separately from construction documents in a secure area. Provide appropriate filing cabinets, shelving, or racks for storage. Digital filing of as-built data is also permitted.
- 1.5.8 Label As-Built Drawings and other documentation with section numbers that correspond to Table of Contents of Project Manual. Clearly label each document "AS-BUILT" in legible font.
- 1.5.9 Maintain the As-Built Drawings and other documentation in legible and clean condition, free from damage or deterioration. As-built Drawings and other documentation must not be used for construction purposes.
- 1.5.10 Keep As-Built Drawings and other documentation readily available for inspection by Consultant.
- 1.5.11 Refer to Section 01 78 00 for additional requirements.

## **1.6 Photographic Documentation**

- 1.6.1 Preconstruction Photographs: Before commencement of the Work, take photographs of the Place of the Work and surrounding areas, including existing items to remain during construction, from different vantage points, as directed by Consultant. Submit video recording to supplement photographs to show existing conditions prior to start of The Work.
  - .1 Take additional photographs as required to flag excavation areas, or record settlement or cracking of adjacent structures, pavements, and improvements.
- 1.6.2 Concealed Work Photographs: Take photographs of concealed work, such as underground utilities, underslab services, piping, conduits, waterproofing, air barriers or vapour retarders, prior to installing or enclosing such work.
- 1.6.3 Periodic Construction Photographs: Arrange for periodic digital photography to document and provide a photographic record of the progress of the Work. Take digital progress photographs weekly from date of commencement of The Work until date of Ready-for-Takeover, sufficient to record the state of The Work.
- 1.6.4 Identify each photograph by project name and date taken. Maintain a key plan with each set to identify photographic locations.

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- 1.6.5 Submission: Submit .jpg format files in standard resolution via e-mail monthly with application for payment.
- .1 Submit photographs as originally recorded, without alteration, manipulation, editing, or modification.
  - .2 Metadata: Ensure photographs accurately provide date, time, and location data for each picture.
- 1.6.6 Do not use progress or any other Project photographs for promotional purposes without Owner's written consent.

**2 . PRODUCTS**

**2.1 Not Used**

**3 . EXECUTION**

**3.1 Not Used**

END OF SECTION

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**1. GENERAL**

**1.1 Summary**

- 1.1.1 Purpose of Section: Section specifies administrative procedures for preparation and submission of Shop Drawings, Product Data and other documentation related to the Work.
- 1.1.2 Read in conjunction with: CCDC 2-2020, Part 3, Execution of the Work and Supplementary Conditions.

**1.2 Definitions**

- 1.2.1 Submittals: This refers to documents or items required by the Contract Documents to be provided by the Contractor, such as:
  - .1 Shop Drawings, samples, models, mock-ups to indicate details or characteristics, before the portion of the Work that they represent can be incorporated into the Work; and
  - .2 As-built drawings and manuals to provide instructions to the operation and maintenance of the Work.

**1.3 Administrative Requirements**

- 1.3.1 Provide submittals in the language of the Contract.
- 1.3.2 Submit specified submittals to Consultant for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in the Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time or for Product substitutions or other deviations from the Drawings and Specifications.
- 1.3.3 Where required by authorities having jurisdiction, provide submittals to such authorities for review and approval.
- 1.3.4 Do not proceed with Work affected by a submittal until review is complete.
- 1.3.5 Present Shop Drawings, Product data, and samples in SI metric units unless indicated otherwise.
- 1.3.6 Review submittals, provide verified field measurements where applicable, and affix Contractor's review stamp prior to submission to Consultant. Contractor's review stamp represents that necessary requirements have been determined and verified, and that the submittal has been checked and coordinated with requirements of the Work and Contract Documents.
- 1.3.7 Verify field measurements and that affected adjacent work is coordinated.

- 1.3.8 Submittals not meeting specified requirements will be returned with comments.
- 1.3.9 Do not propose Substitutions or deviations from Contract Documents via Shop Drawing, Product data and sample submittals. Consultant will return such submissions without review. Refer to Section 01 25 00 for Substitution Procedures.

#### **1.4 Submittal Procedures, Generally**

- 1.4.1 Schedule of Submittals: Refer to 01 32 00 - Construction Progress Documentation.
- 1.4.2 Administrative Requirements:
  - .1 Assemble submittals and transmit to Consultant by sending via email. Include PDF transmittal form. Include information in email subject line clearly identifying project name, project no, and submittal scope.
  - .2 Processing Time: Allow time for submittal review, including time for resubmittals, as follows.
    - .1 Time for review shall commence on Consultant's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
    - .2 Initial Review: Allow 10 working days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Consultant will advise Contractor when a submittal being processed must be delayed for coordination.
    - .3 Resubmittal Review: Allow 10 working days for review of each resubmittal.
  - .3 Deviations and Additional Information:
    - .1 On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Consultant on previous submittals.
    - .2 Indicate by highlighting on each submittal or noting on attached separate sheet.
    - .3 Delete information not applicable to project.
    - .4 Supplement standard information to provide details applicable to project.
    - .5 Identify options requiring selection by Consultant.

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- 1.4.3 Submittals Format: Submit electronic copies of each submittal unless otherwise indicated. Include the following information in each submittal:
- .1 Date and revision dates.
  - .2 Project title and number.
  - .3 Location(s) where product is to be installed, as appropriate.
  - .4 Other necessary identification.
  - .5 Remarks.
  - .6 Transmittal letter, containing:
    - .1 Date.
    - .2 Project title and number.
    - .3 Contractor's name and address.
    - .4 Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
    - .5 Submittal purpose and description.
    - .6 Signature of transmitter.
    - .7 Other pertinent data.
  - .7 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.

**1.5 Contractor's Review Process And Responsibility**

- 1.5.1 Submit to Consultant and to authorities having jurisdiction (as required), documents listed to be submitted for review. Submit promptly and in orderly sequence to not cause delay in Work.
- 1.5.2 Do not submit materials that are not identified in Contract Documents, such submissions will be returned without review.
- 1.5.3 Failure to submit documentation in ample time is not considered sufficient reason for increases to Contract Price or Contract Time. No claims for extension by reason of such default will be allowed.
- 1.5.4 Final approval of authorities having jurisdiction, where required, shall be obtained prior to submitting Shop Drawings or other documentation to Consultant.
- 1.5.5 Do not proceed with, or fabricate Work affected by specific submittals until review is complete.
- 1.5.6 Present Shop Drawings, Product Data, samples and mock-ups in SI Metric or Imperial units to match measurement system indicated on Drawings.

- 1.5.7 Review submittals prior to submission to Consultant. This review shall represent that necessary requirements have been determined and verified, and that each submittal has been checked and coordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, and dated by the Contractor, and identified as to specific project will be returned without being examined and considered rejected.
- 1.5.8 Notify Consultant, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- 1.5.9 Verify field measurements and affected adjacent Work are coordinated. Confirm and coordinate requirements pertaining to fabrication processes, quantities, construction techniques, installation and similar information.
- 1.5.10 Contractor's responsibility for errors and omissions in submission is not relieved by Consultant's review of submittals.
- 1.5.11 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Consultant's review.
- 1.5.12 Record each review as well as inspection and testing reports in manner suitable for inclusion in closeout documentation and submission at completion of Project.
- 1.5.13 Keep one reviewed copy of each submission on site.

## **1.6 Consultant's Review And Responsibilities**

- 1.6.1 Consultant's General Review:
  - .1 Consultant will perform general review of The Work for general conformance with Contract Documents, Code and authorities having jurisdiction. Review includes review of Shop Drawings, review of field Work and review of reports produced by various inspection and testing agencies.
  - .2 Review of Contractors' submittals by Consultant is for sole purpose of ascertaining conformance with general concept.
  - .3 This review shall not mean that Consultant approves detail design inherent in submittals, responsibility for which shall remain with Contractor, and such review shall not relieve Contractor of responsibility for errors or omissions or of responsibility for meeting requirements of Contract Documents.
  - .4 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

1.6.2 Submittal Review and Actions: Consultant will review each submittal, indicate corrections or revisions required, and return annotated files to Contractor. Consultant will indicate, via markup on each submittal, the appropriate action, as follows:

- .1 "REVIEWED FOR GENERAL DESIGN" OR "REVIEWED AS NOTED": Upon review by Consultant, no apparent errors or omissions are discovered by Consultant, or only minor corrections are to be made. Copies will be returned to Contractor and fabrication and installation of Work may proceed.
- .2 "REVISE AND RESUBMIT": Make changes as Consultant may require, consistent with Contract Documents. When resubmitting, notify Consultant in writing of revisions other than those requested.
- .3 "REJECTED": Shop drawings are rejected. Noted copy will be returned and resubmission of corrected submittals, through same procedure indicated above, must be performed before fabrication and installation of Work proceeds.

1.6.3 Fabrication Guidelines:

- .1 Do not fabricate any part of the Work until Shop Drawings are reviewed as "REVIEWED FOR GENERAL DESIGN" or "REVIEWED AS NOTED".
- .2 Do not resubmit Shop Drawings indicated as "REVIEWED FOR GENERAL DESIGN" or "REVIEWED AS NOTED".
- .3 Resubmit Shop Drawings indicated as "REVISE AND RESUBMIT" with required changes and comments addressed. Insert letter "R" after Shop Drawing number on resubmitted Shop Drawings. Re-date and re-sign resubmitted Shop Drawings. Identify revisions from earlier submissions graphically on revised Shop Drawings;

## **1.7 Product Data**

1.7.1 Mark product data sheets to show applicable Products and options. Include the following:

- .1 Manufacturer's written recommendations, Product Specifications, and installation instructions.
- .2 Wiring diagrams showing factory-installed wiring.
- .3 Printed performance curves and operational range diagrams.
- .4 Testing by recognized testing agency.
- .5 Compliance with specified standards and requirements.



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**1.8     Shop Drawings**

- 1.8.1 Provide Shop Drawings required by Contract Documents. Insert Contractor's review stamp complete with date and signature of Contractor's reviewer.
- 1.8.2 Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
- 1.8.3 Include the following on Shop Drawings as applicable:
  - .1 Project-specific information, drawn accurately to scale.
  - .2 fabrication methods.
  - .3 layout, showing dimensions, including verified field dimensions, and clearances.
  - .4 plans, sections and details;
  - .5 materials thicknesses and finishes;
  - .6 setting, erection and sealing details.
  - .7 methods of securing, fastening and anchoring including field connections.
  - .8 capacities.
  - .9 performance characteristics.
  - .10 standards.
  - .11 operating weight.
  - .12 wiring diagrams.
  - .13 single line and schematic diagrams.
  - .14 relationship to adjacent work.
  - .15 engineer's stamp (as applicable)

**1.9     Delegated-Design (Professional Engineer's Shop Drawings)**

- 1.9.1 It must be understood that Drawings and details provided in Contract Documents are diagrammatic, and are intended to show design concept, aesthetics, interfacing requirements, configuration, and arrangement; they are not intended to identify or completely resolve problems of thermal and structural movements, assembly framing, engineering design, fixings and anchorages.
- 1.9.2 Where Specifications delegate design of a specific element or system to Contractor, Contractor must engage a registered professional engineer to fully design system including, sizing of additional supports, anchorages, and bracing as required for safe and secure installation.
  - .1 Professional Engineer's Specific Responsibilities:
    - .1 If required, submit "Confirmation of Commitment" forms to local authorities.

- .2 Design components requiring structural or other engineering performance.
- .3 Determine specific requirements for assemblies, connections, sizes, and joint spacing.
- .4 Produce, review, stamp, and sign Shop Drawings.
- .5 In addition to Shop Drawings, submit statement for each product and system assigned to Contractor. Clearly state that products and systems comply with performance and design criteria outlined in Contract Documents. Provide list of calculations upon request.
- .6 Inspect components during fabrication and erection.
- .7 Perform field review and submit field reports within three days of site visits.

**1.10 Samples**

- 1.10.1 Submit samples for Consultant's review in triplicate where specified in the technical Specifications. Label samples as to origin, Project name, and intended use.
- 1.10.2 Submit Samples for review of kind, colour, pattern, and texture and for a comparison of these characteristics between submittal and actual component as delivered and installed. Include name of manufacturer and Product name on label.
- 1.10.3 For each sample, exhibit materials and finishes, such as colour (including maximum colour range within each specified colour), sheen, tone, texture, range of blemishes and other markings. Where colour, pattern or texture is criterion, submit full range of samples.
- 1.10.4 Adjustments made on samples by Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Consultant prior to proceeding with Work.
- 1.10.5 Contractor may be asked to remove and discard Products for which samples have not been reviewed and accepted by Consultant.
- 1.10.6 Consultant selection from samples is not intended to change the Contract Price or Contract Time. If a selection would affect the Contract Price or Contract Time, notify Consultant in writing prior to proceeding with the Work.
- 1.10.7 Resubmit samples as required by Consultant to comply with Contract Documents.
- 1.10.8 Reviewed and accepted samples will establish the standard against which installed Work will be reviewed.
- 1.10.9 Colours:

- .1 Where a required colour, pattern or texture has not been specified, submit full range of available Products meeting other specified requirements.
- .2 Obtain direction on colours and gloss values in advance of need. If requested, submit samples for colour and gloss selection.
- .3 Follow colour schedule provided by Consultant and use colours and glosses designated.

#### **1.11 Miscellaneous Submittals**

1.11.1 When required by Contract Documents, submit informational and miscellaneous submittals required by Contract Documents (e.g. plans, reports, certifications, results, records, and similar submittals) for Consultant's review.

1.11.2 Test Reports:

- .1 Submit test reports in accordance with requirements of specification Sections and as requested by Consultant.
- .2 Reports must be signed by authorized official of testing laboratory and indicate that material, Product or system is identical to material, Product or system to be provided for Project, and has been tested in accordance with specified requirements.
- .3 Testing must have been within three years of date of Contract award.

1.11.3 Certificates:

- .1 Submit certificates in accordance with requirements of specification Sections and as requested by Consultant.
- .2 Statements must be printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material, and attesting that product, system or material meets specification requirements.
- .3 Certificates must be project-specific, clearly indicated Project name, and dated after date of Contract award.

#### **1.12 Coordination/Interference Drawings**

1.12.1 For all locations, before commencing installation, prepare coordination/interference drawings showing relationship of items, including, but not limited to, structure, electrical, cable trays, communication system, ductwork, conduits, piping, sprinklers, ceiling supports and framing, communication and specialized equipment located within ceiling and shaft spaces.

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- 1.12.2 Contractor shall lead process of interference Drawings in coordination with mechanical, electrical or other Subcontractors as applicable.
- 1.12.3 Prepare Drawings indicating relationship of new and existing and/or unforeseen conditions including new construction or construction which existed prior to commencement of work in the area. For construction in existing areas, survey existing conditions. Show existing conditions on interference Drawings and coordinate such conditions with new work. Submit or post coordination/interference drawing files in PDF format in accordance with Shop Drawing requirements specified in this Section.
- .1 Provide Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination/interference drawings on standard printed data.
  - .2 Use applicable Drawings as a basis for preparation of coordination/interference drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
- 1.12.4 Consultant Review: Consultant will review coordination/interference drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Consultant determines that coordination/interference drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Consultant will so inform Contractor, who shall make suitable modifications and resubmit.
- 1.12.5 Installation shall proceed in accordance with final approved interference Drawings. Work carried out without final approved interference Drawings and which does not meet requirements specified in Contract Documents or specified ceiling heights shall be removed, re-coordinated and re-installed at no additional cost to Owner.
- 1.12.6 Coordination/Interference Drawing Organization: Organize coordination/interference drawings as follows:
- .1 Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
  - .2 Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate

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- layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
- .3 Mechanical Rooms: Provide coordination/interference drawings for mechanical rooms, showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
  - .4 Structural Penetrations: Indicate penetrations and openings required for all disciplines.
  - .5 Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
  - .6 Mechanical and Plumbing Work: Show the following:
    - .1 Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
    - .2 Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
    - .3 Fire-rated enclosures around ductwork.
  - .7 Access Panels:
    - .1 Before commencing mechanical or electrical work after coordination with respective trades, prepare set of reflected ceiling plans indicating exact locations and sizes of access panels and doors. Prepare Drawings for areas/rooms designated by Consultant.
    - .2 Submit Drawings to Consultant for review. Allow Consultant to revise layout or quantity of access doors and panels, by relocating related building services a maximum of 2000 mm (6' - 7"), at no additional cost to Owner.
    - .3 Should a relocation exceed 2000 mm (6' - 7"), Contract Price will be adjusted in accordance with provisions for changes in Contract Documents.
    - .4 Finish access panels and doors to match adjacent wall and/or ceiling finish unless otherwise specified or indicated.
  - .8 Electrical Work: Show the following:
    - .1 Runs of vertical and horizontal conduit 32 mm (1-1/4 inches) in diameter and larger.

- .2 Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
- .3 Panel board, switchboard, switchgear, transformer, busway, generator, and motor-control center locations.
- .4 Location of pull boxes and junction boxes, dimensioned from column center lines.
- .9 Fire-Protection System: Show the following:
  - .1 Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
- 1.12.7 Mechanical and Electrical Location Drawings: Mechanical and electrical Drawings indicate approximate locations diagrammatically. Prior to installation, request and obtain final locations and arrangement Drawings for mechanical and electrical items. Allow Consultant to adjust final locations within a 1500 mm (5') radius from diagrammatic position indicated, without change to Contract Price.
  - .1 In case of conflicts between locations of mechanical and electrical items, such as switches and fixtures, locations indicated on architectural Drawings shall take precedence.
  - .2 Align and cluster devices and fitments neatly in accordance with specified mounting heights, properly aligned horizontally and vertically.

**2 . PRODUCTS**

**2.1 Not Used**

**3 . EXECUTION**

**3.1 Not Used**

END OF SECTION

## 1. **GENERAL**

### 1.1 **Summary**

- 1.1.1 Purpose of Section: Section specifies general requirements pertaining to health and safety for the Work.
- 1.1.2 Read in conjunction with: CCDC 2-2020, Part 9, Protection of Persons and Property and Supplementary Conditions.

### 1.2 **Relevant Statutes And Regulations**

- 1.2.1 Ontario:
  - .1 Occupational Health and Safety Act - R.S.O. 1990, C. O.1 (as amended)
  - .2 Construction Projects - Ontario Regulation 213/91 (as amended)
  - .3 Asbestos on Construction Projects and in Buildings and Repair Operations - Ontario Regulation 278/05
  - .4 WHMIS Regulation - Ontario Regulation 860 (as amended)

### 1.3 **General Requirements**

- 1.3.1 Role of Constructor: Contractor must assume role of "Constructor" or "Principal Contractor" as defined under applicable health and safety regulations.
- 1.3.2 Health and Safety Plan: Prepare site-specific Health and Safety Plan before commencement of Work. Consultant's review of Health and Safety plan does not imply approval nor diminish Contractor's responsibility in adhering to requirements of Authorities Having Jurisdiction.
- 1.3.3 First Aid: Provide necessary equipment and facilities for first aid in compliance with requirements of applicable health and safety regulations.
- 1.3.4 Health and Safety Coordinator: Appoint knowledgeable and experienced coordinator responsible for training, enforcing, and monitoring the Health and Safety Plan.
- 1.3.5 Fire Safety Plan:
  - .1 Comply with Section 2.8 of Fire Code in force at Place of the Work.
  - .2 Develop Fire Safety Plan that includes designation of personnel, emergency procedures, fire hazard control, and maintenance of firefighting facilities.

- .3 Submission and Accessibility: Submit Fire Safety Plan to local Fire Department for approval and keep approved on-site in Fire Safety Plan a secure location.
- 1.3.6 Accident Reporting: Report all accidents causing injury to personnel or damage to property to Owner and provide detailed information.
- 1.3.7 Claim Reporting: Promptly report any claims related to accidents or damage to Owner. Provide detailed information.

## **2 . PRODUCTS**

### **2.1 Not Used**

## **3 . EXECUTION**

### **3.1 Not Used**

END OF SECTION



## **1. GENERAL**

### **1.1 Summary**

- 1.1.1 Section includes general requirements and procedures for achieving targets set for embodied carbon emissions required for certification under the CaGBC ZCB-Design standard.
- 1.1.2 Contractor is responsible for providing products and procedures necessary to support achieving ZCB-Design targets specified for Project. While Technical Specifications may specify requirements contributing to such targets, Contractor must provide additional materials and procedures necessary to achieve specified targets.

### **1.2 References**

- 1.2.1 Carbon Leadership Forum (CLF)
  - .1 North American Material Baselines Report, 2023.
- 1.2.2 Canadian Green Building Council (CaGBC)
  - .1 Zero Carbon Building – Design Standard
- 1.2.3 International Organization for Standardization (ISO)
  - .1 ISO 14025: Environmental labels and declarations — Type III environmental declarations — Principles and procedures
  - .2 ISO 14040: Environmental management — Life cycle assessment — Principles and framework
  - .3 ISO 14044: Environmental management — Life cycle assessment — Requirements and guidelines
  - .4 EN 15804: Sustainability of construction works, Environmental product declarations, Core rules for the product category of construction products
  - .5 ISO 21930: Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services

### **1.3 Definitions**

- 1.3.1 Embodied Carbon: The carbon dioxide (CO<sub>2</sub>) emissions associated with the manufacturing, transport, installation, use, and end-of-life of building materials.
- 1.3.2 Environmental Product Declaration (EPD): A standardized document providing data on the environmental impact of a product.
  - .1 Industry-Wide (Generic) EPD: Provide products with third-party certification (Type III), including external verification, in which

the manufacturer is explicitly recognized as a participant by the program operator. EPD must conform to ISO 14025, 14040, 14044, and EN 15804 or ISO 21930 and have at least a cradle to gate scope.

- .2 Product-Specific Declaration: A product with a publicly available, critically reviewed life-cycle assessment conforming to ISO 14044 that has at least a cradle to gate scope.
  - .3 Product-Specific Type III EPD: A product with a third-party certification, including external verification, in which the manufacturer is explicitly recognized by the program operator. EPD must conform to ISO 14025, 14040, 14044, and EN 15804 or ISO 21930 and have at least a cradle to gate scope.
- 1.3.3 Global Warming Potential (GWP): A metric used to quantify the impact of greenhouse gases in terms of CO<sub>2</sub> equivalents (kg CO<sub>2</sub>e).
- 1.3.4 Life Cycle Assessment (LCA): A systematic procedure for examining the inputs and outputs of materials and energy, and the associated environmental impacts throughout the product's life cycle.

#### **1.4 Embodied Carbon Targets**

- 1.4.1 Whole Building Embodied Carbon Target: Project is required to achieve a maximum carbon intensity of 350 kg CO<sub>2</sub> e/m<sup>2</sup> of built floor area or a minimum 20% improvement in embodied carbon over a functionally equivalent baseline modelled by Sustainability Consultant and included in the Contract Documents.
- 1.4.2 Embodied Carbon Targets for Individual Materials: Unless specified otherwise in individual Specification Sections, maximum GWP target values for individual materials for this project are those specified in CLF North American Material Baselines Report, current edition.
- 1.4.3 Embodied Carbon Baseline Model: Sustainability Consultant has prepared an embodied carbon model for Project. Embodied carbon model serves as a tool to establish a possible pathway to achieving Whole Building Embodied Carbon Target specified for this Project. Contractor will be responsible for reviewing and updating Baseline Model during construction with actual materials quantities used and products used in the work, to ensure compliance with embodied carbon targets set for project. Baseline model is attached to this Specification.

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**1.5 Administrative Requirements**

- 1.5.1 Sustainability Kick-Off Meeting: Schedule pre-construction meeting at a time convenient for Owner, Consultant, and Contractor to discuss low-carbon construction requirements, strategies, and compliance with ZCB Standard.
- .1 Attendees must include:
    - .1 Authorized representatives of the Owner
    - .2 Owner's Commissioning Authority
    - .3 Architect and other consultants
    - .4 Contractor and superintendent
    - .5 Low-carbon design coordinator
    - .6 Major subcontractors
    - .7 Suppliers
    - .8 Other relevant parties
  - .2 Participants must be familiar with Project and authorized to make decisions regarding Work.
  - .3 Agenda: must cover significant items related to low-carbon design requirements, including:
    - .1 Low-carbon design targets
    - .2 General requirements for low-carbon design procurement and documentation
    - .3 Project closeout requirements and low-carbon design certification procedures
    - .4 Role of the Contractor's low-carbon design coordinator
    - .5 Construction operations, low-carbon design requirements, and restrictions
  - .4 Minutes: Record and distribute meeting minutes within three days of the meeting.

**1.6 Contractor Cooperation**

- 1.6.1 Coordinate with Sustainability Consultant to align embodied carbon reduction strategies for project and support ZCB certification requirements.
- 1.6.2 Cooperate with Consultant team and respond to questions and requests from Consultant and CaGBC regarding ZCB-Design requirements that are Contractor's responsibility, including those related to product selection, product qualities, or Contractor's procedures. Document responses as submittals.

1.6.3 Low-Carbon Sustainability Coordinator:

- .1 Engage an experienced professional to coordinate sustainability requirements. Low-Carbon Sustainability Coordinator must have received formal training in one of following courses:
  - .1 Low Carbon Training Foundations Course offered by CaGBC or partner organization available from: <https://lowcarbontraining.ca/>
  - .2 Equivalent LCA coursework offered by a reputable higher learning organization.
  - .3 Submit proof of training upon request.
- .2 Low-Carbon Sustainability Coordinator must be knowledgeable about ZCB-Design Standard.

**1.7 Submittals**

- 1.7.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.7.2 Preliminary Action Plan: Develop an Embodied Carbon Action Plan detailing strategies for reducing embodied carbon throughout project lifecycle, including procurement, and construction stages. Action Plan must include:
  - .1 Identification of major sources of embodied carbon.
  - .2 Specific strategies and materials to be used for reducing embodied carbon.
  - .3 Roles and responsibilities of team members.
- .2 Time submittal with submission of Schedule of Shop Drawings identified in Section 01 33 00.
- 1.7.3 Construction Activity Carbon Reduction Plan (CACRP): Develop and implement a CACRP to outline requirements for subcontractors, suppliers to track fossil fuel use of A4 and A5 emissions.
  - .1 Off-road Vehicles, Equipment, and Tools: Track and report fuel use or operating hours.
  - .2 Delivery Vehicles: Track and report total round-trip miles and vehicle types.
  - .3 Crew Transport: Track fuel use of shuttle buses from parking lots to the jobsite, if provided by the general contractor.
  - .4 Anti-Idling: Implement anti-idling measures to reduce non-productive idling.

- 
- .5 Best Management Practices: Consider equipment electrification, prioritizing Tier 4 final equipment, retrofitting older equipment with best available technology, using biofuel blends, delivery optimization, and using temporary electric power.
  - .6 Data Collection: Use technology to capture data efficiently, such as QR codes or webforms for logging information.
  - 1.7.4 Progress Submittals: Submit updated embodied carbon model on a monthly basis and compare actual construction and procurement activities with preliminary action plan.
    - .1 Compile and report a summary of applicable material quantities with supplier's locations.
    - .2 Bill of Materials: As soon as material sources are known, and at completion of an applicable scope of work, submit a bill of material report summarizing applicable material quantities and location where each material was obtained.
    - .3 Compiled report must present information in a unified format and in consistent units as described within this specification, to allow for final LCA model analysis by Sustainability Consultant.
  - 1.7.5 Environmental Product Declarations (EPDs): Technical Specifications identify products and materials requiring EPDs. As a minimum, EPDs must be prepared in accordance with ISO 14025, ISO 14040, ISO 14044, and EN/ISO 15804 or ISO 21930, and comply with the following:
    - .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
    - .2 EPD Impact Categories:
      - .1 Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit.
      - .2 Must report Ozone Depletion Potential (ODP) in form of unit of kg CFC-11/ declared unit.
      - .3 Must report Acidification Potential (AP) in form of unit of kgSO<sub>2</sub>/ declared unit.
      - .4 Must report Eutrophication Potential (EP) in form of unit of kg N/ declared unit.
      - .5 Must report Photochemical Ozone Creation/Smog Formation Potential (SFP) in form of unit of kgO<sub>3</sub>/declared unit.
    - .3 As a minimum, collect EPDs for products in applicable material categories indicated in the baseline model. At a minimum, provide EPDs for products in the following categories:

- .1 Concrete
- .2 Steel (including structural steel, rebar, steel cold-rolled framing studs, light-gage steel studs)
- .3 Insulation
- .4 Wall and roof panels
- .5 Aluminum framing
- .6 Gypsum wall board
- .4 Product Options: When choice is at Contractor's option, prefer Products with compliant documentation. Product-specific Type III EPDs are preferred or Industry-wide EPD's.

**1.8 Closeout Submittals**

- 1.8.1 At project completion, submit a final embodied carbon report complete with relevant supporting data and EPDs to support ZCB-Design certification.

**1.9 Consultant's Embodied Carbon Baseline Model**

- 1.9.1 A copy of the embodied carbon baseline model prepared for the Project is attached to this Section. Refer to Specification Embodied Carbon Table dated 2024-06-12. This document forms an integral part of this Specification.

**2 . PRODUCTS**

**2.1 Not Used**

**3 . EXECUTION**

**3.1 Not Used**

END OF SECTION

# PRPS Reporting Station, Dockstader

Life Cycle Assessment Report

July 2, 2024

[Introba.com](https://introba.com)



FORMERLY



**Ross & Baruzzini**

Issue	Description	Date	Prepared By	Signed Off
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# 1 Executive Summary

The following executive summary provides an overview of the comprehensive Life Cycle Assessment (LCA) conducted for the Region of Peel Paramedic Services (PRPS) Reporting Station Docksteader in Brampton, ON. This LCA was undertaken to evaluate the embodied carbon of the proposed building.

The LCA includes the structural and envelope building elements. Most of the material takeoff was conducted using the architectural Revit model last updated June 6<sup>th</sup>, 2024, and the structural Revit model last updated June 6<sup>th</sup>. The LCA software tool used for the assessment is One Click LCA.

The building shall be designed to meet the Region of Peel Net Zero Emissions Building Standard for New Construction and achieve CaGBC Zero Carbon Building (ZCB) Design Standard version 3 certification. Below are the Canada Green Building Council Zero Carbon Building Standard targets for reference:

- The Zero Carbon Building Standard sets a maximum intensity of 500 kg CO<sub>2</sub>e/m<sup>2</sup> or 10% reduction from baseline and awards points for 20% reduction/350 kg CO<sub>2</sub>e/m<sup>2</sup> (1 point) and 40% reduction/240 kg CO<sub>2</sub>e/m<sup>2</sup> (2 points).
- This project is targeting 20% reduction/350 kg CO<sub>2</sub>e/m<sup>2</sup> for 1 impact and innovation point.

The assessment performed to date includes a sensitivity analysis with options for lower carbon options, which have been used to calculate a theoretically achievable embodied carbon performance. The design team will need to use their judgement to determine if these products are suitable for this project.

Table 1: Total Embodied Carbon Summary

Life Cycle Stage	Baseline	Proposed
Upfront Carbon (A1-A5) (t CO <sub>2</sub> e)	2996	2271
Upfront Carbon Intensity* (A1-A5) (kg CO <sub>2</sub> e/m <sup>2</sup> )	383	290
Percent Upfront Carbon Reduction (A1-A5)	-	24%
Embodied Carbon (Stage A-C)	3398	2673
Embodied Carbon Intensity* (Stage A-C)	434	341
Percent Embodied Carbon Reduction (A-C)	-	21%
External Impacts (Stage D)	-1056	-1056
Biogenic	450	450

\*Intensity calculations based on a life cycle assessment area of 7,826 m<sup>2</sup>.

Based on the analysis, this project can comply with the zero carbon building requirements achieving the target 20% reduction from the baseline.

## 2 Applicable Terms and Definitions

The following terms and definitions have been sourced from the “National guidelines for whole-building life cycle assessment” and the “Carbon Definitions for the Built Environment, Buildings & Infrastructure”.<sup>12</sup>

**Absolute Zero Carbon:** Eliminating all carbon emissions without the use of offsets.

**Baseline:** A benchmark derived from a single building; may be derived from a theoretical design or a constructed building.

**Benchmark:** Reference point against which comparisons can be made. (ISO 21678:2020)

**Benchmarking:** Process of collecting, analyzing and relating performance data of comparable buildings or other constructed assets. (ISO 21677:2020)

**Biogenic Carbon:** ‘Biogenic Carbon’ refers to the carbon removals associated with carbon sequestration into biomass as well as any emissions associated with this sequestered carbon. Biogenic carbon must be reported separately if reporting only upfront carbon but should be included in the total if reporting embodied carbon or whole life carbon.

**Biomass:** ‘Biomass’ is material of biological origin excluding material embedded in geological formations or transformed to fossilized material and excluding peat. (ISO 21930:2017)

**Carbon Neutral:** All carbon emissions are balanced with offsets based on carbon removals or avoided emissions.

**Contribution Analysis:** The process of grouping indicator results together in different ways to better understand what is driving them.

**Embodied Carbon:** ‘Embodied Carbon’ emissions of an asset are the total GHG emissions and removals associated with materials and construction processes throughout the whole life cycle of an asset (Modules A0-A5, B1-B5, C1-C4, with A2 assumed to be zero for buildings)

**Environmental Product Declaration (EPD):** Environmental declaration providing quantified environmental data using predetermined parameters and, where relevant, additional environmental information. (ISO 21930:2017)

**Greenhouse Gases (GHG):** ‘Greenhouse Gases’ are constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth’s surface, the atmosphere, and clouds.

**Life Cycle Assessment (LCA):** Compilation and evaluation of the inputs, outputs and potential environmental impacts of a product system throughout its life cycle. (ISO 21930:2017)

**Life Cycle Impact Assessment (LCIA):** Phase of LCA aimed at understanding and evaluation the magnitude and significance of the potential environmental impacts for a product system throughout the life cycle of the

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<sup>1</sup> Bowick, O’Connor, Salazar, Meil, and Cooney, “National guidelines for whole-building life cycle assessment,” Canada.ca, <https://nrc-publications.canada.ca/eng/view/object/?id=f7bd265d-cc3d-4848-a666-8eeb1fbde910> (accessed Jul. 25, 2023).

<sup>2</sup> “Carbon Definitions for the Built Environment, Buildings & Infrastructure.” LETI [Online]. Available: [https://www.leti.uk/\\_files/ugd/252d09\\_04f3ex91a9a1a431b8dbaf35a0a1a81f3.pdf](https://www.leti.uk/_files/ugd/252d09_04f3ex91a9a1a431b8dbaf35a0a1a81f3.pdf) (accessed Jul. 26, 2023).

product. (ISO 21930:2017)

**Life Cycle Inventory (LCI) Analysis:** Phase of LCA involving compilation and quantification of inputs and outputs for a product throughout its life cycle.

**Net Zero (Whole Life) Carbon:** A 'Net Zero (whole life) Carbon' Asset is one where the sum total of all asset related GHG emissions, both operational and embodied, over an asset's life cycle (Modules A0-A5, B1-B8, C1-C4) are minimized, which meets local carbon, energy and water targets or limits, and with residual 'offsets', equals zero.

**Net Zero Embodied Carbon:** A 'Net Zero Embodied Carbon' asset is one where the sum total of GHG emissions and removals over an asset's life cycle (Modules A0-A5, B1-B5 and C1-C4) are minimized, which meets local carbon targets or limits (e.g kg CO<sub>2</sub>e/m<sup>2</sup>), and with additional 'offsets', equals zero.

**Net Zero Upfront Carbon:** A 'Net Zero Upfront Carbon' asset is one where the sum total of GHG emissions, excluding 'biogenic carbon', from Modules A0-A5 is minimized, which meets local carbon targets or limits (e.g kg CO<sub>2</sub>e/m<sup>2</sup>), and with additional 'offsets', equals zero.

**Operational Carbon:** Energy, Buildings – 'Operational Carbon – Energy' (Module B6) are the GHG emissions arising from all energy consumed by an asset in-use, over its life cycle.

**Reference Service Life (RSL):** Service life of a construction product which is known to be expected under a set of reference in-use conditions and which can form the basis for estimating the service life under other in-use conditions. (ISO 21930:2017)

**Reference Study Period:** The period over which the time-dependent characteristics of the object of assessment are analyzed. (EN15978:2011)

**Required Service Life:** Service life required by the client or through regulations. (EN 15978:2011)

**Sensitivity Analysis:** The process of changing a parameter in a LCA model and recalculating indicator results to determine its effect on the building.

**System Boundary:** Interface in the assessment between a building and its surroundings or other product systems. (EN 15978:2011)

**Upfront Carbon – Buildings:** 'Upfront Carbon' emissions are the GHG emissions associated with materials and construction processes up to practical completion (Modules A0-A5). Upfront carbon excludes the biogenic carbon sequestered in the installed products at practical completion.

**Whole-building LCA:** Life cycle assessment applied to a building-related functional equivalent (a whole building, or part of a building).

**Whole Life Carbon:** Whole Life Carbon' emissions are the sum total of all asset related GHG emissions and removals, both operational and embodied over the life cycle of an asset including its disposal (Modules: A0-A5; B1-B7; B8 optional; C1-C4, all including biogenic carbon, with A2 assumed to be zero for buildings).

## 3 Introduction

This section summarizes the methodology, scope, and purpose of the preliminary whole-building life cycle assessment (LCA) for the PRPS Reporting Station, located at the corner of Dixie Road and Dockstader Road in the City of Brampton, Ontario.

### 3.1 Purpose of Assessment

This assessment was conducted to provide an estimate of the whole life embodied carbon of the current design to inform further design and ensure compliance with ZCB v3. A contribution analysis identifies most contributing materials to the whole life embodied carbon. A sensitivity analysis extends beyond the contribution analysis and provides suggestions for reducing resource use and selection of resources with lower global warming potential.

### 3.2 Life Cycle Assessment Methodology

Though often considered alone, operational carbon is only part of a building's whole life carbon story. Embodied carbon represents the cradle-to-grave life cycle impacts of the products and materials used within a building: the effects of resource extraction, product manufacturing and transportation, building construction, product maintenance and replacement, and building demolition/deconstruction/disposal. In high-performance buildings, embodied carbon makes up a significant portion of a building's carbon footprint and can equal (or exceed) lifetime operational carbon emissions of the building. Trade-offs that improve building performance and reduce operational carbon, such as improved glazing and increased insulation, can often increase the associated embodied carbon; therefore, it is important to consider both together to understand whole-life carbon of a building and optimize design.

Life cycle assessments categorize the environmental impact of a building into various stages from raw material extraction to end of life. The separation of impacts into various categories can help inform which products or processes result in the largest impact at a certain point in time.

The stages, or modules, of a standard LCA are shown in Figure 1. For a new construction project, the accounting is relatively straightforward: the effects of all materials within the scope of the LCA are calculated for all life cycle stages and added together to calculate the total embodied carbon.

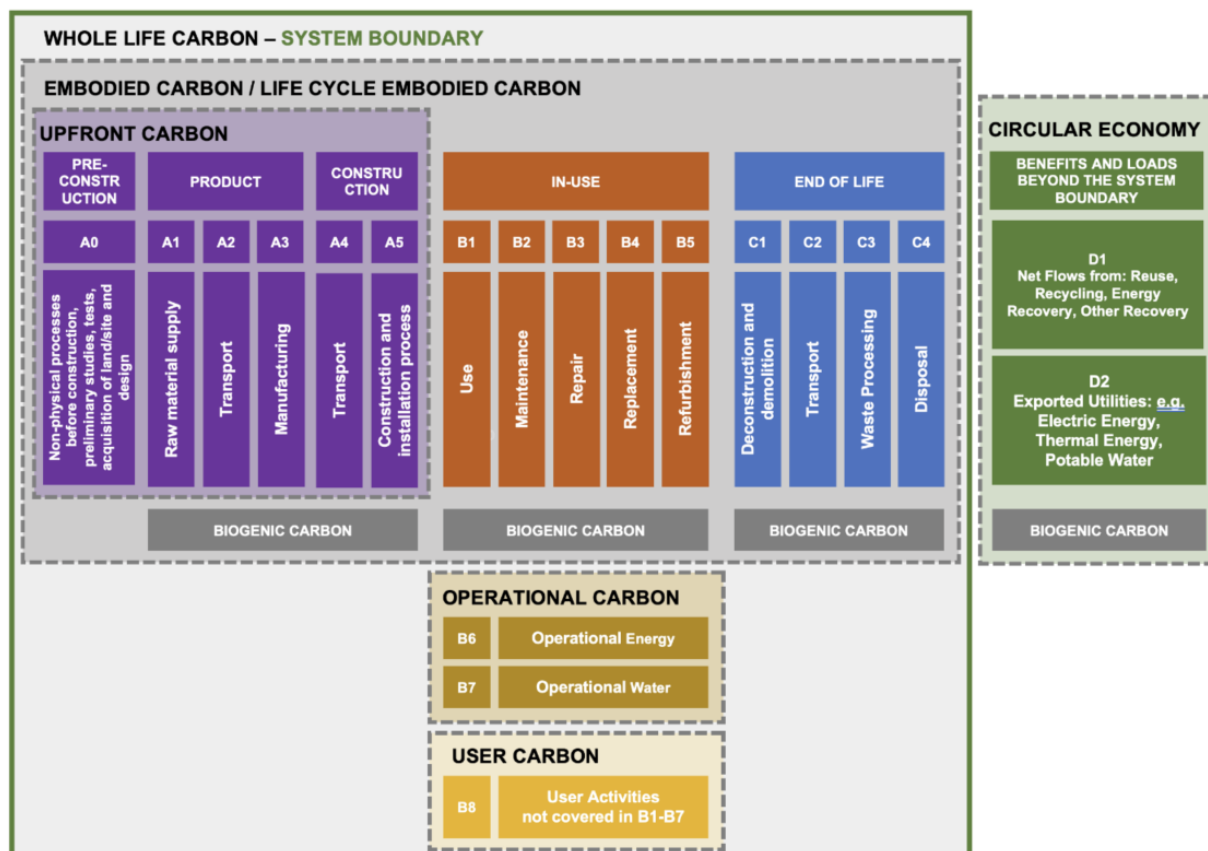


Figure 1: Life Cycle Modules from Carbon Definitions for the Built Environment, Buildings & Infrastructure developed by a working group with the Whole Life Carbon Network and adapted from BS EN 15978, BS EN 174742, PAS 2080: 206 and expected future updates.<sup>3</sup>

<sup>3</sup> "Carbon Definitions for the Built Environment, Buildings & Infrastructure." LETI [Online]. Available: [https://www.leti.uk/\\_files/ugd/252d09\\_04f3ex91a9a1a431b8dbaf35a0a1a81f3.pdf](https://www.leti.uk/_files/ugd/252d09_04f3ex91a9a1a431b8dbaf35a0a1a81f3.pdf) (accessed Jul. 26, 2023).

## 4 Details of Assessment

### 4.1 Data Sources

The LCA was developed from the Architecture Revit Model current as of June 6<sup>th</sup>, 2024, and the Structural Revit Model current as of June 6<sup>th</sup>, 2024. Modelling was conducted using One Click LCA. Quantity takeoffs were recorded using Revit. At this stage of the assessment, material assumptions were used for most product selections and quantities. Estimates based on industry knowledge were used, as described in Appendix A.

The environmental data has been sourced from environmental product declarations (EPDs) in One Click LCA. EPDs summarize the results of a life cycle assessment of a product or service. Most EPDs have been source from Ecoinvent, GaBi, and USLCI. In cases where no EPD was available, projected estimates were included instead.

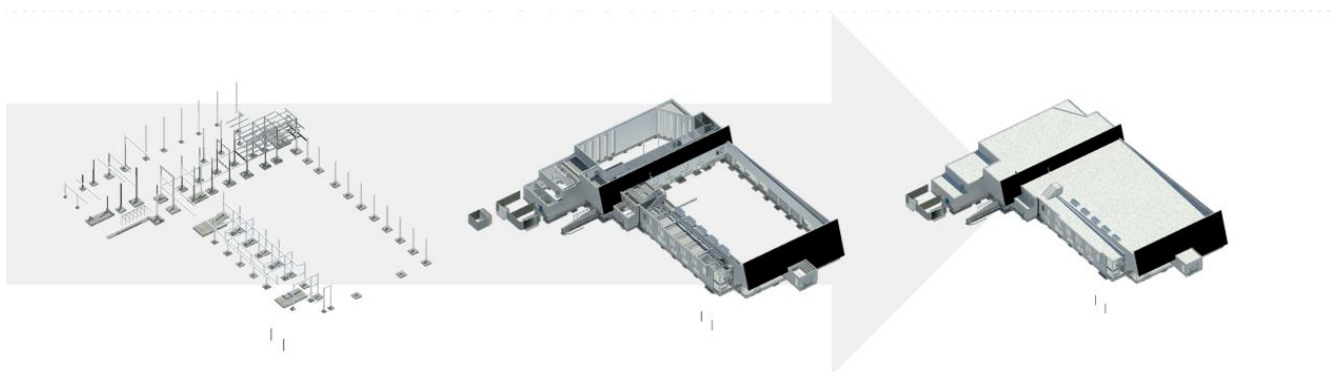
### 4.2 Reference Study Period

The reference study period is the calculation period based on the declared service life of the building. Product replacements and maintenance are calculated for this period. The declared service life of 60 years was used for this assessment.

### 4.3 Scope of Assessment

The LCA is a preliminary assessment of the impact of envelope and structural elements only. Interior fit outs and finishes, MEP systems, and landscaping are outside the scope of this assessment and are not included. Appendix A describes the exact material takeoff in more detail.

Operational carbon was considered outside the scope of this LCA and is excluded from the results. Operational water use was not calculated and is excluded from overall life cycle effects.



### 4.4 System Boundary

The system boundary defines which life cycle assessment stages are included in the analysis. The life cycle stages have been identified by One Click LCA and Table 2 identifies the specific modules included in the assessment.

Table 2: Activities Included in the System Boundary

Module	Module/Activity	Included
<b>A1-A3</b>	Raw material supply, Transport, Manufacturing	
A1-A3	Production, building materials	×
<b>A4</b>	Transport	
A4	Transport to the building site	×
<b>A5</b>	Construction-Installation Process	
A5a	Site operations & site waste handling	
A5b	Site waste transportation	
A5c	Construction site – material wastage - materials	×
A5d	Construction site – material wastage - transport	×
A5e	Construction site – material wastage - waste	×
<b>B1</b>	Use	
<b>B2</b>	Maintenance	
<b>B3</b>	Repair	
<b>B4-B5</b>	Material Replacement and Refurbishment	
B4-5a	Material replacement - materials	×
B4-5b	Material replacement - transport	×
B4-5c	Material replacement - waste	×
<b>B6</b>	Operational energy	
<b>B7</b>	Operational Water	
<b>C1-C4</b>	End of life	
C1	Deconstruction/demolition	
C2	Transport to waste processing/disposal, building materials	×
C3	Waste processing, building materials	×
C4	Disposal, building materials	×
<b>D</b>	Benefits and loads beyond the building lifecycle (not included in totals)	
D	Installed materials – benefit	×

## 4.5 Gross Floor Area Estimate

Based on the “National guidelines for whole-building life cycle assessment”<sup>4</sup>, gross floor area (GFA) for a LCA should measure within the outside face of enclosing walls on each floor area. See Table 3 below for the GFA calculation and Appendix A for more detailed calculation.

Table 3: External Gross Floor Area Summary

Level	Area (m <sup>2</sup> )
<b>Floor 1</b>	5,381
<b>Floor 2</b>	1,808
<b>Floor 3</b>	637
<b>TOTAL</b>	<b>7,826</b>

<sup>4</sup> Bowick, O'Connor, Salazar, Meil, and Cooney, “National guidelines for whole-building life cycle assessment,” Canada.ca, <https://nrc-publications.canada.ca/eng/view/object/?id=f7bd265d-cc3d-4848-a666-8eeb1fbde910> (accessed Jul. 25, 2023).



## 4.6 Environmental Indicators

The life cycle assessment (LCA) has been conducted in accordance with the Life Cycle Carbon – Global tool. The life cycle assessment is compliant with EN 15978, EN 15804, ISO 14040, ISO 14044 and ISO 21929. For the purposes of this study, global warming potential and biogenic carbon are the only factors being compared.

### 4.6.1 External Impacts

Module D accounts for potential environmental benefits and loads that occur beyond the stages A-C. This may include the use of recycled material from the site, reuse of site material elsewhere, energy recovery, or exported energy. This category is used to understand the implications beyond the system boundary which may have further impact on initial design decisions.

### 4.6.2 Biogenic Carbon

Biogenic carbon refers to carbon dioxide (CO<sub>2</sub>) that is absorbed and released during the natural carbon cycle through the growth and decay of plants and other organic matter. Biogenic carbon is distinct from fossil carbon, which involves the release of CO<sub>2</sub> from long-term geological storage of carbon, such as burning fossil fuels like coal, oil, and natural gas.

In most LCAs, biogenic carbon is accounted for as carbon neutral. The carbon neutrality assumption assumes that biogenic carbon operates in a closed loop system. Plants and trees absorb CO<sub>2</sub> from the atmosphere through photosynthesis, and this carbon is stored in their biomass. An assumption is made that emissions released from harvest and use of biomass will be released back into the atmosphere in the same quantity and form as when absorbed (either naturally decomposed or burned). Therefore, there is no net increase in atmospheric carbon emissions.

While some may argue that biogenic carbon has negative effects of whole-life GWP because carbon is stored in the building, it is not accounted for as a reduction in GWP because:

- Biomass must come from certified sustainable sources (i.e. FSC wood) to be considered.
  - If not sustainability sourced, impacts on climate change and biodiversity loss can result from land use change and the various effects on the forest carbon cycle.
- The reuse/recyclability of many mass timber elements is limited because of the adhesives used in products (i.e. CLT, glulam, etc.). Therefore, at end of life, the carbon stored in the building could be released if the timber is landfilled and allowed to decompose. The opportunity to continue to store this carbon is limited to ensuring the building longevity or reuse of the structural members.

With the complexities of accounting for biogenic carbon, special consideration should be made under specific contexts, assumptions, and guidelines. Following international standard ISO 21930, biogenic carbon can be considered carbon neutral, however, it is recommended that biogenic carbon be reported to provide transparency in reporting.

Awareness of biogenic carbon and its potential value in reducing the GWP of a building. It is recommended to use design for disassembly principles (mechanical fasteners) to allow building materials to enter the circular economy.

# 5 Results

## 5.1 Baseline Whole Building Life Cycle Assessment

The DD-Stage LCA estimates a total global warming potential of 3398 t CO<sub>2</sub>e for the embodied carbon of the structure and enclosure using baseline GWPs for the proposed materials.

Table 4: Embodied Carbon During Life Cycle Stages

Stage	Stage Description	Embodied Carbon (t CO <sub>2</sub> e)	Carbon Intensity (kgCO <sub>2</sub> e/m <sup>2</sup> )	Biogenic Carbon (t CO <sub>2</sub> e)
A1-A3	Raw materials extraction, transport, and manufacturing	2693	344	450
A4-A5	Transportation to site and construction/installation process	303	-	-
A1-A5	"Upfront Carbon"	2996	383	450
B	Use phase, maintenance, repair, material replacement and refurbishment	189	-	-
C	End-of-life demolition and waste processing	213	-	-
A-C	"Embodied Carbon"	3398	434	-
D	External Impacts; reuse/recycling - not included in embodied carbon total	-1056	-	-

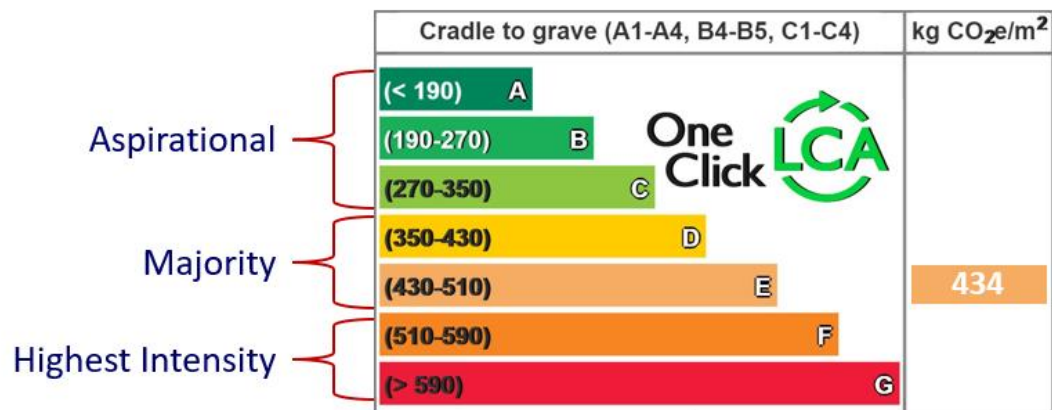


Figure 2: Comparison between all types of buildings.

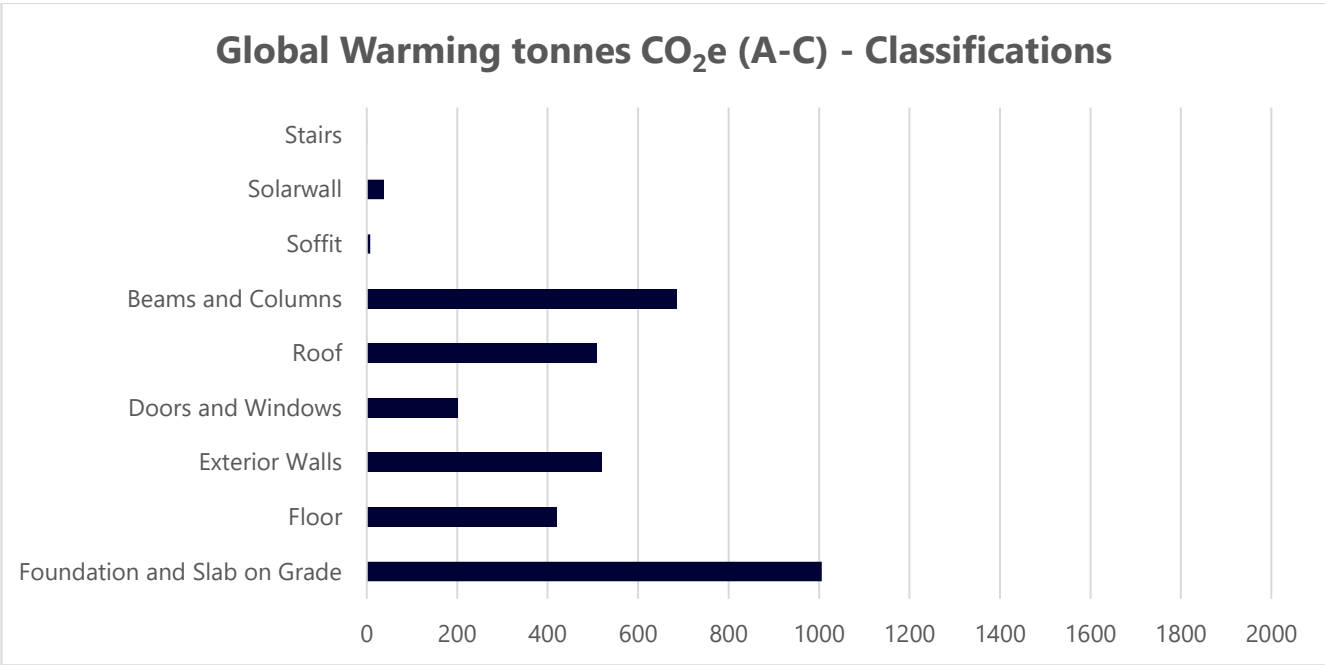


Figure 3: Global warming potential by classification

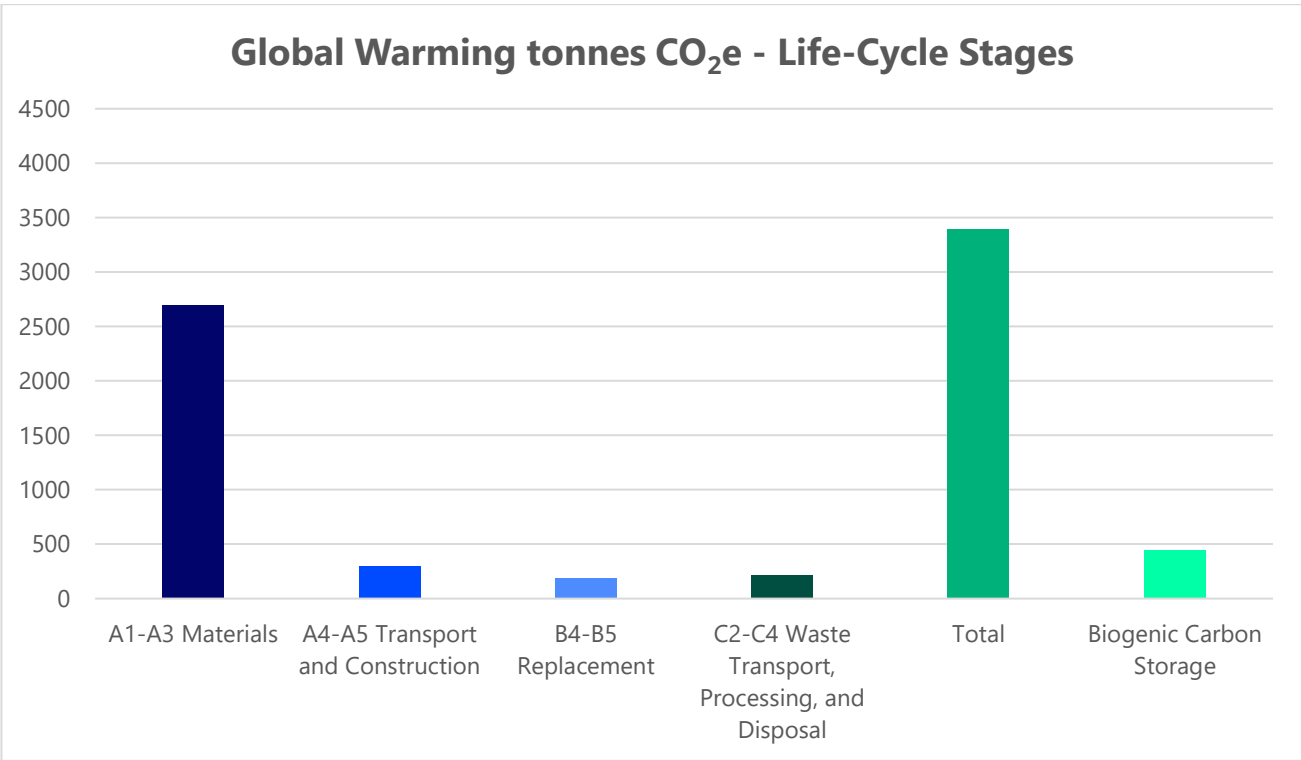


Figure 4: Global warming potential by life cycle stage

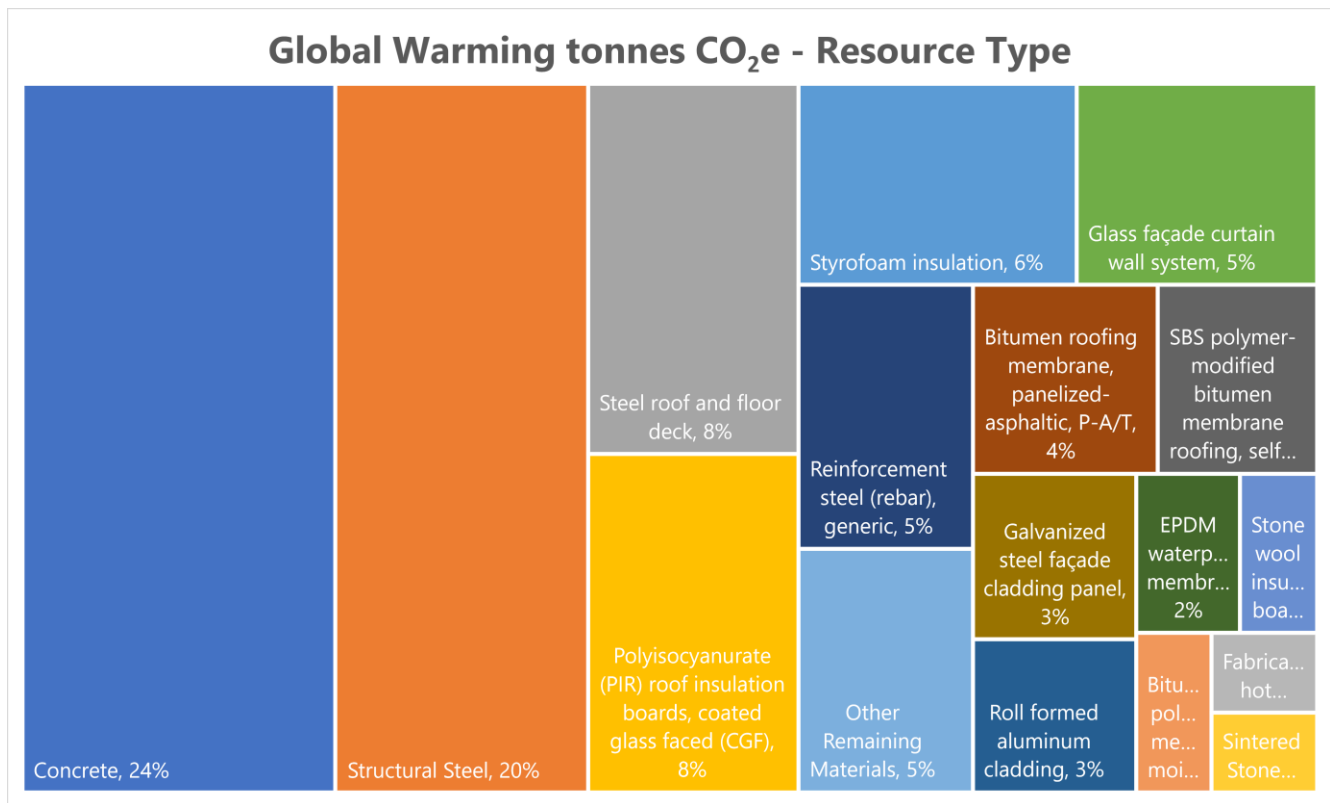


Figure 5: Global warming kg CO<sub>2</sub>e by resource type, stages A-C

## 5.2 Most Contributing Materials and Low GWP Alternatives

Table 5 lists the materials with the highest upfront carbon (A1-A3) in the baseline scenario. Low GWP alternatives can be used to reduce overall upfront carbon.

Table 5: Embodied Carbon During Life Cycle Stages

Number	Resource	Cradle to Gate Impacts (A1-A3) (t CO <sub>2</sub> e)	Of Cradle to Gate (A1-A3)
1	Ready-mix concrete, Ontario industry average	575.2	26.9 %
2	Fabricated hollow structural steel sections, unpainted	572.4	26.8 %
3	Glass façade curtain wall system	178.8	8.4 %
4	Reinforcement steel (rebar), generic	157	7.3 %
5	XPS Insulation	130	6.1 %
6	Galvanized steel façade cladding panel	92.3	4.3 %
7	Roll formed aluminum cladding	85.9	4 %
8	Polyisocyanurate (PIR) roof insulation boards, coated glass faced (CGF)	74.5	3.5 %

Number	Resource	Cradle to Gate Impacts (A1-A3) (t CO <sub>2</sub> e)	Of Cradle to Gate (A1-A3)
9	Stone wool insulation board for exterior cavity wall and rainscreen applications, moisture resistant, with bitumen facing or no facing	41.9	2 %
10	Bitumen roofing membrane, panelized-asphaltic, P-A/T	38	1.8 %

### 5.2.1 Concrete

In the baseline scenario, concrete accounts for 575 tonnes of upfront carbon dioxide using the Ontario industry average EPDs. Less carbon-intensive concrete is readily available, and reductions are possible by setting “Allowable kgCO<sub>2</sub>e” limits. Alternative concrete mixes exist with higher supplementary cementitious material and other mix alternatives. Using the upper range of Lafarge ECOPact concrete alternatives, the project can save at least 105 tonnes CO<sub>2</sub>e compared to the current Ontario industry average benchmark. Further reductions are possible with higher supplementary cementitious material and/or extending cure times.

### 5.2.2 Structural Steel

Structural steel with 60% recycled content is used in the baseline scenario and accounts for 572 tonnes of upfront carbon dioxide. Structural steel with higher % recycled content and less energy intensive manufacturing processes (e.g. electric arc furnace rather than basic oxygen furnace) can save at least 434 tonnes CO<sub>2</sub>e reduction in emissions. Further reductions are possible by using products with EPDs that demonstrate lower GWP.

### 5.2.3 Rebar

Rebar with 60% recycled content accounts for 157 tonnes of upfront carbon dioxide in the baseline scenario. Locally produced rebar can be sourced with higher recycled content and reduce rebar upfront carbon by at least 82 tonnes. Further reductions are possible by using products with EPDs that demonstrate lower GWP.

### 5.2.4 Insulation

Extruded polystyrene (XPS) in the roof, slab on grade, and foundation walls contributes to a third of the total embodied carbon. In the baseline model, the Dow Highload 40 XPS material baseline embodied carbon intensity was used to determine the XPS GWP. The baseline is 11.19 kg CO<sub>2</sub>e /m<sup>2</sup> @RSI-1 (North America). There are alternative product options available, such as the Soprema XPS with an embodied carbon of 1.8 kg CO<sub>2</sub>e /m<sup>2</sup> @RSI-1 (Canada) and an 104 tonne reduction in upfront carbon.

The GWP of insulation can vary widely depending on material type, thermal resistance, and manufacturer; nuances which are difficult to capture through early-stage LCA modelling. Generally, rigid foam insulations such as extruded polystyrene (XPS) and spray foam insulation that use blowing agents have higher GWPs than loose fill and batt insulations of 4 kg CO<sub>2</sub>e / m<sup>2</sup> @RSI-1; however, all petroleum-based products have non-negligible carbon footprints because end-of-life processes typically involve incineration or landfill. Specific product EPDs should be reviewed before selecting insulation to allow only the most environmentally friendly options.

## 5.3 Proposed Building Whole Building Life Cycle Assessment

Specifying low carbon concrete, steel, and XPS can meet the 20% target, with a 21.3% or 725 tonnes carbon dioxide

reduction.

Refer to Appendix C for a detailed table showing the alternative product EPDs suggested for the proposed design.

Table 6: Embodied Carbon During Life Cycle Stages

Life Cycle Stage	Baseline	Proposed
Upfront Carbon (A1-A5) (t CO2e)	2996	2271
Upfront Carbon Intensity* (A1-A5) (kg CO2e/m²)	383	290
Percent Upfront Carbon Reduction (A1-A5)	-	24%
Embodied Carbon (Stage A-C)	3398	2673
Embodied Carbon Intensity* (Stage A-C)	434	341
Percent Embodied Carbon Reduction (A-C)	-	21%
External Impacts (Stage D)	-1056	-1056
Biogenic	450	450

\*Intensity calculations based on a life cycle assessment area of 7,826 m².

# Appendix A: Material Quantity Takeoff and Assumptions

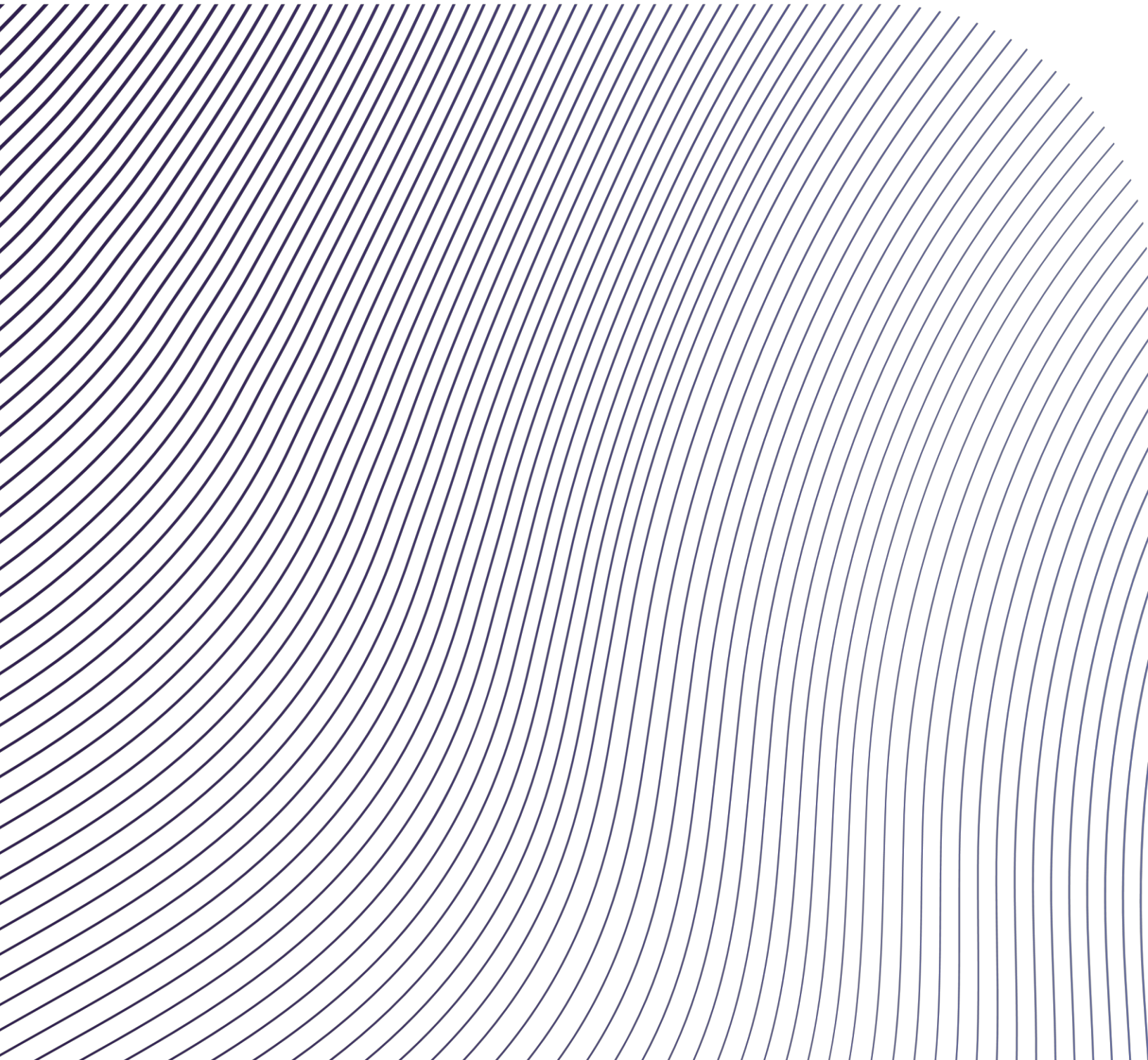


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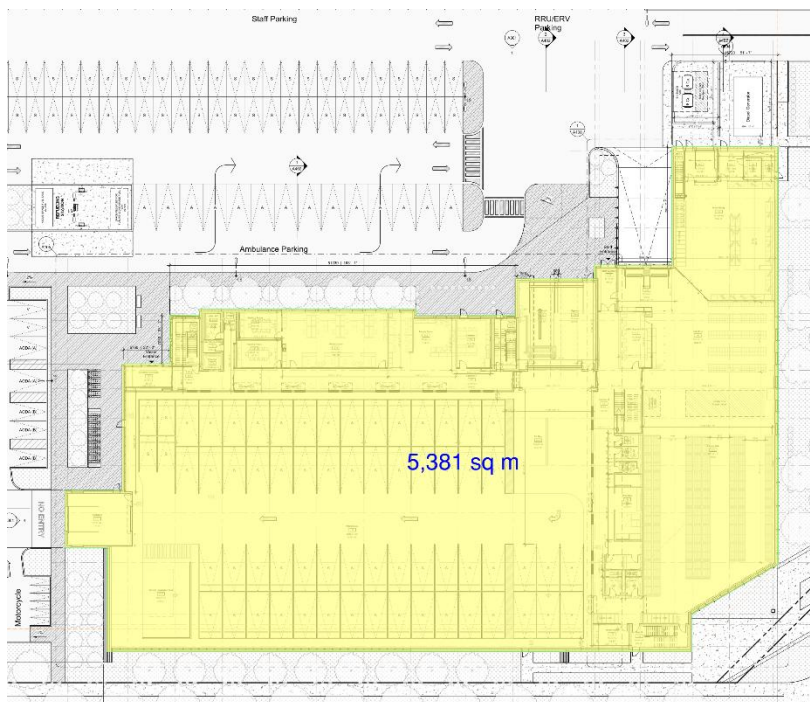
# 1 Building Parameters

Modelled External GFA	7826 m <sup>2</sup>
# Floors (above grade)	3
# Floors (below grade)	0
Building Height	13 m
Building Footprint	5381 m <sup>2</sup>

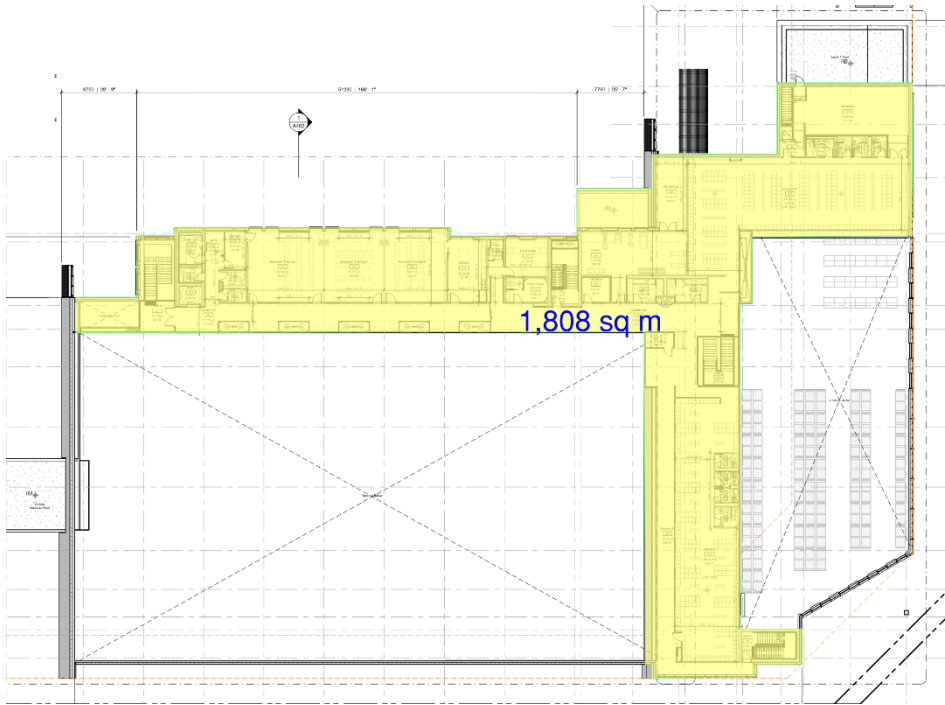
## 1.1 Gross Floor Area Estimate

Level	Area (m <sup>2</sup> )
Floor 1	5,381
Floor 2	1,808
Floor 3	637
TOTAL	7,826

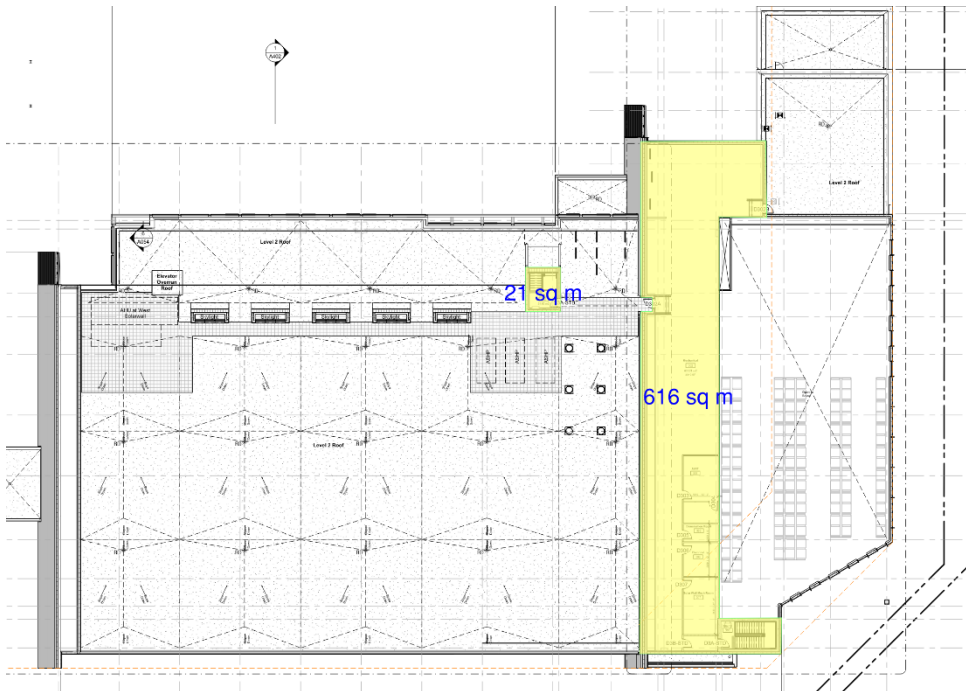
### 1.1.1 Floor Area Takeoff



Level 1



Level 2



Level 3

## 2 Building Envelope Assumptions

Classification	Assumption
Exterior Walls	Metal studs are spaced at 400mm
Stairs	Metal staircase has mass of 91 kg/step and 8000 kg/m <sup>3</sup>

## 3 Building Materials

ID	Component	Assembly Details	Quantities	Notes
3.1.1	EW1A/B- Metal Cladding System	Prefinished Metal Cladding Panel	21255 kg	Steel 8000 kg/m3
3.1.2	EW1A/B- Metal Cladding System	Engineered Cladding Rails	5314 kg	Assumed there are 2 rails in a 9m2 area and each rail is 0.15m*3m. Steel 8000 kg/m3
3.1.3	EW1A/B- Metal Cladding System	Insulation Type INS-1	443 m3	
3.1.4	EW1A/B- Metal Cladding System	Engineered 300mm Thermal Clip System	2044 kg	Steel 8000 kg/m3
3.1.5	EW1A/B- Metal Cladding System	Membrane Type AVBM-1	2214 m2	
3.2.6	EW2 - Metal Cladding System - Uninsulated	Prefinished Metal Cladding Panel	3575 kg	Steel 8000 kg/m3
3.2.7	EW2 - Metal Cladding System - Uninsulated	Engineered Cladding Rails	894 kg	Assumed there are 2 rails in a 9m2 area and each rail is 0.15m*3m. Steel 8000 kg/m3
3.3.8	EW3 - Solar Wall	22mm 24 Gauge Corrugated Perforated Rolled Steel Wall Cladding	4752 kg	Steel 8000 kg/m3
3.3.9	EW3 - Solar Wall	26 Gauge Galvanized Steel Solarwall Liner	3523 kg	Steel 8000 kg/m3
3.3.10	EW3 - Solar Wall	Insulation Type INS-1	196 m3	
3.3.11	EW3 - Solar Wall	Membrane Type AVBM-1	979 m2	
3.4.12	EW4 - Metal Panel Cladding System	Composite Metal Panel	0 m3	

ID	Component	Assembly Details	Quantities	Notes
3.4.13	EW4 - Metal Panel Cladding System	Engineered Cladding Rails	202 kg	Assumed there are 2 rails in a 9m2 area and each rail is 0.15m*3m. Steel 8000 kg/m3
3.4.14	EW4 - Metal Panel Cladding System	Insulation Type INS-1	17 m3	
3.4.15	EW4 - Metal Panel Cladding System	Engineered 300mm Thermal Clip System	78 kg	Steel 8000 kg/m3
3.4.16	EW4 - Metal Panel Cladding System	Membrane Type AVBM-1	84 m2	
3.5.17	EW5 - Composite Metal Panel - Uninsulated	Composite Metal Panel	1 m3	
3.5.18	EW5 - Composite Metal Panel - Uninsulated	Engineered Cladding Rails	4369 kg	Assumed there are 2 rails in a 9m2 area and each rail is 0.15m*3m. Steel 8000 kg/m3
3.6.19	EW6 - Stone Panel Cladding	Sintered Stone Panel	8 m3	
3.6.20	EW6 - Stone Panel Cladding	Engineered Cladding Rails	3074 kg	Assumed there are 2 rails in a 9m2 area and each rail is 0.15m*3m. Steel 8000 kg/m3
3.6.21	EW6 - Stone Panel Cladding	Insulation Type INS-1	38 m3	
3.6.22	EW6 - Stone Panel Cladding	Engineered 300mm Thermal Clip System	177 kg	Steel 8000 kg/m3
3.6.23	EW6 - Stone Panel Cladding	Membrane Type AVBM-1	12 m2	
3.7.24	EW7 - Roof Parapet and Curb - Inside Face	SBS Roof Membrane	89 m2	
3.7.25	EW7 - Roof Parapet and Curb - Inside Face	Polyisocyanurate Insulation	9 m3	
3.8.26	EW8 - Corrugated Metal Cladding	Corrugated Aluminum Cladding	22674 kg	Aluminum 2700 kg/m3
3.8.27	EW8 - Corrugated Metal Cladding	Engineered Cladding Rails	504 kg	Assumed there are 2 rails in a 9m2 area and each rail is

ID	Component	Assembly Details	Quantities	Notes
				0.15m*3m. Steel 8000 kg/m3
3.8.28	EW8 - Corrugated Metal Cladding	Insulation Type INS-1	42 m3	
3.8.29	EW8 - Corrugated Metal Cladding	Membrane Type AVBM-1	210 m2	
3.9.30	EW10 - Glass Faced Rainscreen Cladding Panel	Glass Faced Rainscreen Panel	66 m2	
3.9.31	EW10 - Glass Faced Rainscreen Cladding Panel	Engineered Cladding Rails	158 kg	Assumed there are 2 rails in a 9m2 area and each rail is 0.15m*3m. Steel 8000 kg/m3
3.9.32	EW10 - Glass Faced Rainscreen Cladding Panel	Insulation Type INS-1	13 m3	
3.9.33	EW10 - Glass Faced Rainscreen Cladding Panel	Engineered Cladding Rails	1054 kg	Assumed there are 2 rails in a 9m2 area and each rail is 0.15m*3m. Steel 8000 kg/m3
3.9.34	EW10 - Glass Faced Rainscreen Cladding Panel	Membrane Type AVBM-1	66 m2	
3.13.35	MS1 - Steel Stud Back-Up Wall	Exterior Sheathing Board	0 m3	
3.13.36	MS1 - Steel Stud Back-Up Wall	Lateral Load-Bearing Cold Formed Metal Framing	96 kg	Assumed 18 gauge steel and 400mm o.c.
3.13.37	MS1 - Steel Stud Back-Up Wall	Gypsum Board	0 m3	
3.42.38	MS2 - Steel Stud Back-Up Wall	Exterior Sheathing Board	36 m3	
3.42.39	MS2 - Steel Stud Back-Up Wall	Lateral Load-Bearing Cold Formed Metal Framing	11226 kg	Assumed 18 gauge steel and 400mm o.c.
3.42.40	MS2 - Steel Stud Back-Up Wall	Gypsum Board	36 m3	
3.43.41	MS3 - Steel Stud Back-Up Wall	Exterior Sheathing Board	16 m3	
3.43.42	MS3 - Steel Stud Back-Up Wall	Lateral Load-Bearing Cold Formed Metal Framing	5871 kg	Assumed 18 gauge steel and 400mm o.c.

ID	Component	Assembly Details	Quantities	Notes
3.43.43	MS3 - Steel Stud Back-Up Wall	Gypsum Board	16 m3	
1.14.44	FW1 - Typical CIP Concrete Foundation Wall	16 Gauge 316 Stainless Steel Flashing to Grade	0 m3	
1.14.45	FW1 - Typical CIP Concrete Foundation Wall	XPS Insulation	21 m3	
1.14.46	FW1 - Typical CIP Concrete Foundation Wall	Damp Proofing Membrane	142 m2	
1.44.47	FW2 - CIP Foundation Wall	XPS Insulation	109 m3	
1.45.48	FW3 - CIP Foundation Wall	XPS Insulation	2 m3	
6.37.49	Concrete Column	Concrete Column	24 m3	Baseline 35MPa concrete with air & 0.40 w/cm (C-1) GU 25 SL
5.19.50	38mm Steel Roof Deck	Steel Deck	18645 kg	Multiply by 1.3 for corrugation. Steel 8000 kg/m3
2.18.51	64mm Concrete Topping on Steel Deck	Min. Depth Poured-In Place Concrete	1 m3	
2.18.52	64mm Concrete Topping on Steel Deck	Steel Deck	151 kg	Multiply by 1.75 for corrugation. Steel 8000 kg/m3
2.48.53	75mm Concrete Topping	Self-Levelling Concrete Topping	147 m3	
2.48.54	75mm Concrete Topping	Rebar	442 kg	3 kg/m3
5.49.55	76mm Steel Roof Deck	Steel Deck	62899 kg	Multiply by 1.75 for corrugation. Steel 8000 kg/m3
2.47.56	89mm Concrete Topping on Steel Deck	Min. Depth Poured-In Place Concrete	234 m3	
2.47.57	89mm Concrete Topping on Steel Deck	Steel Deck	33818 kg	Multiply by 1.75 for corrugation. Steel 8000 kg/m3
1.50.58	100 Slab	Foundation Slab	1 m3	
1.50.59	100 Slab	Rebar	66 kg	55 kg/m3
1.51.60	150 Deep	Foundation Slab	13 m3	

ID	Component	Assembly Details	Quantities	Notes
1.52.61	317 Deep	Foundation Slab	0 m3	
1.52.62	317 Deep	Rebar	19 kg	60 kg/m3
1.53.63	250 Slab	Foundation Slab	9 m3	55 kg/m3
1.16.64	SOG1 - 175	XPS Insulation	279 m3	
1.16.65	SOG1 - 175	Damp Proofing Membrane	2785 m2	
1.16.66	SOG1 - 175	Foundation Slab	487 m3	
1.16.67	SOG1 - 175	Rebar	26806 kg	55 kg/m3
1.17.68	SOG2 - 125	XPS Insulation	59 m3	
1.17.69	SOG2 - 125	Damp Proofing Membrane	592 m2	
1.17.70	SOG2 - 125	Foundation Slab	74 m3	
1.17.71	SOG2 - 125	Rebar	3700 kg	50 kg/m3
1.54.72	SOG2 - 175	XPS Insulation	26 m3	
1.54.73	SOG2 - 175	Damp Proofing Membrane	255 m2	
1.54.74	SOG2 - 175	Foundation Slab	45 m3	
1.54.75	SOG2 - 175	Rebar	2454 kg	55 kg/m3
1.55.76	SOG3 - 175	XPS Insulation	133 m3	
1.55.77	SOG3 - 175	Damp Proofing Membrane	1325 m2	
1.55.78	SOG3 - 175	Foundation Slab	232 m3	
1.55.79	SOG3 - 175	Rebar	12753 kg	55 kg/m3
1.56.80	SOG5 - 175	XPS Insulation	23 m3	

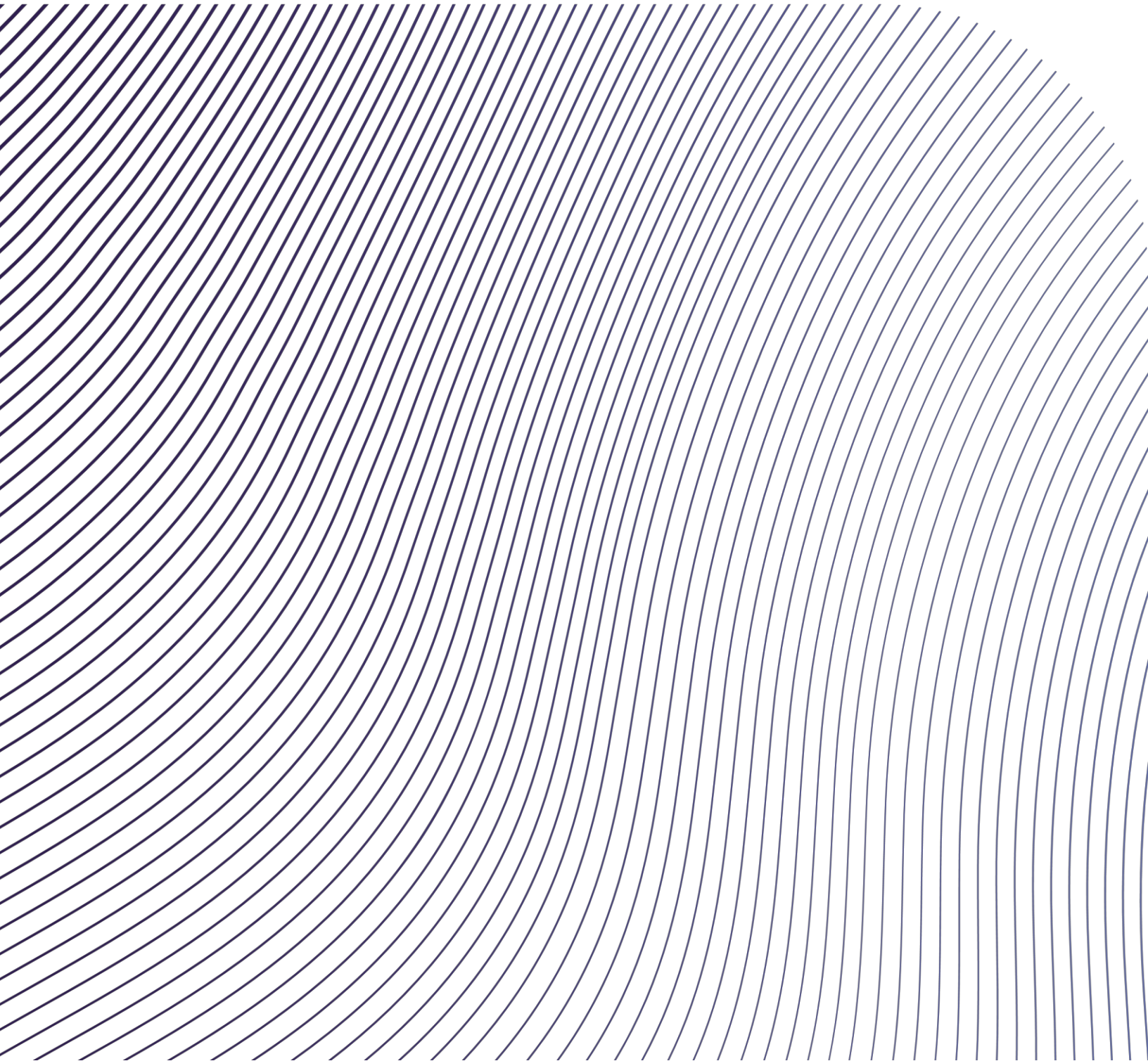
ID	Component	Assembly Details	Quantities	Notes
1.56.81	SOG5 - 175	Damp Proofing Membrane	226 m2	
1.56.82	SOG5 - 175	Foundation Slab	40 m3	
1.56.83	SOG5 - 175	Rebar	2175 kg	55 kg/m3
1.57.84	SOG6 - 240	XPS Insulation	23 m3	
1.57.85	SOG6 - 240	Damp Proofing Membrane	226 m2	
1.57.86	SOG6 - 240	Foundation Slab	54 m3	
1.57.87	SOG6 - 240	Rebar	3254 kg	60 kg/m3
1.36.88	Footing	Footing	210 m3	
1.36.89	Footing	Rebar	14571 kg	
1.40.90	Foundation Slab	Foundation Slab	143 m3	
1.40.91	Foundation Slab	Rebar	17134 kg	
1.41.92	Wall Foundation	Wall Foundation	200 m3	
1.41.93	Wall Foundation	Rebar	10085 kg	
9.21.94	S1 - Interlocking Metal Panel Soffit	Fibreglass Faced Gypsum Sheathing	2 m3	
9.21.95	S1 - Interlocking Metal Panel Soffit	Polyethylene Vapour Barrier	96 m2	10mm
9.21.96	S1 - Interlocking Metal Panel Soffit	Insulation Type INS-1	19 m3	
9.21.97	S1 - Interlocking Metal Panel Soffit	Galvanized Steel Girts	38 kg	Assumed there is 1 rail per 1m2 with cross section area of 1.3*0.025 and length of 1m. Steel 8000 kg/m3
9.21.98	S1 - Interlocking Metal Panel Soffit	Interlocking Pre-Finished Galvanized Metal Panel	553 kg	Multiply by 1.2 for corrugation. Steel 8000 kg/m3
9.58.99	S2 - Interlockig Metal Panel Soffit - Uninsulated	Fibreglass Faced Gypsum Sheathing	1 m3	
9.58.100	S2 - Interlockig Metal Panel Soffit - Uninsulated	Polyethylene Vapour Barrier	46 m2	10mm
9.58.101	S2 - Interlockig Metal Panel Soffit - Uninsulated	Galvanized Steel Girts	18 kg	Assumed there is 1 rail per 1m2 with cross section area of 1.3*0.025 and length of 1m. Steel 8000 kg/m3



ID	Component	Assembly Details	Quantities	Notes
9.58.102	S2 - Interlockig Metal Panel Soffit - Uninsulated	Interlocking Pre-Finished Galvanized Metal Panel	264 kg	Multiply by 1.2 for corrugation. Steel 8000 kg/m3
5.22.103	R1 - SBS Membrane - Low Slope	SBS Roof Membrane	5126 m2	2-Ply
5.22.104	R1 - SBS Membrane - Low Slope	Asphaltic Roof Protection Board	67 m3	
5.22.105	R1 - SBS Membrane - Low Slope	Polyisocyanurate Insulation	1302 m3	
5.22.106	R1 - SBS Membrane - Low Slope	Polyethylene Vapour Barrier	5126 m2	10mm
5.22.107	R1 - SBS Membrane - Low Slope	Fibreglass Faced Gypsum Sheathing	82 m3	
5.23.108	R2 - SBS Membrane - Low Slope, Reduced Insulation	SBS Roof Membrane	49 m2	2-Ply
5.23.109	R2 - SBS Membrane - Low Slope, Reduced Insulation	Asphaltic Roof Protection Board	1 m3	
5.23.110	R2 - SBS Membrane - Low Slope, Reduced Insulation	Polyisocyanurate Insulation	6 m3	
5.23.111	R2 - SBS Membrane - Low Slope, Reduced Insulation	Polyethylene Vapour Barrier	49 m2	10mm
5.23.112	R2 - SBS Membrane - Low Slope, Reduced Insulation	Fibreglass Faced Gypsum Sheathing	1 m3	
4.24.113	Door - Swing Single Framed	Heavy Metal Door	34 m2	
4.27.114	Glazed Aluminum Framed Door	Glazed Aluminum Framed Door	108 m2	
4.25.115	Industrial Door	Industrial Door	59 m2	
4.29.116	CW3 - Vestibule Curtain Wall	Curtain Wall	114 m2	
4.11.117	CW2 - IGU in Insulated Fibreglass Frame	Curtain Wall	222 m2	IGU in Fibreglass Frame - Okalux, Bird Frit on Surface
4.10.118	CW1 - IGU in Insulated Fibreglass Frame	Curtain Wall	412 m2	IGU in Fibreglass Frame - Bird Frit on Surface
7.31.119	Stair - Folded Metal - Wood Tread	Wood Tread	1 m3	
7.33.120	Stair - Folded Metal - Stringer	Metal Tread	2 m3	
6.35.121	Steel Column	Steel Column	89540 kg	7850 kg/m3
6.38.122	Steel Framing	Steel Framing - HSS	248675 kg	
6.38.123	Steel Framing	Steel Framing - OWSJ	3219 kg	
7.32.124	Stair - Cast-in-place	Cast-in-place Concrete	1 m3	Baseline 25MPa concrete without air GU 10 SL

ID	Component	Assembly Details	Quantities	Notes
7.39.125	Rebar	Rebar	63 kg	60 kg/m3
3.59.126	Shear Wall	Shear Wall	165 m3	
3.59.127	Shear Wall	Rebar	14886 kg	90 kg/m3
3.60.128	Above Grade Concrete Wall	Above Grade Concrete Wall	337 m3	
3.60.129	Above Grade Concrete Wall	Rebar	16846 kg	50 kg/m3

# Appendix B: Contribution Analysis

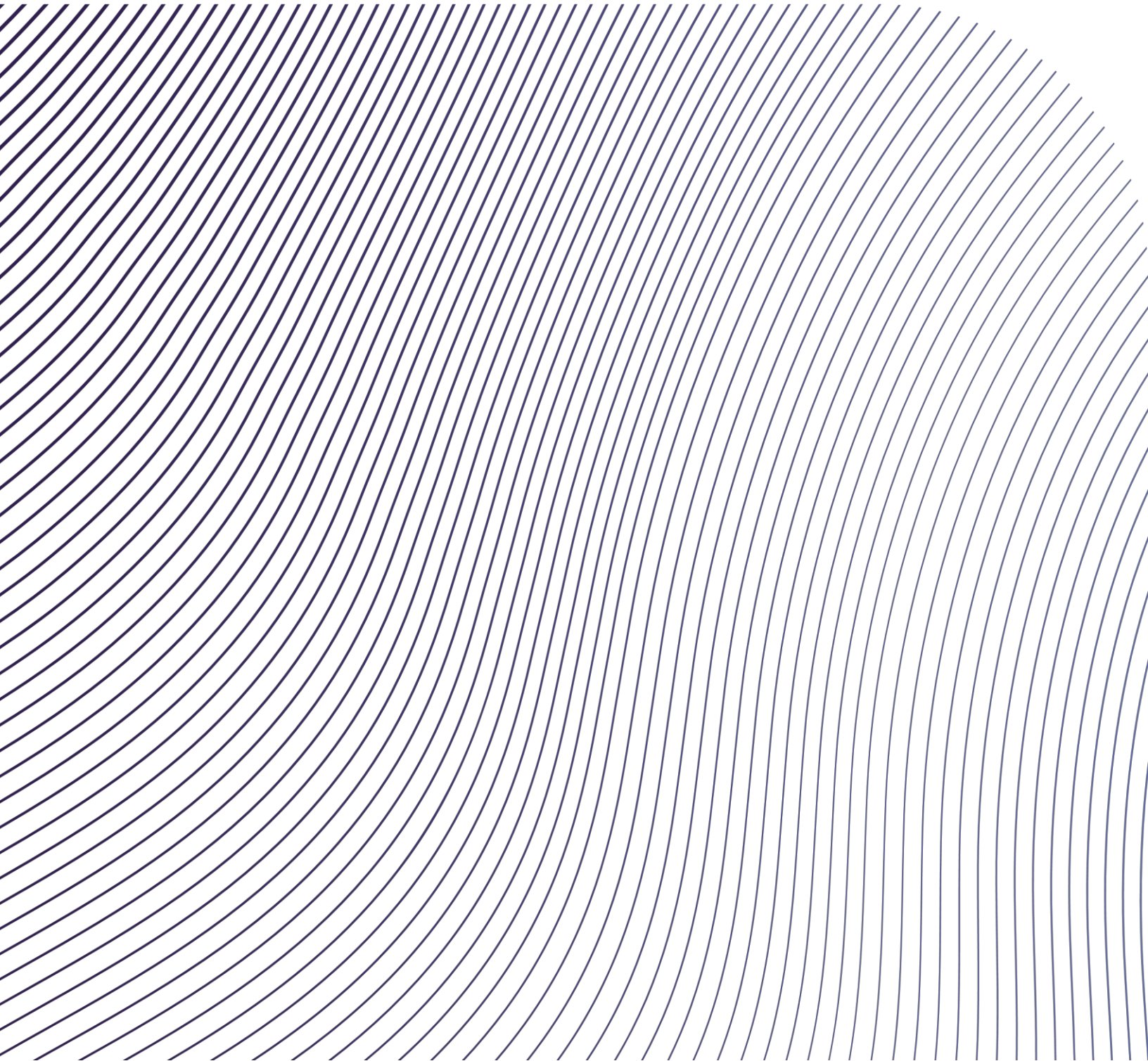


## Appendix B: Baseline Upfront Carbon Breakdown by Material

Component	Cradle to gate impacts (A1-A3) (tCO2e)	Of cradle to gate (A1-A3) (%)
Ready-mix concrete, Ontario industry average	575	28
Fabricated hollow structural steel sections, unpainted	572	27.9
Glass façade curtain wall system	179	8.7
Styrofoam insulation	130	6.3
Galvanized steel façade cladding panel	92	4.5
Roll formed aluminum cladding	86	4.2
Polyisocyanurate (PIR) roof insulation boards, coated glass faced (CGF)	75	3.6
Reinforcement steel (rebar), generic	71	3.5
Stone wool insulation board for exterior cavity wall and rainscreen applications, moisture resistant, with bitumen facing or no facing	42	2
Bitumen roofing membrane, panelized-asphaltic, P-A/T	38	1.9
SBS polymer-modified bitumen membrane roofing, self-adhered	36	1.7
Sintered stone slabs, for internal and external cladding	30	1.5
Fabricated hot-rolled structural steel sections, unpainted	30	1.4
Hot-dip galvanized steel sheets	26	1.3
EPDM waterproofing membrane	25	1.2
Gypsum plaster board, regular	22	1.1
Bitumen-polymer membrane, moisture control layer	13	0.6
Aluminium framed double glazed doors, per m2	9	0.4
Steel, stainless, 304	7	0.3
Insulated glass unit (IGU), two or more panels	5	0.2
Roll formed steel cladding	5	0.2
Expanded polystyrene (EPS)	4	0.2
Double metal door (for technical premises, cellars, service ...)	3	0.2
Aluminium composite panel, polyethylene core	3	0.1
PIR (polyisocyanurate foam) insulation panels, unfaced, generic	2	0.1
Industrial and garage doors from steel panels, per m2	2	0.1
Gypsum board with glass mat sheathing	1	0



# Appendix C: Proposed Prescriptive Example and Performance Table for Compliance with Target



OPTION 1: PRESCRIPTIVE TABLE

Baseline Embodied Carbon of All Materials (A-C)																	3,398,000 kg CO <sub>2</sub> e	434 kg CO <sub>2</sub> e/m <sup>2</sup>
Upfront Carbon (A1-A3) of Most Contributing Materials																		
Column A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Category	Materials	Estimated Material Qty	Estimated Wastage 4%	Total Estimated Material Qty	Unit	Material Description	Baseline		Allowable GWP Limit		Proposed Material		Reduction (kg CO <sub>2</sub> e)		Project of Embodied Carbon			
Calculation Reference		Per takeoffs	= C x 0.04	= C+D			GWP (A1-A3)	Units	Total (kg CO <sub>2</sub> e)	GWP (A1-A3)	Units	Product Name	EPD Number	GWP (A1-A3)	Units	Total (kg CO <sub>2</sub> e)	= E x O	= J - Q
Insulation	Extruded Polystyrene (Foundation)	541	21.6	562.6	m3	XPS - Dow Highload 40	220.3	kg CO <sub>2</sub> e/m3	123,920	131.9	kg CO <sub>2</sub> e/m3	Soprema XPS	EPD-283			kg CO <sub>2</sub> e/m3		
		10648	425.9	11074.2	m2 @ 1 RSI	XPS - Dow Highload 40	11.19	kg CO <sub>2</sub> e/m2 @ 1 RSI	123,920	6.7	kg CO <sub>2</sub> e/m2 @ 1 RSI					1.8	kg CO <sub>2</sub> e/m2 @ 1 RSI	19,933
Rebar	Rebar	125253	5010.1	130263.1	kg	60% Recycled Content Rebar (Canada)	1.41	kg CO <sub>2</sub> e/kg	183,671	0.92	kg CO <sub>2</sub> e/kg	Gerdau Long Steel Rebar, Whitby, ON Steel Mill	SCS-EPD-07290		0.78	kg CO <sub>2</sub> e/kg	101,605	82,066
Structural Steel	Steel Plate	179	7.2	186.2	tonne	CISC Industry Average	1710	kg CO <sub>2</sub> e/tonne	318,334	1710	kg CO <sub>2</sub> e/tonne	CISC Industry Average	SCS-EPD-07593		1710	kg CO <sub>2</sub> e/tonne	318,334	-
	Rollad Steel Sections	172	6.9	178.9	tonne	CISC Industry Average	1720	kg CO <sub>2</sub> e/tonne	307,674	1720	kg CO <sub>2</sub> e/tonne	Structural steel product, hot-rolled, North America average, 7850 kg/m3 (Gerdau)	SCS-EPD-07504		820	kg CO <sub>2</sub> e/tonne	146,682	160,992
	HSS	338	13.5	351.7	tonne	CISC Industry Average	1860	kg CO <sub>2</sub> e/tonne	654,214	1860	kg CO <sub>2</sub> e/tonne	CISC Industry Average	SCS-EPD-07425		1860	kg CO <sub>2</sub> e/tonne	654,214	-
	OWSJ	322	12.9	334.7	tonne	SJI Industry	1430	kg CO <sub>2</sub> e/tonne	478,581	1430	kg CO <sub>2</sub> e/tonne	Fabricated open-web steel joists and joist girders, 7800 kg/m3 (Nucor)	EPD-394		840	kg CO <sub>2</sub> e/tonne	281,124	197,456
	Steel Deck	116	4.6	120.1	tonne	Steel Deck Institute	2370	kg CO <sub>2</sub> e/tonne	284,684	1800	kg CO <sub>2</sub> e/tonne	Steel roof and floor deck using electric arc furnace (EAF) technology, North America average, 7800 kg/m3 (Nucor Corporation's Vulcraft Group)	SCS-EPD-09144		1740	kg CO <sub>2</sub> e/tonne	209,009	75,676
Concrete	Piers	24	0.9	24.6	m3	Ontario Industry Average Concrete Baseline 35MPa concrete with air & 0.40 w/cm (C-1)GU 25 SL	313.07	kg CO <sub>2</sub> e/m3	7,717	270	kg CO <sub>2</sub> e/m3	Lafarge ECOPEX GWP Range (Upper)			270	kg CO <sub>2</sub> e/m3	6,655	1,062
	Topping on Steel Deck	234	9.4	243.4	m3	Ontario Industry Average Concrete Baseline 25MPa concrete without air GU 10 SL	254.05	kg CO <sub>2</sub> e/m3	61,826	215	kg CO <sub>2</sub> e/m3	Lafarge ECOPEX GWP Range (Upper)			215	kg CO <sub>2</sub> e/m3	52,322	9,503
	Topping	147	5.9	152.9	m3	Ontario Industry Average Concrete Baseline 25MPa concrete without air GU 10 SL	254.05	kg CO <sub>2</sub> e/m3	38,839	215	kg CO <sub>2</sub> e/m3	Lafarge ECOPEX GWP Range (Upper)			215	kg CO <sub>2</sub> e/m3	32,869	5,970
	Foundation Slab	1098	43.9	1141.9	m3	Ontario Industry Average Concrete Baseline 35MPa concrete with air & 0.40 w/cm (C-1)GU 25 SL	313.07	kg CO <sub>2</sub> e/m3	357,501	270	kg CO <sub>2</sub> e/m3	Lafarge ECOPEX GWP Range (Upper)			270	kg CO <sub>2</sub> e/m3	308,318	49,182
	Footing	210	8.4	217.9	m3	Ontario Industry Average Concrete Baseline 30MPa concrete without air GU 15 SL	313.07	kg CO <sub>2</sub> e/m3	66,212	236	kg CO <sub>2</sub> e/m3	Lafarge ECOPEX GWP Range (Upper)			236	kg CO <sub>2</sub> e/m3	51,420	16,792
	Foundation Walls	200	8.0	207.7	m3	Ontario Industry Average Concrete Baseline 32MPa concrete with air & 0.45 w/cm (C-2) GU 10 SL	326.46	kg CO <sub>2</sub> e/m3	67,802	326	kg CO <sub>2</sub> e/m3	Ontario Industry Average Concrete Baseline 32MPa concrete with air & 0.45 w/cm (C-2) GU 10 SL			326	kg CO <sub>2</sub> e/m3	67,802	-
	Stairs	1	0.0	1.0	m3	Ontario Industry Average Concrete Baseline 25MPa concrete without air GU 10 SL	254.05	kg CO <sub>2</sub> e/m3	264	215	kg CO <sub>2</sub> e/m3	Lafarge ECOPEX GWP Range (Upper)			215	kg CO <sub>2</sub> e/m3	224	41
	Core Walls	502	20.1	522.1	m3	Ontario Industry Average Concrete Baseline 35MPa concrete with air & 0.40 w/cm (C-1)GU 25 SL	313.07	kg CO <sub>2</sub> e/m3	163,448	270	kg CO <sub>2</sub> e/m3	Lafarge ECOPEX GWP Range (Upper)			270	kg CO <sub>2</sub> e/m3	140,962	22,486
Total Column J										3,116,685								
Total Column Q										2,391,473		Total Column R		3,398,000 kg CO <sub>2</sub> e		21.3%		
												725,212		Must be greater than 20%				

OPTION 2: PERFORMANCE TABLE

Baseline Embodied Carbon of All Materials (A-C)																	3,398,000 kg CO2e	434 kg CO2e/m2	
Upfront Carbon (A1-A3) of Most Contributing Materials																			
Column A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	
Category	Materials	Estimated Material Qty	Estimated Wastage 4%	Total Estimated Material Qty	Unit	Material Description	Baseline		Allowable GWP Limit		Proposed Material		Reduction (kg CO2e)		Project of Embodied Carbon				
Calculation Reference			=C x 0.04	=C+D			GWP (A1-A3)	Units	Total (kg CO2e)	GWP (A1-A3)	Units	Product Name	EPD Number	GWP (A1-A3)	Units	Total (kg CO2e)	=E x O	=J - Q	= R / 3,398,000 kg CO2e
Insulation		541	21.6	562.6	m3	XPS - Dow Highload 40		220.3	kg CO2e/m3		131.9	kg CO2e/m3							
	Extruded Polystyrene (Foundation)	10648	425.9	11074.2	m2 @ 1 RSI	XPS - Dow Highload 40		11.19	kg CO2e/m2 @ 1 RSI	123,920	6.7	kg CO2e/m2 @ 1 RSI							
Rebar	Rebar	125253	5010.1	130263.1	kg	60% Recycled Content Rebar (Canada)		1.41	kg CO2e/kg	183,671	0.92	kg CO2e/kg							
Structural Steel	Steel Plate	179	7.2	186.2	tonne	CISC Industry Average		1710	kg CO2e/tonne	318,334	1710	kg CO2e/tonne							
	Rollad Steel Sections	172	6.9	178.9	tonne	CISC Industry Average		1720	kg CO2e/tonne	307,674	1720	kg CO2e/tonne							
	HSS	338	13.5	351.7	tonne	CISC Industry Average		1860	kg CO2e/tonne	654,214	1860	kg CO2e/tonne							
	OWSJ	322	12.9	334.7	tonne	SJI Industry		1430	kg CO2e/tonne	478,581	1430	kg CO2e/tonne							
	Steel Deck	116	4.6	120.1	tonne	Steel Deck Institute		2370	kg CO2e/tonne	284,684	1800	kg CO2e/tonne							
Concrete	Piers	24	0.9	24.6	m3	Ontario Industry Average Concrete Baseline 35MPa concrete with air & 0.40 w/cm (C-1)GU 25 SL		313.07	kg CO2e/m3	7,717	270	kg CO2e/m3							
	Topping on Steel Deck	234	9.4	243.4	m3	Ontario Industry Average Concrete Baseline 25MPa concrete without air GU 10 SL		254.05	kg CO2e/m3	61,826	215	kg CO2e/m3							
	Topping	147	5.9	152.9	m3	Ontario Industry Average Concrete Baseline 25MPa concrete without air GU 10 SL		254.05	kg CO2e/m3	38,839	215	kg CO2e/m3							
	Foundation Slab	1098	43.9	1141.9	m3	Ontario Industry Average Concrete Baseline 35MPa concrete with air & 0.40 w/cm (C-1)GU 25 SL		313.07	kg CO2e/m3	357,501	270	kg CO2e/m3							
	Footing	210	8.4	217.9	m3	Ontario Industry Average Concrete Baseline 30MPa concrete without air GU 15 SL		313.07	kg CO2e/m3	66,212	236	kg CO2e/m3							
	Foundation Walls	200	8.0	207.7	m3	Ontario Industry Average Concrete Baseline 32MPa concrete with air & 0.45 w/cm (C-2) GU 10 SL		326.46	kg CO2e/m3	67,802	313.07	kg CO2e/m3							
	Stairs	1	0.0	1.0	m3	Ontario Industry Average Concrete Baseline 25MPa concrete without air GU 10 SL		254.05	kg CO2e/m3	264	215	kg CO2e/m3							
	Core Walls	502	20.1	522.1	m3	Ontario Industry Average Concrete Baseline 35MPa concrete with air & 0.40 w/cm (C-1)GU 25 SL		313.07	kg CO2e/m3	163,448	270	kg CO2e/m3							
Total Column J																	3,116,685		
Total Column Q																		Total Column R	Total Column R / 3,398,000 kg CO2e
																		725,212	21.3%
																		Must be greater than 20%	

\*XPS is reported in either m3 or m2 @ 1 RSI. Fill only one of the two

OPTIONAL: ADDITIONAL OPPORTUNITIES FOR IMPROVEMENT ABOVE 20%

Material Name	Qty	Unit	GWP (A1-A3)	Unit	Resulting Total GWP	Resulting Savings (kg CO <sub>2</sub> e)	Cost Premium (\$)

Add additional pages as required.



OneClick Embodied Carbon (A-C)

3398

OPTION 1: PRESCRIPTIVE TABLE

Baseline Embodied Carbon of All Materials (A-C)

3,398,000 kg CO2e

Upfront Carbon (A1-A3) of Most Contributing Materials																		
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Category	Materials	Estimated Material Qty	Estimated Wastage 4%	Total Estimated Material Qty	Unit	Material Description	Baseline		Allowable GWP Limit		Proposed Material		Product Name		Total (kg CO2e)		Upfront Carbon Reduction (kg CO2e)	% Reduction Project Embodied Carbon
			=C x 0.04	=C+D			GWP (A1-A3)	Units	Total (kg CO2e)	GWP (A1-A3)	Units		EPD Number	GWP (A1-A3)	Units	Total (kg CO2e)	=E x O	=J - Q
Insulation	Extruded Polystyrene (Foundation)	541	21.6	562.6	m3	XPS - Dow Highload 40	220.3	kg CO2e/m3	123.900	131.9	kg CO2e/m3					19,933		3.1%
		109.48	425.9	11074.2	m2 @ 1 RSI	XPS - Dow Highload 40	11.19	kg CO2e/m2 @ 1 RSI	123.900	6.7	kg CO2e/m2 @ 1 RSI	Suprema XPS	EPD-283	1.8	kg CO2e/m2 @ 1 RSI	103,989		
	Rebar	130263	5010.1	130263.1	kg	80% Recycled Content Rebar (Canada)	1.41	kg CO2e/kg	183.671	0.92	kg CO2e/kg	Gerdau Long Steel Rebar, Whitby, ON Steel Mill	SCS-EPD-07290	0.78	kg CO2e/kg	101,605	82,066	2.4%
Structural Steel	Steel Plate	179	7.2	186.2	tonne	CISC Industry Average	1710	kg CO2e/tonne	318.334	1710	kg CO2e/tonne					318,334		
	Roller Steel Sections	172	6.9	178.9	tonne	CISC Industry Average	1720	kg CO2e/tonne	307.674	1720	kg CO2e/tonne	Structural steel product, hot-rolled, North America average, 7850 kg/m3 (Gerdau)	SCS-EPD-07504	820	kg CO2e/tonne	146,682	160,962	4.7%
	HSS	338	13.5	351.7	tonne	CISC Industry Average	1860	kg CO2e/tonne	654.214	1860	kg CO2e/tonne	CISC Industry Average	SCS-EPD-07425	1860	kg CO2e/tonne	654,214		
	OWSJ	322	12.9	334.7	tonne	SJI Industry	1430	kg CO2e/tonne	478.581	1430	kg CO2e/tonne	Fabricated open-web steel joists and joist girders, 7800 kg/m3 (Nucor)	EPD-394	840	kg CO2e/tonne	281,124	197,456	5.8%
	Steel Deck	116	4.6	120.1	tonne	Steel Deck Institute	2370	kg CO2e/tonne	284.684	1800	kg CO2e/tonne	Steel roof and floor deck using electric arc furnace (EAF) technology, North America average, 7800 kg/m3 (Nucor Corporation's Vulcraft Group)	SCS-EPD-09144	1740	kg CO2e/tonne	208,009	75,678	2.2%
Concrete	Piers	24	0.9	24.6	m3	Ontario Industry Average Concrete Baseline 35MPa concrete with air & 0.40 w/cm (C-1) GU 25 SL	313.07	kg CO2e/m3	7.717	270	kg CO2e/m3	Lafarge ECOPEX GWP Range (Upper)		270	kg CO2e/m3	6,655	1,062	0.3%
	Topping on Steel Deck	234	9.4	243.4	m3	Ontario Industry Average Concrete Baseline 25MPa concrete without air GU 10 SL	254.05	kg CO2e/m3	61.826	215	kg CO2e/m3	Lafarge ECOPEX GWP Range (Upper)		215	kg CO2e/m3	52,322	9,503	0.0%
	Topping	147	5.9	152.9	m3	Ontario Industry Average Concrete Baseline 25MPa concrete without air GU 10 SL	254.05	kg CO2e/m3	38.839	215	kg CO2e/m3	Lafarge ECOPEX GWP Range (Upper)		215	kg CO2e/m3	32,869	5,970	0.2%
	Foundation Slab	1098	43.9	1141.9	m3	Ontario Industry Average Concrete Baseline 35MPa concrete with air & 0.40 w/cm (C-1) GU 25 SL	313.07	kg CO2e/m3	357,501	270	kg CO2e/m3	Lafarge ECOPEX GWP Range (Upper)		270	kg CO2e/m3	308,318	48,182	1.4%
	Footing	210	8.4	217.9	m3	Ontario Industry Average Concrete Baseline 30MPa concrete without air GU 15 SL	313.07	kg CO2e/m3	68,212	236	kg CO2e/m3	Lafarge ECOPEX GWP Range (Upper)		236	kg CO2e/m3	51,420	16,792	0.5%
	Foundation Walls	200	8.0	207.7	m3	Ontario Industry Average Concrete Baseline 32MPa concrete with air & 0.45 w/cm (C-2) GU 10 SL	326.46	kg CO2e/m3	67,802	326	kg CO2e/m3	Ontario Industry Average Concrete Baseline 32MPa concrete with air & 0.45 w/cm (C-2) GU 10 SL		326	kg CO2e/m3	67,802	-	-
	Stairs	1	0.0	1.0	m3	Ontario Industry Average Concrete Baseline 25MPa concrete without air GU 10 SL	254.05	kg CO2e/m3	254	215	kg CO2e/m3	Lafarge ECOPEX GWP Range (Upper)		215	kg CO2e/m3	224	41	0.0%
	Core Walls	502	20.1	522.1	m3	Ontario Industry Average Concrete Baseline 35MPa concrete with air & 0.40 w/cm (C-1) GU 25 SL	313.07	kg CO2e/m3	163,448	270	kg CO2e/m3	Lafarge ECOPEX GWP Range (Upper)		270	kg CO2e/m3	149,982	22,466	0.7%
								Total Column J								Total Column Q	Total Column R	Total Column R / Total Column Q
							3,116,685								2,391,473	725,212	23.1%	

OPTION 2: PERFORMANCE TABLE

Baseline Embodied Carbon of All Materials (A-C)

3,398,000 kg CO2e

Upfront Carbon (A1-A3) of Most Contributing Materials																			
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	
Category	Materials	Estimated Material Qty	Estimated Wastage 4%	Total Estimated Material Qty	Unit	Material Description	Baseline		Allowable GWP Limit		Proposed Material		Product Name	Upfront Carbon Reduction		Reduction Project Embodied Carbon			
							GWP (A1-A3)	Units	GWP (A1-A3)	Units	EPD Number	GWP (A1-A3)		Units	Total (kg CO2e)		Total (kg CO2e)		
			=C x 0.04		=C+D				=E x H								=E x O	=J - Q	
Insulation	Extruded Polystyrene (Foundation)	541	21.6		562.6 m3	XPS - Dow Highload 40	220.3	kg CO2e/m3		123.900	131.9	kg CO2e/m3							
		109.48	425.9		11074.2 m2 @ 1 RSI	XPS - Dow Highload 40	11.19	kg CO2e/m2 @ 1 RSI		123.900	6.7	kg CO2e/m2 @ 1 RSI							
Rebar	Rebar	130263	5010.1		130263.1 kg	80% Recycled Content Rebar (Canada)	1.41	kg CO2e/kg		183.671	0.92	kg CO2e/kg							
	Steel Plate	179	7.2		186.2 tonne	CISC Industry Average	1710	kg CO2e/tonne		318.334	1710	kg CO2e/tonne							
Structural Steel	Roller Steel Sections	172	6.9		178.9 tonne	CISC Industry Average	1720	kg CO2e/tonne		307.674	1720	kg CO2e/tonne							
	HSS	338	13.5		351.7 tonne	CISC Industry Average	1860	kg CO2e/tonne		654.214	1860	kg CO2e/tonne							
	OWSJ	322	12.9		334.7 tonne	SJI Industry	1430	kg CO2e/tonne		478.581	1430	kg CO2e/tonne							
	Steel Deck	116	4.6		120.1 tonne	Steel Deck Institute	2370	kg CO2e/tonne		284.684	1800	kg CO2e/tonne							
Concrete	Piers	24	0.9		24.6 m3	Ontario Industry Average Concrete Baseline 35MPa concrete with air & 0.40 w/cm (C-1) GU 25 SL	313.07	kg CO2e/m3		7.717	270	kg CO2e/m3							
	Topping on Steel Deck	234	9.4		243.4 m3	Ontario Industry Average Concrete Baseline 25MPa concrete without air GU 10 SL	254.05	kg CO2e/m3		61.826	215	kg CO2e/m3							
	Topping	147	5.9		152.9 m3	Ontario Industry Average Concrete Baseline 25MPa concrete without air GU 10 SL	254.05	kg CO2e/m3		38.839	215	kg CO2e/m3							
	Foundation Slab	1098	43.9		1141.9 m3	Ontario Industry Average Concrete Baseline 35MPa concrete with air & 0.40 w/cm (C-1) GU 25 SL	313.07	kg CO2e/m3		357.501	270	kg CO2e/m3							
	Footing	210	8.4		217.9 m3	Ontario Industry Average Concrete Baseline 30MPa concrete without air GU 15 SL	313.07	kg CO2e/m3		68.212	236	kg CO2e/m3							
	Foundation Walls	200	8.0		207.7 m3	Ontario Industry Average Concrete Baseline 32MPa concrete with air & 0.45 w/cm (C-2) GU 10 SL	326.46	kg CO2e/m3		67.802	313.07	kg CO2e/m3							
	Stairs	1	0.0		1.0 m3	Ontario Industry Average Concrete Baseline 25MPa concrete without air GU 10 SL	254.05	kg CO2e/m3		264	215	kg CO2e/m3							
	Core Walls	502	20.1		522.1 m3	Ontario Industry Average Concrete Baseline 35MPa concrete with air & 0.40 w/cm (C-1) GU 25 SL	313.07	kg CO2e/m3		163.448	270	kg CO2e/m3							
							Total Column J								Total Column Q	Total Column R	Total Column R / Total Column Q		
							3,116,685								2,391,473	725,212	21.3%		
*XPS is reported in either m3 or m2 @ 1 RSI. Fill only one of the two rows.																		Must be greater than 20%	

OPTIONAL: ADDITIONAL OPPORTUNITIES FOR IMPROVEMENT ABOVE 20%

Material Name	Qty	Unit	GWP (A1-A3)	Unit	Resulting Total GWP	Resulting Savings (kg CO2e)	Cost Premium (\$)



## **1. GENERAL**

### **1.1 Summary**

- 1.1.1 Purpose of Section: Section specifies minimum quality requirements for the Work.
- 1.1.2 Read in conjunction with: CCDC 2-2020, Part 3, Execution of the Work and Supplementary Conditions.

### **1.2 Regulatory Requirements**

- 1.2.1 Building Code Information:
  - .1 Project has been designed and must be constructed in accordance with requirements of Ontario Building Code, 2012 including any amendments (The Building Code or "OBC").
  - .2 Building Code Occupancy Classification: {{occupancy type}}.
- 1.2.2 Compliance with Laws: Contract Documents including Drawings, Specifications and other information for the Work are intended to comply with federal, provincial and municipal laws, by-laws, regulations and other requirements of authorities having jurisdiction. Perform Work in accordance with such requirements.
  - .1 Specific design and performance requirements listed in specifications or indicated on Drawings may exceed minimum requirements established by referenced Building Code; these requirements will govern over the minimum requirements listed in Building Code.
  - .2 Where OBC or Contract Documents do not cover a specific requirement, which is covered by the National Building Code of Canada, latest edition (or NBC), conform to requirements of NBC including its related supplements.
  - .3 Where Specifications do not provide sufficient details for a particular item of work indicated on Drawings or Schedules, conform to minimum standards indicated in Building Code, and in the absence of more restrictive requirements comply with specifications, installation methods, and standards of workmanship indicated in OBC, Part 9 "Housing and Small Buildings".

### **1.3 Design Requirements For Post Disaster Buildings**

- 1.3.1 All new construction associated with this Project is designated under the Ontario Building Code as "Post-Disaster". Post-disaster building means a building that is essential to the provision of services in the event of a disaster.

- 1.3.2 Provide fitments, restraints and attachment to meet post-disaster design requirements in accordance with OBC for designated seismic category. In addition, conform to requirements of CSA S832. Refer to Section 13 48 50 for additional requirements.
- 1.3.3 Employ the services a Professional Engineer to design seismic restraints and connections for Project based on anticipated ground motion, soil type in specific geographic area and occupancy category.
- 1.3.4 Refer to Structural Drawings for seismic sensitivity values.

#### **1.4 Permits, Certificates And Transcripts**

- 1.4.1 Required Documentation Prior to Commencement of the Work:
  - .1 Ensure permits, licenses and certificates included under specific Sections are provided as specified. Forward copies of permits to Owner and Consultant before commencing Work.
- 1.4.2 Building Permit Acquisition and Display:
  - .1 Building permit application and fee payment has been made by Consultant on behalf of Owner.
  - .2 Contractor must display building permit and other relevant permits in visible location at Place of the Work.
- 1.4.3 Contractor's Responsibilities for Other Permits:
  - .1 Except as otherwise noted, Contractor is responsible for applying for, obtaining, and covering fees for other necessary permits, licenses, certificates, inspections, and approvals mandated by Authorities Having Jurisdiction or Contract Documents.

#### **1.5 Abbreviations And Acronyms**

- 1.5.1 Commonly Assigned Meanings: Words and phrases in these Specifications or in other Contract Documents that are not expressly defined in the General Conditions or Supplementary Conditions of the Contract must be interpreted based on their common meanings within the specific context in which they are used. When interpreting these terms, take into account specialized usage within various trades and professions relevant to the terminology. Refer uncertainties to Consultant.

#### **1.6 Minimum Qualification Requirements**

- 1.6.1 Where Specifications use the term "experienced" in the context of qualifications, the following minimum criteria must be applied; individual Specification Sections may specify additional requirements.
- 1.6.2 Manufacturer Qualifications:

- 
- .1 Experience: Manufacturer must have a minimum of 10 years' experience in producing systems similar to those specified for the Project.
  - .2 Capabilities: Manufacturer must demonstrate successful in-service performance and have adequate production capacity.
  - .3 Additional Requirements: Must meet qualification, warranty, and technical or factory-authorized service representative requirements.
- 1.6.3 Fabricator Qualifications:
- .1 Experience: Fabricator should have at least 10 years' experience in producing products similar to those indicated for the Project.
  - .2 Capabilities: Fabricator must have a record of successful in-service performance and sufficient production capacity.
- 1.6.4 Welder Qualifications:
- .1 Certification: Welders must be certified per CSA W47.1 and CSA W59-M, with a minimum certification level of "Division 1" or "Division 2".
  - .2 Operators: Must be qualified per CSA W47.1 for work specified in Contract Documents, with a minimum certification level of "Class O".
  - .3 Inspectors and Supervisors: Must meet CSA W178.1 and CSA W178.2 qualifications and be certified by the Canadian Welding Bureau for "Category (a), Buildings".
  - .4 Documentation: Submit copies of welding certificates to Consultant prior to Work commencement.
- 1.6.5 Installer Qualifications:
- .1 Experience: Installer should have at least 5 years' experience in installing systems similar to those specified for the Project and, where applicable, be certified by the manufacturer.
- 1.6.6 Professional Engineer Qualifications:
- .1 Credentials: Must be a member in good standing of the Professional Engineers Ontario (PEO) and legally qualified to practice in the jurisdiction where the Project is located.
  - .2 Experience: Not less than 5 years' experience in providing engineering services of similar scope.
  - .3 Insurance: as noted in the Owner's supplementary conditions.
  - .4 Restrictions: Engineers opting for "Mandatory Disclosure" or "Suggested Disclosure" approaches as permitted by PEO are not eligible to work on this Project.
- 1.6.7 Surveyor Qualifications:

- .1 Credentials: Must be a member in good standing of the Association of Ontario Land Surveyors and legally qualified to practice in the jurisdiction where the Project is located.
  - .2 Experience: Not less than 5 years' experience in providing professional land surveying services of similar scope.
- 1.6.8 Manufacturer's Technical Representative Qualifications:
- .1 Credentials: Must be an authorized, trained, and manufacturer-approved representative to observe and inspect the installation of products similar to those specified for the Project.
- 1.6.9 Testing and Inspecting Agency Qualifications:
- .1 Credentials: Must be an SCC-accredited laboratory or independent agency acceptable to Owner and Consultant with experience and capability to conduct testing and inspection indicated, as documented according to ASTM E329, and with additional qualifications specified in individual sections. Where required by authorities having jurisdiction, testing agency must be acceptable to such authorities.

## **1.7 Quality Control**

- 1.7.1 Contractor's Quality Control: Quality Control is Contractor's responsibility. Use qualified personnel trained and experienced in managing and executing quality assurance and quality control procedures as required for the Project.
- 1.7.2 Contractor-Requested Testing: Testing and inspection requested by Contractor but not required by Contract Documents are Contractor's responsibility.
- 1.7.3 Manufacturer's Field Services: Engage factory-authorized service representatives for inspection and observation as specified in Contract Documents or required by manufacturer. Responsibilities include participation in preinstallation meetings, examination of conditions, verification of materials, observation of installation activities, and submission of written reports.
- 1.7.4 Removal and Replacement of Rejected Work: Promptly remove and replace defective Work rejected by Consultant. Promptly repair damage caused by removals or replacements.
- 1.7.5 Equipment and Systems: Refer to Divisions 21, 22, 23, and 26 for detailed requirements.

## **1.8 Independent Inspection And Testing Agencies**

- 1.8.1 Appointment and Payment: Section 01 21 00 – Allowances designates an amount for retaining and paying independent inspection and testing agencies. These agencies will inspect, test, or perform quality control reviews of parts of the Work. The following

are specifically excluded from the inspection and testing allowance and must be included in Contract Price:

- .1 Inspection and testing mandated by laws, ordinances, rules, regulations, or orders of public authorities.
  - .2 Inspection and testing conducted solely for Contractor's convenience or own quality control.
  - .3 Testing, adjustment, and balancing of conveying systems, mechanical and electrical equipment and systems.
  - .4 Mill tests and certificates of compliance.
  - .5 Inspections and tests specifically designated as Contractor's responsibility in Divisions 02 – 49 of the Specifications.
- 1.8.2 Contractor's Responsibility: Employment of inspection and testing agencies by Owner does not relieve Contractor from responsibility to perform the Work in accordance with Contract Documents.
- 1.8.3 Cooperation with Inspection and Testing Agencies:
- .1 Allow and arrange for inspection and testing agencies to have access to the Work, including access to off-site manufacturing and fabrication plants.
  - .2 Submit test samples required for testing in accordance with schedule of submittals specified in Section 01 32 00 – Construction Progress Documentation.
  - .3 Provide labour, Construction Equipment and temporary facilities to obtain and handle test samples on site.
- 1.8.4 Notification for Required Inspection and Testing: For inspection and testing required by Contract Documents or by authorities having jurisdiction, provide Consultant and inspection and testing agencies with timely notification in advance of required inspection and testing.
- 1.8.5 Reporting:
- .1 Contractor's Reporting Obligation: For inspection and testing required by Contract Documents or by regulatory requirements, and performed by Contractor retained inspection and testing agencies, submit to Consultant and Owner copies of reports. Submit within three Working Days after completion of inspection and testing.
  - .2 Owner's Reporting Requirements: For inspection and testing performed by Owner retained inspection and testing agencies, copies of inspection and testing agency reports will be provided to Contractor.

## **1.9 Mock-Ups**

- 1.9.1 General Requirements: Before starting Work specified in technical Specifications, prepare mock-ups for Consultant's review. Obtain

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Consultant's acceptance before proceeding with corresponding Work.

- 1.9.2 Size and Location: If mock-up location is not indicated in the Drawings or Specifications, locate where directed by Consultant on site.
- 1.9.3 Notification: Inform Consultant minimum 5 working days prior to mock-up construction.
- 1.9.4 Supervision: For mock-up construction, use supervisory personnel and workers who will perform similar tasks on Project.
- 1.9.5 Aesthetic and Workmanship Range: Demonstrate intended aesthetic effects and quality.
- 1.9.6 Revisions and Review:
  - .1 Modify mock-up as required until Consultant acceptance is obtained. Address unsatisfactory conditions identified in preliminary review and modify mock-ups as necessary. Allow time in schedule for multiple reviews.
  - .2 Accepted mock-ups establish an acceptable standard for the Work.
  - .3 Acceptance of mock-ups does not imply acceptance of deviations from requirements of Contract Documents, unless such deviations are confirmed in writing by Consultant.
  - .4 Unless otherwise specified in the technical Specifications, accepted mock-ups forming part of the Work may remain as part of the Work.
- 1.9.7 Protection and Removal:
  - .1 Protect mock-ups from damage until the Work they represent is complete.
  - .2 Remove mock-ups only when the Work they represent is complete or when otherwise directed by Consultant.
- 1.9.8 Specific Requirements:
  - .1 In-Situ Mock-ups: Refer to Technical Specifications.
  - .2 Building Envelope Mock-ups: Build on-site mock-ups of exterior envelope assemblies, as specified in individual Specification Sections.

## **1.10 Special Requirements For Acoustic Construction**

- 1.10.1 Ensure construction of all assemblies is airtight. Responsibility for airtight construction falls on Contractor. Employ pertinent details for airtightness and coordinate work between trades to ensure airtightness is achieved. Conform to requirements of ASTM E497.
- 1.10.2 Representative details for airtight penetrations, recessed elements, edges, etc. are shown on Drawings. Specific materials and

components to be used to accomplish airtight detailing are specified in the technical Specifications (Divisions 02 - 49). Bring to attention of Consultant any condition that may require special details or materials in order to achieve airtightness.

1.10.3 Requirements specified in this Section are to be read in conjunction with other requirements stipulated in Contract Documents. They do not in any way negate or supersede other provisions stipulated elsewhere in Contract Documents.

1.10.4 General STC ratings: Provide airtight partitions and ceilings in locations indicated to meet required minimum Sound Transmission Class (STC) ratings. Coordinate work of various Subcontractors to avoid "short circuiting" of the STC ratings.

1.10.5 Generally conform to the following:

- .1 Unless indicated otherwise, build walls to underside of structure.
- .2 In STC-rated walls, provide smoke-rated and fire-rated sealants tested by manufacturer to provide required acoustic ratings.
- .3 Ensure walls and partitions are sealed along the ceiling, floor and column joints.
- .4 Ensure holes in any layer of gypsum board are filled with drywall compound.
- .5 Caulk or mud each drywall layer individually around its entire perimeter.
- .6 Ensure penetrations are fully sealed, air tight, using drywall collars, drywall compound and/or fire rated caulking.
- .7 Provide to be light gauge steel gauge (25 gauge or higher). If lower (thicker) gauge studs are required then resilient channel or acoustic clips (Genie Clips) must be installed on one side of the wall.
- .8 As far as practical, minimize additional studs in walls.
- .9 Do not locate more than one electrical box within the same stud cavity. If additional electrical boxes are required, then a moldable putty pad such as 3M Fire Barrier Moldable PuttyPad MPP+ or equivalent is required for all boxes.
- .10 Do not install drywall to pass between rooms; suitably break (separate) drywall to at Tees, cross and corner junctions to avoid direct link between the two rooms.
- .11 No walls are to have any bridging between double walls. If bridging is to be used, then a resilient channel must be installed on one side of the wall.
- .12 No steel studs are to have a bracing bar within the studs. If they require a bracing bar, then resilient channel must be installed on one side of the wall.

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- 1.10.6 Carefully locate and treat ducts, grilles, diffusers, electrical outlets, boxes and other similar mechanical and electrical devices.
  - 1.10.7 Build and Install all construction joints, structural penetrations, mechanical and electrical duct penetrations, pipe and conduit penetrations, electrical boxes and fixtures, cabinets, doors, access panels, windows, frames, supports, etc. in such manner as to prevent sound transmission and flanking.
  - 1.10.8 Provide lintels, extra frames, blocking, escutcheons, grouting, gaskets, packing, caulking, dense putties, taping, filling, etc. as required to stop sound transmission. Use flexible sealant or acoustical gasket to seal between assemblies and dissimilar surfaces.
  - 1.10.9 Extend construction to a minimum of 3 mm (1/8") and a maximum of 13 mm (1/2") of adjacent construction or penetrations to Provide suitable space for packing and caulking.
  - 1.10.10 Cut openings in construction accurately for electrical boxes, piping, ductwork and other penetrating elements. Leave enough space around such elements so they remain free of rigid connection with the surrounding construction.
  - 1.10.11 Prior to packing and caulking penetrations, verify that all penetrating elements such as piping and ductwork are free and clear of the opening to be packed and caulked.
  - 1.10.12 Where multiple layers of gypsum board are used, stagger all joints in adjacent layers for a minimum of 610 mm (24").
  - 1.10.13 Where resilient channels are used as part of a demising wall assembly, ensure that screws do not "short-circuit" the resilient channels, by passing through the gypsum board into the studs.
  - 1.10.14 Where gypsum board ceilings are used for sound control, there should be no penetrations through the gypsum board ceiling layers. Lighting should ideally be surface mounted. If flush mounted lights must be used, each light should be boxed in on the back side with two layers of gypsum board.
  - 1.10.15 Apply all acoustical sealants and caulks in accordance with manufacturer's instructions and requirements of ASTM C919.
  - 1.10.16 Airtight construction requirements for the Project include, but are not limited to the following:
  - 1.10.17 Partition Bases: Provide continuous bead of acoustical sealant at all locations where gypsum board meets structural floor or roof (this includes all sides of partitions). Depth of sealant to be equal thickness of gypsum layer or layers.
  - 1.10.18 Partition Heads: Provide the same detail as for bases at flat structure. Refer to Drawings for details for other conditions.



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- 1.10.19 Partition or Ceiling Joints at Dissimilar Materials: Provide continuous bead of acoustical sealant at all locations where gypsum board meets dissimilar material. Depth of sealant to be equal thickness of gypsum layer or layers.
  - 1.10.20 Pipe, Duct, Conduit, or Structural Penetrations: In accordance with requirements of Division 21,22,23,26 and 27.
  - 1.10.21 Electrical Boxes: Provide acoustical putty pad continuously around boxes. Refer to Divisions 26 and 27 for additional requirements.
  - 1.10.22 Electrical, Lighting, or Other Recessed Boxes Over 100 mm x 100 mm (4" x 4"): Provide one layer of 13 mm (5/8") gypsum board continuous around the back of such boxes. Caulk or tape all joints and caulk all conduit penetrations with acoustical sealant. Refer to Divisions 26 and 27 for additional requirements.
  - 1.10.23 Vibration Isolation: Vibration isolate all pieces of mechanical/electrical equipment that can rotate or vibrate. As a minimum, vibration isolation should be selected to meet ASHRAE requirements.

## **2 .    PRODUCTS**

### **2.1    Not Used**

## **3 .    EXECUTION**

### **3.1    Not Used**

END OF SECTION

## **1. GENERAL**

### **1.1 Reference Standards**

- 1.1.1 “Reference standards” means consensus standards, trade association standards, guides, and other publications expressly referenced in Contract Documents.
- 1.1.2 Where an edition or version date is not specified, referenced standards shall be deemed to be the latest edition or revision issued by the publisher at the time of bid closing. However if a particular edition or revision date of a specified standard is referenced in an applicable code or other regulatory requirement, the regulatory referenced edition or version shall apply.
- 1.1.3 Reference standards establish minimum requirements. If Contract Documents call for requirements that differ from a referenced standard, the more stringent requirements shall govern.
- 1.1.4 If compliance with two or more reference standards is specified and the standards establish different or conflicting requirements, comply with the most stringent requirement. Refer uncertainties to Consultant for clarification.
- 1.1.5 Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- 1.1.6 Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

### **1.2 Standards Producing Industry Organizations**

- 1.2.1 The following associations and organizations are cited in specification sections with acronym, name, and Internet URL addresses as follows:
- 1.2.2 Canadian Organizations:

Abbreviation /Acronym	Name	Website
ACEC	Association of Consulting Engineers of Canada	<a href="http://www.acec.ca">www.acec.ca</a>

Abbreviation /Acronym	Name	Website
AWMAC	Architectural Woodwork Manufacturers Association of Canada	www.awmac.com
CaGBC	Canada Green Building Council	www.cagbc.org
CCA	Canadian Construction Association:	www.cca-acc.com
CCDC	Canadian Construction Documents Committee,	www.CCDC.org
CFFM	Canadian Forces Fire Marshal	www.dnd.ca/admie/dgcps/CFFMe.htm
CGA	Canadian Gas Association	www.cga.ca
CGSB	Canadian General Standards Board	http://w3.pwgsc.gc.ca/cgsb
CISC	Canadian Institute of Steel Construction	www.cisc-icca.ca
CLA	Canadian Lumbermen's Association	www.cfa-international.org
CNLA	Canadian Nursery Landscape Association	www.canadanursery.com
CRCA	Canadian Roofing Contractors Association	www.roofingcanada.com
CSA	Canadian Standards Association International	www.csa-international.org
CSC	Construction Specifications Canada	www.csc-dcc.ca
CSDMA	Canadian Steel Door Manufacturers Association	www.csdma.org
CSPI	Corrugated Steel Pipe Institute	www.cspi.ca
CSSBI	Canadian Sheet Steel Building Institute	www.cssbi.ca
CUFCA	Canadian Urethane Foam Contractor's Association	www.cufca.ca
CWC	Canadian Wood Council	www.cwc.ca
EC	Environment Canada	www.ec.gc.ca
EFC	Electro Federation of Canada	www.electrofed.com
MPI	The Master Painters Institute,	www.paintinfo.com
NABA	National Air Barrier Association	www.naba.ca
NLGA	National Lumber Grades Authority	www.nlga.org
NRC	National Research Council	www.nrc.gc.ca
QPL	Qualification Program List, c/o Canadian General Standards Board,	www.pwgsc.gc.ca/cg sb
RAIC	Royal Architectural Institute of Canada	www.raic.org
SCC	Standards Council of Canada	www.scc.ca

Abbreviation /Acronym	Name	Website
TTMAC	Terrazzo, Tile and Marble Association of Canada	www.ttmac.com
ULC	Underwriters' Laboratories of Canada	www.ulc.ca

**1.2.3 USA Organizations:**

Abbreviation /Acronym	Name	Website
c	Aluminum Association (The)	www.aluminum.org
AABC	Associated Air Balance Council	www.aabchq.com
AAMA	American Architectural Manufacturers Association	www.aamanet.org
AASHTO	American Association of Province Highway and Transportation Officials	www.transportation.org
AATCC	American Association of Textile Chemists and Colorists	www.aatcc.org
ABAA	Air Barrier Association of America	www.airbarrier.org
ABMA	American Bearing Manufacturers Association	www.abma-dc.org
ACI	American Concrete Institute	www.concrete.org
ACPA	American Concrete Pipe Association	www.concrete-pipe.org
AEIC	Association of Edison Illuminating Companies, Inc. (The)	www.aeic.org
AF&PA	American Forest & Paper Association	www.afandpa.org
AGA	American Gas Association	www.aga.org
AHAM	Association of Home Appliance Manufacturers	www.aham.org
AHRI	Air-Conditioning, Heating, and Refrigeration Institute, The	www.ahrinet.org
AI	Asphalt Institute	www.asphaltinstitute.org
AIA	American Institute of Architects (The)	www.aia.org
AISC	American Institute of Steel Construction	www.aisc.org
AISI	American Iron and Steel Institute	www.steel.org
AITC	American Institute of Timber Construction	www.aitc-glulam.org
ALSC	American Lumber Standard Committee, Incorporated	www.alsc.org
AMCA	Air Movement and Control Association International, Inc.	www.amca.org
ANSI	American National Standards Institute	www.ansi.org
AOSA	Association of Official Seed Analysts, Inc.	www.aosaseed.com

Abbreviation /Acronym	Name	Website
APA	APA - The Engineered Wood Association	<a href="http://www.apawood.org">www.apawood.org</a>
APA	Architectural Precast Association	<a href="http://www.archprecast.org">www.archprecast.org</a>
API	American Petroleum Institute	<a href="http://www.api.org">www.api.org</a>
ARI	Air-Conditioning & Refrigeration Institute	<a href="http://www.ari.org">www.ari.org</a>
ARMA	Asphalt Roofing Manufacturers Association	<a href="http://www.asphaltroofing.org">www.asphaltroofing.org</a>
ASCE	American Society of Civil Engineers	<a href="http://www.asce.org">www.asce.org</a>
ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute	(See ASCE)
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers	<a href="http://www.ashrae.org">www.ashrae.org</a>
ASME	ASME International (American Society of Mechanical Engineers International)	<a href="http://www.asme.org">www.asme.org</a>
ASSE	American Society of Sanitary Engineering	<a href="http://www.asse-plumbing.org">www.asse-plumbing.org</a>
ASTM	ASTM International (American Society for Testing and Materials International)	<a href="http://www.astm.org">www.astm.org</a>
ATIS	Alliance for Telecommunications Industry Solutions	<a href="http://www.atis.org">www.atis.org</a>
AWCI	Association of the Wall and Ceiling Industry	<a href="http://www.awci.org">www.awci.org</a>
AWCMA	American Window Covering Manufacturers Association (Now WCMA)	
AWI	Architectural Woodwork Institute	<a href="http://www.awinet.org">www.awinet.org</a>
AWPA	American Wood Protection Association (Formerly: American Wood Preservers' Association)	<a href="http://www.awpa.com">www.awpa.com</a>
AWS	American Welding Society	<a href="http://www.aws.org">www.aws.org</a>
AWWA	American Water Works Association	<a href="http://www.awwa.org">www.awwa.org</a>
BHMA	Builders Hardware Manufacturers Association	<a href="http://www.buildershardware.com">www.buildershardware.com</a>
BIA	Brick Industry Association (The)	<a href="http://www.bia.org">www.bia.org</a>
BICSI	BICSI, Inc.	<a href="http://www.bicsi.org">www.bicsi.org</a>
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association International)	<a href="http://www.bifma.com">www.bifma.com</a>
BISSC	Baking Industry Sanitation Standards Committee	<a href="http://www.bissc.org">www.bissc.org</a>
CCC	Carpet Cushion Council	<a href="http://www.carpetcushion.org">www.carpetcushion.org</a>
CDA	Copper Development Association	<a href="http://www.copper.org">www.copper.org</a>
CEA	Consumer Electronics Association	<a href="http://www.ce.org">www.ce.org</a>

Abbreviation /Acronym	Name	Website
CFFA	Chemical Fabrics & Film Association, Inc.	<a href="http://www.chemicalfabricsandfilm.com">www.chemicalfabricsandfilm.com</a>
CGA	Compressed Gas Association	<a href="http://www.cganet.com">www.cganet.com</a>
CIMA	Cellulose Insulation Manufacturers Association	<a href="http://www.cellulose.org">www.cellulose.org</a>
CISCA	Ceilings & Interior Systems Construction Association	<a href="http://www.cisca.org">www.cisca.org</a>
CISPI	Cast Iron Soil Pipe Institute	<a href="http://www.cispi.org">www.cispi.org</a>
CLFMI	Chain Link Fence Manufacturers Institute	<a href="http://www.chainlinkinfo.org">www.chainlinkinfo.org</a>
CPA	Composite Panel Association	<a href="http://www.pbmdf.com">www.pbmdf.com</a>
CRI	Carpet and Rug Institute (The)	<a href="http://www.carpet-rug.com">www.carpet-rug.com</a>
CRRC	Cool Roof Rating Council	<a href="http://www.coolroofs.org">www.coolroofs.org</a>
CRRC	Cool Roof Rating Council	<a href="http://www.coolroofs.org">www.coolroofs.org</a>
CRSI	Concrete Reinforcing Steel Institute	<a href="http://www.crsi.org">www.crsi.org</a>
CSI	Construction Specifications Institute (The)	<a href="http://www.csinet.org">www.csinet.org</a>
CSSB	Cedar Shake & Shingle Bureau	<a href="http://www.cedarbureau.org">www.cedarbureau.org</a>
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute)	<a href="http://www.cti.org">www.cti.org</a>
DHI	Door and Hardware Institute	<a href="http://www.dhi.org">www.dhi.org</a>
ECA	Electrical Components Association	<a href="http://www.ec-central.org">www.ec-central.org</a>
EIA	Electronic Industries Alliance	<a href="http://www.eia.org">www.eia.org</a>
EIMA	EIFS Industry Members Association	<a href="http://www.eima.com">www.eima.com</a>
EJCDC	Engineers Joint Contract Documents Committee	<a href="http://content.asce.org/ejcdc/">http://content.asce.org/ejcdc/</a>
EJMA	Expansion Joint Manufacturers Association, Inc.	<a href="http://www.ejma.org">www.ejma.org</a>
ESD	ESD Association (Electrostatic Discharge Association)	<a href="http://www.esda.org">www.esda.org</a>
ETL SEMCO	Intertek ETL SEMCO (Formerly: ITS - Intertek Testing Service NA)	<a href="http://www.intertek-etlsemko.com">www.intertek-etlsemko.com</a>
FIBA	Federation Internationale de Basketball (The International Basketball Federation)	<a href="http://www.fiba.com">www.fiba.com</a>
FIVB	Federation Internationale de Volleyball (The International Volleyball Federation)	<a href="http://www.fivb.ch">www.fivb.ch</a>
FM Approvals	FM Approvals LLC	<a href="http://www.fmglobal.com">www.fmglobal.com</a>
FM Global	FM Global (Formerly: FMG - FM Global)	<a href="http://www.fmglobal.com">www.fmglobal.com</a>
FRSA	Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.	<a href="http://www.floridarroof.com">www.floridarroof.com</a>
FSA	Fluid Sealing Association	<a href="http://www.fluidsealing.com">www.fluidsealing.com</a>

Abbreviation /Acronym	Name	Website
FSC	Forest Stewardship Council	<a href="http://www.fsc.org">www.fsc.org</a>
GA	Gypsum Association	<a href="http://www.gypsum.org">www.gypsum.org</a>
GANA	Glass Association of North America	<a href="http://www.glasswebsite.com">www.glasswebsite.com</a>
GRI	(Part of GSI)	
GS	Green Seal	<a href="http://www.greenseal.org">www.greenseal.org</a>
GSI	Geosynthetic Institute	<a href="http://www.geosynthetic-institute.org">www.geosynthetic-institute.org</a>
HI	Hydronics Institute	<a href="http://www.gamanet.org">www.gamanet.org</a>
HI/GAMA	Hydronics Institute/Gas Appliance Manufacturers Association Division of Air-Conditioning, Heating, and Refrigeration Institute (AHRI)	<a href="http://www.ahrinet.org">www.ahrinet.org</a>
HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)	
HPVA	Hardwood Plywood & Veneer Association	<a href="http://www.hpva.org">www.hpva.org</a>
HPW	H. P. White Laboratory, Inc.	<a href="http://www.hpwhite.com">www.hpwhite.com</a>
IAPSC	International Association of Professional Security Consultants	<a href="http://www.iapsc.org">www.iapsc.org</a>
ICBO	International Conference of Building Officials	<a href="http://www.iccsafe.org">www.iccsafe.org</a>
ICEA	Insulated Cable Engineers Association, Inc.	<a href="http://www.icea.net">www.icea.net</a>
ICPA	International Cast Polymer Association	<a href="http://www.icpa-hq.org">www.icpa-hq.org</a>
ICRI	International Concrete Repair Institute, Inc.	<a href="http://www.icri.org">www.icri.org</a>
IEC	International Electrotechnical Commission	<a href="http://www.iec.ch">www.iec.ch</a>
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The)	<a href="http://www.ieee.org">www.ieee.org</a>
IES	Illuminating Engineering Society of North America	<a href="http://www.iesna.org">www.iesna.org</a>
IENT	Institute of Environmental Sciences and Technology	<a href="http://www.ient.org">www.ient.org</a>
IGMA	Insulating Glass Manufacturers Alliance	<a href="http://www.igmaonline.org">www.igmaonline.org</a>
ILI	Indiana Limestone Institute of America, Inc.	<a href="http://www.iliai.com">www.iliai.com</a>
ISA	Instrumentation, Systems, and Automation Society, The	<a href="http://www.isa.org">www.isa.org</a>
ISO	International Organization for Standardization	<a href="http://www.iso.ch">www.iso.ch</a>
ISSFA	International Solid Surface Fabricators Association	<a href="http://www.issfa.net">www.issfa.net</a>
ITS	Intertek Testing Service NA	(Now ETL SEMCO)
ITU	International Telecommunication Union	<a href="http://www.itu.int/home">www.itu.int/home</a>
KCMA	Kitchen Cabinet Manufacturers Association	<a href="http://www.kcma.org">www.kcma.org</a>
LGSEA	Light Gauge Steel Engineers Association	<a href="https://www.cfsei.org/">https://www.cfsei.org/</a>

Abbreviation /Acronym	Name	Website
LMA	Laminating Materials Association	(Now part of CPA)
LPI	Lightning Protection Institute	<a href="http://www.lightning.org">www.lightning.org</a>
MBMA	Metal Building Manufacturers Association	<a href="http://www.mbma.com">www.mbma.com</a>
MCA	Metal Construction Association	<a href="http://www.metalconstruction.org">www.metalconstruction.org</a>
MFMA	Maple Flooring Manufacturers Association, Inc.	<a href="http://www.maplefloor.org">www.maplefloor.org</a>
MFMA	Metal Framing Manufacturers Association, Inc.	<a href="http://www.metalframingmf.org">www.metalframingmf.org</a>
MH	Material Handling	(Now MHIA)
MHIA	Material Handling Industry of America	<a href="http://www.mhia.org">www.mhia.org</a>
MIA	Marble Institute of America	<a href="http://www.marble-institute.com">www.marble-institute.com</a>
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc.	<a href="http://www.mss-hq.com">www.mss-hq.com</a>
NAAMM	National Association of Architectural Metal Manufacturers	<a href="http://www.naamm.org">www.naamm.org</a>
NACE	NACE International (National Association of Corrosion Engineers International)	<a href="http://www.nace.org">www.nace.org</a>
NADCA	National Air Duct Cleaners Association	<a href="http://www.nadca.com">www.nadca.com</a>
NAGWS	National Association for Girls and Women in Sport	<a href="http://www.aahperd.org/nagws/">www.aahperd.org/nagws/</a>
NAIMA	North American Insulation Manufacturers Association	<a href="http://www.naima.org">www.naima.org</a>
NBGQA	National Building Granite Quarries Association, Inc.	<a href="http://www.nbgqa.com">www.nbgqa.com</a>
NCAA	National Collegiate Athletic Association (The)	<a href="http://www.ncaa.org">www.ncaa.org</a>
NCMA	National Concrete Masonry Association	<a href="http://www.ncma.org">www.ncma.org</a>
NCTA	National Cable & Telecommunications Association	<a href="http://www.ncta.com">www.ncta.com</a>
NEBB	National Environmental Balancing Bureau	<a href="http://www.nebb.org">www.nebb.org</a>
NECA	National Electrical Contractors Association	<a href="http://www.necanet.org">www.necanet.org</a>
NeLMA	Northeastern Lumber Manufacturers' Association	<a href="http://www.nelma.org">www.nelma.org</a>
NEMA	National Electrical Manufacturers Association	<a href="http://www.nema.org">www.nema.org</a>
NETA	InterNational Electrical Testing Association	<a href="http://www.netaworld.org">www.netaworld.org</a>
NFHS	National Federation of Province High School Associations	<a href="http://www.nfhs.org">www.nfhs.org</a>
NFPA	National Fire Protection Association	<a href="http://www.nfpa.org">www.nfpa.org</a>
NFRC	National Fenestration Rating Council	<a href="http://www.nfrc.org">www.nfrc.org</a>
NGA	National Glass Association	<a href="http://www.glass.org">www.glass.org</a>



Abbreviation /Acronym	Name	Website
NHLA	National Hardwood Lumber Association	<a href="http://www.natlhardwood.org">www.natlhardwood.org</a>
NOFMA	NOFMA: The Wood Flooring Manufacturers Association (Formerly: National Oak Flooring Manufacturers Association)	<a href="http://www.nofma.org">www.nofma.org</a>
NOMMA	National Ornamental & Miscellaneous Metals Association	<a href="http://www.nomma.org">www.nomma.org</a>
NRCA	National Roofing Contractors Association	<a href="http://www.nrca.net">www.nrca.net</a>
NRMCA	National Ready Mixed Concrete Association	<a href="http://www.nrmca.org">www.nrmca.org</a>
NSF	NSF International	<a href="http://www.nsf.org">www.nsf.org</a>
NSSGA	National Stone, Sand & Gravel Association	<a href="http://www.nssga.org">www.nssga.org</a>
NTMA	National Terrazzo & Mosaic Association, Inc. (The)	<a href="http://www.ntma.com">www.ntma.com</a>
NWFA	National Wood Flooring Association	<a href="http://www.nwfa.org">www.nwfa.org</a>
PCI	Precast/Prestressed Concrete Institute	<a href="http://www.pci.org">www.pci.org</a>
PDI	Plumbing & Drainage Institute	<a href="http://www.pdionline.org">www.pdionline.org</a>
PGI	PVC Geomembrane Institute	<a href="http://pgi-tp.cee.uiuc.edu">http://pgi-tp.cee.uiuc.edu</a>
PTI	Post-Tensioning Institute	<a href="http://www.post-tensioning.org">www.post-tensioning.org</a>
RCSC	Research Council on Structural Connections	<a href="http://www.boltcouncil.org">www.boltcouncil.org</a>
RFCI	Resilient Floor Covering Institute	<a href="http://www.rfci.com">www.rfci.com</a>
RIS	Redwood Inspection Service	<a href="http://www.redwoodinspection.com">www.redwoodinspection.com</a>
SAE	SAE International	<a href="http://www.sae.org">www.sae.org</a>
SCAQMD	South Coast Air Quality Management District	<a href="http://www.aqmd.com">www.aqmd.com</a>
SCTE	Society of Cable Telecommunications Engineers	<a href="http://www.scte.org">www.scte.org</a>
SDI	Steel Deck Institute	<a href="http://www.sdi.org">www.sdi.org</a>
SDI	Steel Door Institute	<a href="http://www.steeldoor.org">www.steeldoor.org</a>
SEFA	Scientific Equipment and Furniture Association	<a href="http://www.sefalabs.com">www.sefalabs.com</a>
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers	(See ASCE)
SIA	Security Industry Association	<a href="http://www.siaonline.org">www.siaonline.org</a>
SJI	Steel Joist Institute	<a href="http://www.steeljoist.org">www.steeljoist.org</a>
SMA	Screen Manufacturers Association	<a href="http://www.smacentral.org">www.smacentral.org</a>
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association	<a href="http://www.smacna.org">www.smacna.org</a>
SMPTE	Society of Motion Picture and Television Engineers	<a href="http://www.smpte.org">www.smpte.org</a>

Abbreviation /Acronym	Name	Website
SPFA	Spray Polyurethane Foam Alliance (Formerly: SPI/SPFD - The Society of the Plastics Industry, Inc.; Spray Polyurethane Foam Division)	<a href="http://www.sprayfoam.org">www.sprayfoam.org</a>
SPIB	Southern Pine Inspection Bureau (The)	<a href="http://www.spib.org">www.spib.org</a>
SPRI	Single Ply Roofing Industry	<a href="http://www.spri.org">www.spri.org</a>
SSINA	Specialty Steel Industry of North America	<a href="http://www.ssina.com">www.ssina.com</a>
SSPC	SSPC: The Society for Protective Coatings	<a href="http://www.sspc.org">www.sspc.org</a>
STI	Steel Tank Institute	<a href="http://www.steeltank.com">www.steeltank.com</a>
SWI	Steel Window Institute	<a href="http://www.steelwindows.com">www.steelwindows.com</a>
SWPA	Submersible Wastewater Pump Association	<a href="http://www.swpa.org">www.swpa.org</a>
TCA	Tilt-Up Concrete Association	<a href="http://www.tilt-up.org">www.tilt-up.org</a>
TCNA	Tile Council of North America, Inc.	<a href="http://www.tileusa.com">www.tileusa.com</a>
TEMA	Tubular Exchanger Manufacturers Association	<a href="http://www.tema.org">www.tema.org</a>
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance	<a href="http://www.tiaonline.org">www.tiaonline.org</a>
TMS	The Masonry Society	<a href="http://www.masonrysociety.org">www.masonrysociety.org</a>
TPI	Truss Plate Institute, Inc.	<a href="http://www.tpinst.org">www.tpinst.org</a>
TPI	Turfgrass Producers International	<a href="http://www.turfgrasssod.org">www.turfgrasssod.org</a>
TRI	Tile Roofing Institute	<a href="http://www.tilerroofing.org">www.tilerroofing.org</a>
UL	Underwriters Laboratories Inc.	<a href="http://www.ul.com">www.ul.com</a>
UNI	Uni-Bell PVC Pipe Association	<a href="http://www.uni-bell.org">www.uni-bell.org</a>
USAV	USA Volleyball	<a href="http://www.usavolleyball.org">www.usavolleyball.org</a>
USGBC	U.S. Green Building Council	<a href="http://www.usgbc.org">www.usgbc.org</a>
USITT	United States Institute for Theatre Technology, Inc.	<a href="http://www.usitt.org">www.usitt.org</a>
WASTEC	Waste Equipment Technology Association	<a href="http://www.wastec.org">www.wastec.org</a>
WCLIB	West Coast Lumber Inspection Bureau	<a href="http://www.wclib.org">www.wclib.org</a>
WCMA	Window Covering Manufacturers Association	<a href="http://www.wcmanet.org">www.wcmanet.org</a>
WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association)	<a href="http://www.wdma.com">www.wdma.com</a>
WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of California)	<a href="http://www.wicnet.org">www.wicnet.org</a>
WMMPA	Wood Moulding & Millwork Producers Association	<a href="http://www.wmmpa.com">www.wmmpa.com</a>

Abbreviation /Acronym	Name	Website
WSRCA	Western States Roofing Contractors Association	<a href="http://www.wsrca.com">www.wsrca.com</a>
WWPA	Western Wood Products Association	<a href="http://www.wwpa.org">www.wwpa.org</a>

### **1.3 List Of Standards**

<b>Standard No.</b>	<b>Standard Name</b>
AAMA 1304	Voluntary Specification For Determining Forced Entry Resistance Of Side-Hinged Door Systems
AAMA 1503	Voluntary Test Method For Thermal Transmittance And Condensation Resistance Of Windows, Doors And Glazed Wall Sections
AAMA 1503.1	Thermal Transmittance And Condensation Resistance Of Windows, Doors And Glazed Wall Sections
AAMA 2603	Voluntary Specification, Performance Requirements And Test Procedures For Pigmented Organic Coatings On Aluminum Extrusions And Panels (With Coil Coating Appendix)
AAMA 2604	Voluntary Specification, Performance Requirements And Test Procedures For High Performance Organic Coatings On Aluminum Extrusions And Panels (With Coil Coating Appendix)
AAMA 2605	Voluntary Specification, Performance Requirements And Test Procedures For Superior Performing Organic Coatings On Aluminum Extrusions And Panels (With Coil Coating Appendix)
AAMA 501	Methods Of Test For Exterior Walls
AAMA 501.1	Standard Test Method For Water Penetration Of Windows, Curtain Walls And Doors Using Dynamic Pressure
AAMA 501.2	Quality Assurance And Water Field Check Of Installed Storefronts, Curtain Walls And Sloped Glazing Systems
AAMA 501.4	Recommended Static Test Method For Evaluating Curtain Wall And Storefront Systems Subjected To Seismic And Wind Induced Inter-Story Drifts.
AAMA 501.4	Recommended Static Test Method For Evaluating Curtain Wall And Storefront Systems Subjected To Seismic And Wind Induced Interstory Drifts
AAMA 501.7	Recommended Static Test Method For Evaluating Windows, Window Wall, Curtain Wall And Storefront Systems Subjected To Vertical Inter-Story Movements
AAMA 501.8	Standard Test Method For Determination Of Resistance To Human Impact Of Window Systems Intended For Use In Psychiatric Applications

AAMA 503	Field Testing Of Newly Installed Storefronts, Curtain Walls, And Sloped Glazing Systems
AAMA 507	Standard Practice For Determining The Thermal Performance Characteristics Of Fenestration Systems In Commercial Buildings
AAMA 508	Voluntary Test Method And Specification For Pressure Equalized Rainscreen Wall Cladding Systems
AAMA 609 & 610	Cleaning And Maintenance Guide For Architecturally Finished Aluminum
AAMA 611	Voluntary Specification For Anodized Architectural Aluminum
AAMA 701/702	Voluntary Specification For Pile Weatherstripping And Replaceable Fenestration Weatherseals
AAMA 800	Voluntary Specifications And Test Methods For Sealants
AAMA 804.1	Voluntary Specification For Ductile Back-Bedding Glazing Tapes
AAMA 912	Voluntary Specification For Non-Residential Fenestration Building Information Modeling (BIM)
ACI 315	Details And Detailing Of Concrete Reinforcement
AISC 370	Structural Stainless Steel Buildings
AISI 304	Stainless Steel
AISI S100	North American Specification For The Design Of Cold-Formed Steel Structural Members
ANSI 51	Idmtl Overcurrent Protection
ANSI A108	Installation Of Ceramic Tile
ANSI A108.1	Installation Of Ceramic Tile With Portland Cement Mortar
ANSI A108.11	American National Specifications For The Installation Of Ceramic Tile
ANSI A108.13	American National Specifications For The Installation Of Ceramic Tile
ANSI A108.1A	American National Specifications For The Installation Of Ceramic Tile
ANSI A118.1	American National Standard Specifications For Dry-Set Cement Mortar.(Forming Part Of ANSI A108/A118/A136.1)
ANSI A118.10	American National Standard Specifications For Load Bearing, Bonded, Waterproof Membranes For Thin-Set Ceramic Tile And Dimension Stone Installation.(Forming Part Of ANSI A108/A118/A136.1)
ANSI A118.11	American National Standard Specifications For EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar.(Forming Part Of ANSI A108/A118/A136.1)
ANSI A118.7	High Performance Cement Grouts For Tile Installation
ANSI A118.9	Test Methods And Specifications For Cementitious Backer Units

ANSI A118.12	Crack Isolation Membranes For Thin-Set Ceramic Tile And Dimension Stone Installations
ANSI A118.15	Compliant Mortars
ANSI A118.3	American National Standard Specifications For Chemical Resistant, Water Cleanable Tile-Setting And -Grouting Epoxy And Water Cleanable Tile-Setting Epoxy Adhesive.
ANSI A118.4	American National Standard Specifications For Modified Dry-Set Cement Mortar.(Forming Part Of ANSI A108/A118/A136.1)
ANSI A137.1	American National Standards Specifications For Ceramic Tile
ANSI A137.3	Specifications For Gauged Porcelain Tile And Gauged Porcelain Tile Panels/Slabs (Material And Installation Standards)
ANSI A208.2	Medium Density Fiberboard (MDF) For Interior Applications
ANSI A208.2	Medium Density Fiberboard (MDF) Standard For Interior Applications
ANSI A326.3	Dynamic Coefficient Of Friction (Dcof) Of Hard Surface Flooring Materials
ANSI Standard 61	Drinking Water System Components – Health Effects
ANSI Z 124.3	Plastic Lavatories
ANSI Z124.3	Plastic Lavatories (Superseded By IAPMO Z124-2017)
ANSI Z245.2	Stationary Compactors - Safety Requirements For Installation, Maintenance, And Operation
ANSI Z97.1	Safety Glazing Materials Used In Buildings – Safety Performance Specifications And Methods Of Test
ASTM A780	Standard Practice For Repair Of Damaged And Uncoated Areas Of Hot-Dip Galvanized Coatings
ASTM A1008/A1008M	Cold Rolled, Carbon Steel
ASTM A1011/A1011M	Hot-Rolled, Steel Sheet And Strip And Coils Of Carbon Steel, Structural Steel, High-Strength Low-Alloy Steel, High-Strength Low-Alloy Steel With Improved Formability, And Ultra-High Strength Steel
ASTM A36/A36M	Standard Specification For Carbon Structural Steel
ASTM A53/A53M	Standard Specification For Pipe, Steel, Black And Hot-Dipped, Zinc-Coated, Welded And Seamless
ASTM A123/A123M	Standard Specification For Zinc (Hot-Dip Galvanized) Coatings On Iron And Steel Products
ASTM A167	Standard Specification For Stainless And Heat-Resisting Chromium-Nickel Steel Plate, Sheet, And Strip (WITHDRAWN)
ASTM A176	Standard Specification For Stainless And Heat-Resisting Chromium Steel Plate, Sheet, And Strip (Withdrawn)

ASTM A240/A240M	Standard Specification For Chromium And Chromium-Nickel Stainless Steel Plate, Sheet, And Strip For Pressure Vessels And For General Applications
ASTM A268/A268M	Standard Specification For Seamless And Welded Ferritic And Martensitic Stainless Steel Tubing For General Service
ASTM A269	Standard Specification For Seamless And Welded Austenitic Stainless Steel Tubing For General Service
ASTM A307	Standard Specification For Carbon Steel Bolts, Studs, And Threaded Rod 60000 PSI Tensile Strength
ASTM A325	Standard Specification For Structural Bolts, Steel, Heat Treated, 120/105 Ksi Minimum Tensile Strength (Withdrawn 2016)
ASTM A500/A500M	Standard Specification For Cold-Formed Welded And Seamless Carbon Steel Structural Tubing In Rounds And Shapes
ASTM A510	Standard Specification For General Requirements For Wire Rods And Coarse Round Wire, Carbon Steel, And Alloy Steel
ASTM A653/A653M	Standard Specification For Steel Sheet, Zinc-Coated (Galvanized) Or Zinc-Iron Alloy-Coated (Galvannealed) By The Hot-Dip Process
ASTM A666	Standard Specification For Annealed Or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, And Flat Bar
ASTM A780	Standard Practice For Repair Of Damaged And Uncoated Areas Of Hot-Dip Galvanized Coatings
ASTM A924/A924M	Standard Specification For General Requirements For Steel Sheet, Metallic-Coated By The Hot-Dip Process
ASTM B209/B209M	Standard Specification For Aluminum And Aluminum-Alloy Sheet And Plate
ASTM B210	Standard Specification For Aluminum And Aluminum-Alloy Drawn Seamless Tubes
ASTM B221/B221M	Standard Specification For Aluminum And Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, And Tubes
ASTM B247	Standard Specification For Aluminum And Aluminum-Alloy Die Forgings, Hand Forgings, And Rolled Ring Forgings
ASTM B308/B308M	Standard Specification For Aluminum-Alloy 6061-T6 Standard Structural Profiles
ASTM B456	Standard Specification For Electrodeposited Coatings Of Copper Plus Nickel Plus Chromium And Nickel Plus Chromium
ASTM B633	Standard Specification For Electrodeposited Coatings Of Zinc On Iron And Steel
ASTM B117	Standard Practice For Operating Salt Spray (Fog) Apparatus
ASTM B221	Standard Specification For Aluminum And Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, And Tubes
ASTM C33	Standard Specification For Concrete Aggregates

ASTM C39	Standard Test Method For Compressive Strength Of Cylindrical Concrete Specimens
ASTM C109/C109M	Standard Test Method For Compressive Strength Of Hydraulic Cement Mortars (Using 2-In. Or 50 mm Cube Specimens)
ASTM C150/C150M	Standard Specification For Portland Cement
ASTM C170	Standard Test Method For Compressive Strength Of Dimension Stone
ASTM C190	Standard Test Method For Tensile Strength Of Hydraulic Cement Mortars
ASTM C272	Standard Test Method For Water Absorption Of Core Materials For Sandwich Constructions
ASTM C475	Standard Specification For Joint Compound And Joint Tape For Finishing Gypsum Board
ASTM C501	Standard Test Method For Relative Resistance To Wear Of Unglazed Ceramic Tile By The Taber Abraser
ASTM C595	Standard Specification For Blended Hydraulic Cements
ASTM C957	Standard Specification For High-Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane With Integral Wearing Surface
ASTM C979	Standard Specification For Pigments For Integrally Colored Concrete
ASTM C1047	Standard Specification For Accessories For Gypsum Wallboard And Gypsum Veneer Base
ASTM C1002	Standard Specification For Steel Self-Piercing Tapping Screws For Application Of Gypsum Panel Products Or Metal Plaster Bases To Wood Studs Or Steel Studs
ASTM C1021	Standard Practice For Laboratories Engaged In Testing Of Building Sealants
ASTM C1036	Standard Specification For Flat Glass
ASTM C1048	Standard Specification For Heat-Strengthened And Fully Tempered Flat Glass
ASTM C1087	Standard Test Method For Determining Compatibility Of Liquid-Applied Sealants With Accessories Used In Structural Glazing Systems
ASTM C1115	Standard Specification For Dense Elastomeric Silicone Rubber Gaskets And Accessories
ASTM C1127	Standard Guide For Use Of High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane With An Integral Wearing Surface
ASTM C1135	Standard Test Method For Determining Tensile Adhesion Properties Of Structural Sealants
ASTM C1172	Standard Specification For Laminated Architectural Flat Glass
ASTM C1177/1177M	Standard Specification For Glass Mat Gypsum Substrate For Use As Sheathing

ASTM C1178	Standard Specification For Coated Glass Mat Water-Resistant Gypsum Backing Panel
ASTM C1184	Standard Specification For Structural Silicone Sealants
ASTM C1280	Standard Specification For Application Of Exterior Gypsum Panel Products For Use As Sheathing
ASTM C1281	Standard Specification For Preformed Tape Sealants For Glazing Applications
ASTM C1305	Standard Test Method For Crack Bridging Ability Of Liquid-Applied Waterproofing Membrane
ASTM C1311	Standard Specification For Solvent Release Sealants
ASTM C1330	Standard Specification For Cylindrical Sealant Backing For Use With Cold Liquid-Applied Sealants
ASTM C1378	Standard Test Method For Determination Of Resistance To Staining
ASTM C1382	Standard Test Method For Determining Tensile Adhesion Properties Of Sealants When Used In Exterior Insulation And Finish Systems (EIFS) Joints
ASTM C1396	Standard Specification For Gypsum Board
ASTM C1401	Standard Guide For Structural Sealant Glazing
ASTM C144	Standard Specification For Aggregate For Masonry Mortar
ASTM C1503	Standard Specification For Silvered Flat Glass Mirror
ASTM C156	Standard Test Method For Water Loss (From A Mortar Specimen) Through Liquid Membrane-Forming Curing Compounds For Concrete
ASTM C1652	Standard Test Method For Measuring Optical Distortion In Flat Glass Products Using Digital Photography Of Grids
ASTM C1708	Standard Test Methods For Self-Leveling Mortars Containing Hydraulic Cements
ASTM C171	Standard Specification For Sheet Materials For Curing Concrete
ASTM C207	Standard Specification For Hydrated Lime For Masonry Purposes
ASTM C216	Standard Specification For Facing Brick (Solid Masonry Units Made From Clay Or Shale)
ASTM C219	Standard Terminology Relating To Hydraulic And Other Inorganic Cements
ASTM C267	Standard Test Methods For Chemical Resistance Of Mortars, Grouts, And Monolithic Surfacing And Polymer Concretes
ASTM C373	Standard Test Methods For Determination Of Water Absorption And Associated Properties By Vacuum Method For Pressed Ceramic Tiles And Glass Tiles And Boil Method For Extruded Ceramic Tiles And Non-Tile Fired Ceramic Whiteware Products



ASTM C501	Standard Test Method For Relative Resistance To Wear Of Unglazed Ceramic Tile By The Taber Abraser
ASTM C509	Standard Specification For Elastomeric Cellular Preformed Gasket And Sealing Material
ASTM C510	Standard Test Method For Staining And Color Change Of Single- Or Multicomponent Joint Sealants
ASTM C518	Standard Test Method For Steady-State Thermal Transmission Properties By Means Of The Heat Flow Meter Apparatus
ASTM C587	Standard Specification For Gypsum Veneer Plaster
ASTM C612	Standard Specification For Mineral Fiber Block And Board Thermal Insulation
ASTM C627	Standard Test Method For Evaluating Ceramic Floor Tile Installation Systems Using The Robinson-Type Floor Tester
ASTM C631	Standard Specification For Gypsum Veneer Plaster
ASTM C645	Standard Specification For Non Structural Steel Framing Members
ASTM C754	Standard Specification For Installation Of Steel Framing Members To Receive Screw-Attached Gypsum Panel Products
ASTM C780	Standard Test Method For Preconstruction And Construction Evaluation Of Mortars For Plain And Reinforced Unit Masonry
ASTM C794	Standard Test Method For Adhesion-In-Peel Of Elastomeric Joint Sealants
ASTM C834	Standard Specification For Latex Sealants
ASTM C840	Standard Specification For Application And Finishing Of Gypsum Board
ASTM C864	Standard Specification For Dense Elastomeric Compression Seal Gaskets, Setting Blocks, And Spacers
ASTM C919	Standard Practice For Use Of Sealants In Acoustical Applications
ASTM C920	Standard Specification For Elastomeric Joint Sealants
ASTM C954	Standard Specification For Steel Drill Screws For The Application Of Gypsum Panel Products Or Metal Plaster Bases To Steel Studs From 0.033 In. (0.84 Mm) To 0.112 In. (2.84 Mm) In Thickness
ASTM D226	Standard Specification For Asphalt-Saturated Organic Felt Used In Roofing And Waterproofing
ASTM D790	Standard Test Methods For Flexural Properties Of Unreinforced And Reinforced Plastics And Electrical Insulating Materials
ASTM D1056	Standard Specification For Flexible Cellular Materials -- Sponge Or Expanded Rubber
ASTM D843	Standard Specification For Nitration Grade Xylene

ASTM D1187	Standard Specification For Asphalt-Base Emulsions For Use As Protective Coatings For Metal
ASTM D1308	Standard Test Method For Effect Of Household Chemicals On Clear And Pigmented Organic Finishes
ASTM D1335	Standard Test Method For Tuft Bind Of Pile Yarn Floor Coverings
ASTM D1411	Standard Test Methods For Water-Soluble Chlorides Present As Admixtures In Graded Aggregate Road Mixes (Withdrawn 2018)
ASTM D1622	Standard Test Method For Apparent Density Of Rigid Cellular Plastics
ASTM D1709	Standard Test Methods For Impact Resistance Of Plastic Film By The Free-Falling Dart Method
ASTM D1876	Standard Test Method For Peel Resistance Of Adhesives (T-Peel Test)
ASTM D1970	Standard Specification For Self-Adhering Polymer Modified Bituminous Sheet Materials Used As Steep Roofing Underlayment For Ice Dam Protection
ASTM D2047	Standard Test Method For Static Coefficient Of Friction Of Polish-Coated Flooring Surfaces As Measured By The James Machine
ASTM D2240	Standard Test Method For Rubber Property-Durometer Hardness
ASTM D2244	Standard Practice For Calculation Of Color Tolerances And Color Differences From Instrumentally Measured Color Coordinates
ASTM D245	Standard Practice For Establishing Structural Grades And Related Allowable Properties For Visually Graded Lumber
ASTM D2487	Standard Practice For Classification Of Soils For Engineering Purposes (Unified Soil Classification System)
ASTM D2822	Standard Specification For Asphalt Roof Cement, Asbestos Containing (Withdrawn 2016)
ASTM D2842	Standard Test Method For Water Absorption Of Rigid Cellular Plastics
ASTM D3019	Standard Specification For Lap Cement Used With Asphalt Roll Roofing, Non-Fibered, And Fibered
ASTM D3936	Standard Test Method For Resistance To Delamination Of The Secondary Backing Of Pile Yarn Floor Covering
ASTM D4068	Standard Specification For Chlorinated Polyethylene (CPE) Sheeting For Concealed Water-Containment Membrane
ASTM D4073	Standard Test Method For Tensile-Tear Strength Of Bituminous Roofing Membranes
ASTM D412	Standard Test Methods For Vulcanized Rubber And Thermoplastic Elastomers-Tension

ASTM D4214	Standard Test Methods For Evaluating The Degree Of Chalking Of Exterior Paint Films
ASTM D4258	Standard Practice For Surface Cleaning Concrete For Coating
ASTM D4263	Standard Test Method For Indicating Moisture In Concrete By The Plastic Sheet Method
ASTM D4355	Standard Test Method For Deterioration Of Geotextiles By Exposure To Light, Moisture, And Heat In A Xenon Arc-Type Apparatus
ASTM D4397	Standard Specification For Polyethylene Sheeting For Construction, Industrial, And Agricultural Applications
ASTM D4491	Standard Test Methods For Water Permeability Of Geotextiles By Permittivity
ASTM D4533	Standard Test Method For Trapezoid Tearing Strength Of Geotextiles
ASTM D4541	Standard Test Method For Pull-Off Strength Of Coatings Using Portable Adhesion Testers
ASTM D4632	Standard Test Method For Grab Breaking Load And Elongation Of Geotextiles
ASTM D4751	Standard Test Methods For Determining Apparent Opening Size Of A Geotextile
ASTM D4833	Standard Test Method For Index Puncture Resistance Of Geomembranes And Related Products
ASTM D523	Standard Test Method For Specular Gloss
ASTM D5252	Standard Practice For The Operation Of The Hexapod Tumble Drum Tester
ASTM D5385	Standard Test Method For Hydrostatic Pressure Resistance Of Waterproofing Membranes
ASTM D5417	Standard Practice For Operation Of The Vettermann Drum Tester
ASTM D543	Standard Practices For Evaluating The Resistance Of Plastics To Chemical Reagents
ASTM D570	Standard Test Method For Water Absorption Of Plastics
ASTM D5848	Standard Test Method For Mass Per Unit Area Of Pile Yarn Floor Coverings
ASTM D6135	Standard Practice For Application Of Self-Adhering Modified Bituminous Waterproofing (Withdrawn)
ASTM D6241	Standard Test Method For Static Puncture Strength Of Geotextiles And Geotextile-Related Products Using A 50-Mm Probe
ASTM D6506	Standard Specification For Asphalt Based Protection Board For Below-Grade Waterproofing
ASTM D6693	Standard Test Method For Determining Tensile Properties Of Nonreinforced Polyethylene And Nonreinforced Flexible Polypropylene Geomembranes

ASTM D698	Standard Test Methods For Laboratory Compaction Characteristics Of Soil Using Standard Effort (12,400 Ft-Lbf/Ft <sup>3</sup> (600 Kn-M/M <sup>3</sup> ))
ASTM D7877	Standard Guide For Electronic Methods For Detecting And Locating Leaks In Waterproof Membranes
ASTM D792	Standard Test Methods For Density And Specific Gravity (Relative Density) Of Plastics By Displacement
ASTM D8231	Standard Practice For The Use Of A Low Voltage Electronic Scanning System For Detecting And Locating Breaches In Roofing And Waterproofing Membranes
ASTM D882	Standard Test Method For Tensile Properties Of Thin Plastic Sheeting
ASTM D903	Standard Test Method For Peel Or Stripping Strength Of Adhesive Bonds
ASTM E96/E96M	Standard Test Methods For Gravimetric Determination Of Water Vapor Transmission Rate Of Materials
ASTM E154	Standard Test Methods For Water Vapor Retarders Used In Contact With Earth Under Concrete Slabs, On Walls, Or As Ground Cover
ASTM E283	Standard Test Method For Determining Rate Of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, And Doors Under Specified Pressure Differences Across The Specimen
ASTM E330	Standard Test Method For Structural Performance Of Exterior Windows, Doors, Skylights And Curtain Walls By Uniform Static Air Pressure Difference
ASTM E1155	Standard Test Method For Determining FF Floor Flatness And FL- Floor Levelness Numbers
ASTM E1186	Standard Practices For Air Leakage Site Detection In Building Envelopes And Air Barrier Systems
ASTM E331	Standard Test Method For Water Penetration Of Exterior Windows, Skylights, Doors, And Curtain Walls By Uniform Static Air Pressure Difference
ASTM E488	Standard Test Methods For Strength Of Anchors In Concrete Elements
ASTM E497	Standard Practice For Installing Sound-Isolating Lightweight Partitions (Withdrawn 2008)
ASTM E514	Standard Test Method For Water Penetration And Leakage Through Masonry
ASTM E699	Standard Specification For Agencies Involved In Testing, Quality Assurance, And Evaluating Of Manufactured Building Components
ASTM E1233	Standard Test Method For Structural Performance Of Exterior Windows, Doors, Skylights, And Curtain Walls By Cyclic Air Pressure Differential

ASTM E1300	Standard Practice For Determining Load Resistance Of Glass In Buildings
ASTM E1332	Standard Classification For Rating Outdoor-Indoor Sound Attenuation
ASTM E1425	Standard Practice For Determining The Acoustical Performance Of Windows, Doors, Skylight, And Glazed Wall Systems
ASTM E1643	Standard Practice For Selection, Design, Installation, And Inspection Of Water Vapor Retarders Used In Contact With Earth Or Granular Fill Under Concrete Slabs
ASTM E1745	Standard Specification For Plastic Water Vapor Retarders Used In Contact With Soil Or Granular Fill Under Concrete Slabs
ASTM E2016	Standard Specification For Industrial Woven Wire Cloth
ASTM E2099	Standard Practice For Specification And Evaluation Of Pre-Construction Laboratory Mockups Of Exterior Wall Systems
ASTM E2178	Standard Test Method For Determining Air Leakage Rate And Calculation Of Air Permeance Of Building Materials
ASTM E2190	Standard Specification For Insulating Glass Unit Performance And Evaluation
ASTM E2486	Standard Test Method For Impact Resistance Of Class PB And PI Exterior Insulation And Finish Systems (EIFS)
ASTM E331	Standard Test Method For Water Penetration Of Exterior Windows, Skylights, Doors, And Curtain Walls By Uniform Static Air Pressure Difference
ASTM E413	Classification For Rating Sound Insulation
ASTM E547	Standard Test Method For Water Penetration Of Exterior Windows, Skylights, Doors, And Curtain Walls By Cyclic Static Air Pressure Difference
ASTM E662	Standard Test Method For Specific Optical Density Of Smoke Generated By Solid Materials
ASTM E783	Standard Test Method For Field Measurement Of Air Leakage Through Installed Exterior Windows And Doors
ASTM E84	Standard Test Method For Surface Burning Characteristics Of Building Materials
ASTM E90	Standard Test Method For Laboratory Measurement Of Airborne Sound Transmission Loss Of Building Partitions And Elements
ASTM F1249	Standard Test Method For Water Vapor Transmission Rate Through Plastic Film And Sheeting Using A Modulated Infrared Sensor
ASTM F1344	Standard Specification For Rubber Floor Tile
ASTM F1859	Standard Specification For Rubber Sheet Floor Covering Without Backing

ASTM F1860	Standard Specification For Rubber Sheet Floor Covering With Backing
ASTM F2170	Standard Test Method For Determining Relative Humidity In Concrete Floor Slabs Using In Situ Probes
ASTM F2285	Standard Consumer Safety Performance Specification For Diaper Changing Tables For Commercial Use
ASTM F3010	Standard Practice For Two-Component Resin Based Membrane-Forming Moisture Mitigation Systems For Use Under Resilient Floor Coverings
ASTM F3131	Standard Specification For Epoxy / Cotton Raw Materials For The Use In Bearing Cages
ASTM F925	Standard Test Method For Resistance To Chemicals Of Resilient Flooring
ASTM F970	Standard Test Method For Measuring Recovery Properties Of Floor Coverings After Static Loading
ASTM G21	Standard Practice For Determining Resistance Of Synthetic Polymeric Materials To Fungi
ASTM G22	Standard Practice For Determining Resistance Of Plastics To Bacteria (Withdrawn)
AWS A5.10	Bare Aluminum & Aluminum-Alloy Welding Electrodes & Rods
AWS D1.3	Specification For Welding Sheet Steel In Structures
BHMA A156	Door Standards
BHMA A 156.9	American National Standard For Cabinet Hardware
CAN/CSA A3000	Cementitious Materials Compendium, Includes Update No. 1 And Errata
CAN/CSA A371	Masonry Construction For Buildings
CAN/CSA G164	Hot Dip Galvanizing Of Irregularly Shaped Articles
CAN/ULC S101	Standard Methods Of Fire Endurance Tests Of Building Construction And Materials
CAN/ULC S102	Standard Method Of Test For Surface Burning Characteristics Of Building Materials And Assemblies
CAN/ULC S102.2	Method Of Test For Surface Burning Characteristics Of Flooring, Floor Coverings, And Miscellaneous Materials And Assemblies
CAN/ULC S104	Standard Method For Fire Tests Of Door Assemblies
CAN/ULC S109	Standard Method For Flame Tests Of Flameresistant Fabrics And Films
CAN/ULC S114	Standard Method Of Test For Determination Of Non-Combustibility In Building Materials
CAN/ULC S134	Standard Method Of Fire Test Of Exterior Wall Assemblies
CAN/ULC S702	Mineral Fibre Thermal Insulation For Buildings (Withdrawn Replaced With CAN/ULC S702.1 And S702.2)

CAN/ULC S716.1	Standard For Exterior Insulation And Finish Systems (EIFS) – Materials And Systems
CAN/ULC S716.3	Standard For Exterior Insulation And Finish Systems (EIFS) – Design Application
CAN/ULC S741	Standard For Air Barrier Materials - Specification
CAN/ULC S742	Standard For Air Barrier Assemblies – Specification
CGSB 1-GP-48M	Primer, Marine, For Steel
CGSB 4.2	Textile Test Methods Table Of Contents, Moisture Regain Values, SI Units Used In CAN/CGSB-4.2-M And Fibre, Yarn, Fabric, Garment And Carpet Properties
CGSB 11-GP-3M	Rigid Panels
CGSB 12.1-M	Tempered Or Laminated Safety Glass
CGSB 12.9	Spandrel Glass
CGSB 25.20	Surface Sealer For Floors
CGSB 82.6	Doors, Mirrored Glass, Sliding Or Folding, Wardrobe
CGSB 148.1	Methods Of Testing Geosynthetics Conditioning Geosynthetics For Testing
CSA A23.1	Concrete Materials And Methods Of Concrete Construction
CSA A23.2	Methods Of Test For Concrete
CSA A82.22	Gypsum Plasters
CSA A165	CSA Standards On Concrete Masonry Units
CSA A179	Mortar And Grout For Unit Masonry
CSA A23.4	Precast Concrete – Materials And Construction
CSA A370	Connectors For Masonry
CSA A371	Masonry Construction For Buildings
CSA A440.2	Fenestration Energy Performance/User Guide To CSA A440.2:19, Fenestration Energy Performance
CSA A440.6	High Exposure Fenestration Installation
CSA A440S1	Canadian Supplement To AAMA/WDMA/CSA 101/I.S.2/A440-17, NAFS – North American Fenestration Standard/Specification For Windows, Doors, And Skylights
CSA A460	Bird-Friendly Building Design
CSA A82	Fired Masonry Brick Made From Clay Or Shale
CSA A500	Building Guards
CSA A3000	Cementitious Materials Compendium
CSA B111	Wire Nails, Spikes And Staples
CSA B651	Accessible Design For The Built Environment
CSA G164	Hot Dip Galvanizing Of Irregularly Shaped Articles
CSA G30.3-M	Cold Drawn Steel Wire For Concrete Reinforcement

CSA G40.20	General Requirements For Rolled Or Welded Structural Quality Steel
CSA G40.21	General Requirements For Rolled Or Welded Structural Quality Steel / Structural Quality Steel
CSA O121	Douglas Fir Plywood
CSA O141	Softwood Lumber
CSA O151	Canadian Softwood Plywood
CSA O80.1	Preservative Treatment Of All Timber Products By Pressure Processes
CSA O153-M	Poplar Plywood
CSA O188	Standard Test Methods For Mat-Formed Wood Particleboards And Waferboard
CSA S136	North American Specification For The Design Of Cold-Formed Steel Structural Members And S136.1-16, Commentary On North American Specification For The Design Of Cold-Formed Steel Structural Members
CSA S157/S157.1	Strength Design In Aluminum
CSA S16	Design Of Steel Structures
CSA S304	Design Of Masonry Structures
CSA S413	Parking Structures
CSA W178.1	Certification Of Welding Inspection Organizations
CSA W178.2	Certification Of Welding Inspectors
CSA W186	Welding Of Reinforcing Bars In Reinforced Concrete Construction
CSA W47.1	Certification Of Companies For Fusion Welding Of Steel
CSA W47.2	Certification Of Companies For Fusion Welding Of Aluminum
CSA W48	Filler Metals And Allied Materials For Metal Arc Welding
CSA W48.1-M	Carbon Steel Covered Electrodes For Shielded Metal Arc Welding
CSA W59	Welded Steel Construction
CSA W59.2	Welded Aluminum Construction
CSA Z259	Fall Protection Equipment
CSA Z271	Design Of Suspended Access Equipment
CSSBI 61	Product Certification Standard - Cold Formed Steel Framing Members
DASMA 108	Standard Method For Testing Sectional Garage Doors, Rolling Doors And Flexible Doors: Determination Of Structural Performance Under Uniform Static Air Pressure Difference
DIN EN 14179-1	Glass In Building - Heat Soaked Thermally Toughened Soda Lime Silicate Safety Glass



EPA 832	Storm Water Management For Construction Activities: Developing Pollution Prevention Plans And Best Management Practices
EPA Method 24	Determination Of Volatile Matter Content, Water Content, Density, Volume Solids, And Weight Solids Of Surface Coatings
ISO 10545	Ceramic Tiles –Part 13: Determination Of Chemical Resistance
ISO 2551	Textile Floor Coverings And Textile Floor Coverings In Tile Form Determination Of Dimensional Changes Due To The Effects Of Varied Water And Heat Conditions And Distortion Out Of Plane
ISO 4526	Metallic Coatings — Electroplated Coatings Of Nickel For Engineering Purposes
ISO 9001	Quality Management Systems — Requirements
ISO 130007	Ceramic Tiles Grouts And Adhesives
ISO 14025	Grouts And Adhesives
ISO 21930	Part 1: Terms, Definitions And Specifications For Adhesives
KCMA A161.1	Performance And Construction Standard For Kitchen And Vanity Cabinets
MPI 15	Light Industrial Coating, Interior, Water Based (Mpi Gloss Level 3)
MPI 153	Light Industrial Coating, Interior, Water Based, Semi-Gloss (Mpi Gloss Level 5)
MPI 97	Primer, Alkyd, Anti-Corrosive For Metal
NAAMM MBG 531	Metal Bar Grating Manual
NAAMM MBG 532	Heavy Duty Metal Bar Grating Manual
NEMA 4	Indoor Or Outdoor Use Primarily To Provide A Degree Of Protection Against Windblown Dust And Rain, Splashing Water, Hose-Directed Water And Damage From External Ice Formation.
NEMA 13	Indoor Use Primarily To Provide A Degree Of Protection Against Dust, Spraying Of Water, Oil, And Non-Corrosive Coolant.
NEMA LD3	Performance, Application, Fabrication, And Installation Of High Pressure Decorative Laminates
NFPA 701	Standard Methods Of Fire Tests For Flame Propagation Of Textiles And Films
NFPA 80	Standard For Fire Doors And Other Opening Protectives
NFPA 82	Standard On Incinerators And Waste And Linen Handling Systems And Equipment
NFRC 100	Procedure For Determining Fenestration Product U-Factors

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NFRC 200	Procedure For Determining Fenestration Product Solar Heat Gain Coefficient And Visible Transmittance At Normal Incidence
NSF 342	Sustainability Assessment For Wallcovering Products
SCAQMD Rule 1113	Architectural Coatings
SCAQMD Rule 1168	Adhesive And Sealant Applications
UL 2818	Greenguard Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings
UL 325	External Entrapment Protection Devices
ULC S115	Standard Method Of Fire Tests Of Firestop Systems
ULC S1001	Integrated Systems Testing Of Fire Protection And Life Safety Systems

**2 .     PRODUCTS**

**2.1     Not Used**

**3 .     EXECUTION**

**3.1     Not Used**

END OF SECTION

## **1. GENERAL**

### **1.1 Summary**

- 1.1.1 Purpose of Section: Section specifies responsibilities for temporary facilities and controls for the Work.
- 1.1.2 Read in conjunction with: CCDC 2-2020, Part 3, Execution of the Work; specifically, GC 3.3 and Supplementary Conditions.

### **1.2 Temporary Utilities**

- 1.2.1 General: Provide temporary utilities as specified and as otherwise necessary to perform the Work expeditiously. Remove temporary utilities after use.
- 1.2.2 Temporary Water Supply:
  - .1 Arrange and pay for a temporary supply of water required during construction. Arrange and pay for necessary water supply connections and disconnections.
- 1.2.3 Temporary Heating And Ventilation
  - .1 Arrange and pay for temporary heating and ventilation required during construction.
  - .2 Vent construction heaters in enclosed spaces to the outside or use flameless type of construction heaters.
  - .3 Provide temporary heat for the Work as required to:
    - .1 Facilitate progress of Work.
    - .2 Protect the Work against dampness and cold.
    - .3 Prevent moisture condensation on surfaces, freezing, or other damage to finishes or stored Products.
    - .4 Maintain specified minimum ambient temperatures and humidity levels for storage, installation and curing of Products.
    - .5 After building is enclosed, maintain interior temperature of minimum 10 degrees C.
  - .4 Provide temporary ventilation for the Work as required to:
    - .1 Prevent accumulations of fumes, exhaust, vapours, gases and other hazardous, noxious, or volatile substances in enclosed spaces, as required to maintain a safe work environment meeting applicable regulatory requirements.
    - .2 Ventilate temporary sanitary facilities.

- .5 Do not use permanent building heating and ventilation systems during construction.

1.2.4 Temporary Electrical Power and Lighting

- .1 Arrange and pay for temporary power and lighting required during construction. Arrange and pay for necessary connections and disconnections of temporary power and lighting in accordance with regulatory requirements. . Temporary power for equipment requiring more capacity than above is responsibility of Contractor.
- .2 Do not use permanent building lighting systems during construction.

**1.3 Construction Facilities**

- 1.3.1 Generally: Provide temporary construction facilities as necessary for performance of the Work and in compliance with applicable regulatory requirements.

- .1 Maintain temporary construction facilities in good condition for the duration of the Work.
- .2 Remove temporary construction facilities from Place of the Work when no longer required.

1.3.2 Construction Parking

- .1 Provision for parking is Contractor's responsibility. Make required arrangements to provide temporary parking areas for construction personnel.
- .2 Owner will not be responsible for parking fines incurred by Contractor, Subcontractors or their employees.

1.3.3 Vehicular Access

- .1 Provide and maintain adequate access to Place of the Work.
- .2 Existing roads at Place of the Work may be used for access to Place of the Work, provided Contractor assumes responsibility for any damage caused by construction traffic, and prevents or promptly cleans up any mud tracking or material spillage.

1.3.4 Traffic Control

- .1 Do not block public roads, or impede traffic during the course of the Work, unless otherwise permitted. If necessary to temporarily block traffic, Provide and pay for trained personnel acceptable to authorities having jurisdiction to direct traffic as required.
- .2 Manage construction traffic by using designated roads and by providing trained flag persons to direct public traffic as appropriate.

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- .3 Do not block streets, walkways or allow their use for parking by construction crew or visitors except with approved specific permission from appropriate authorities and in accordance with stipulated standing regulations and restrictions.
  - 1.3.5 Site Offices
    - .1 Provide temperature controlled and ventilated office, with suitable lighting, of sufficient size to accommodate site meetings.
  - 1.3.6 Sanitary Facilities:
    - .1 Provide and maintain temporary sanitary facilities for use by workers in compliance with applicable health and safety legislation, and requirements of authorities having jurisdiction. Provide portable, weatherproof toilets, serviced at least weekly, unless noted otherwise. Keep sanitary facilities clean and fully stocked with the necessary supplies.
    - .2 Do not use newly installed or constructed permanent washroom facilities during construction.
  - 1.3.7 Temporary Fire Protection:
    - .1 Provide and maintain fire protection systems to the satisfaction of relevant authorities, the local fire department, the Consultant, the Owner, and insurance agents.
    - .2 Access and Identification: Maintain clear access routes to exits, fire line valves, hoses, and portable fire extinguishers. Ensure devices are visibly marked.
    - .3 Fire Extinguishers: Provide and maintain ULC-labeled fire extinguishers in prominent locations in accordance with requirements of authorities having jurisdiction.
    - .4 Tarpaulin Use: Only fire-resistant tarpaulins are permitted.
    - .5 Hot work: Comply with CSA W117.2.
    - .6 Flammable Materials Storage and Handling:
      - .1 Prohibit bulk storage of flammable liquids on site.
      - .2 Store flammable liquids in approved containers and keep combustibles away from the building.
      - .3 Transport and dispose of flammable materials safely.
    - .7 Fire Risk Mitigation:
      - .1 Familiarize workers with fire-fighting equipment locations and usage.
      - .2 Suspend work if fire protection deficiencies are found.
      - .3 Wet areas before and after hot work operations where feasible, or use fire-retardant materials where wetting is impractical.

- .8 Fire Watch Requirements:
  - .1 Provide continuous fire watch for each of following activities:
    - .1 open flame activities (e.g. soldering, welding and similar operations).
    - .2 shutdown of fire detection system.
    - .3 shutdown of sprinkler system.
    - .4 any other situation that Consultant may deem appropriate.
  - .2 Equip fire watchers with fire extinguishers and assign them solely to fire watch duties.
  - .3 Fire Reporting Immediately report any fire to the fire department and Consultant, regardless of whether it has been extinguished or not.

1.3.8 Elevators

- .1 Do not use newly installed permanent elevators for construction purposes.

1.3.9 Temporary Safety Signs: Install directional signs as necessary to inform the public and individuals seeking entrance to Project area. Provide safety signs in accordance with requirements of authorities having jurisdiction. Conform to CAN/CSA-Z321.

**1.4 Temporary Barriers And Enclosures**

- 1.4.1 Generally: Provide temporary barriers and enclosures necessary to protect the public and to secure Place of the Work during performance of the Work.
  - .1 Comply with applicable regulatory requirements.
  - .2 Maintain temporary barriers and enclosures in good condition for the duration of the Work.
  - .3 Remove temporary barriers and enclosures from Place of the Work when no longer required.
- 1.4.2 Fencing: Erect temporary security and safety site fencing of minimum type and height specified enclosing entire site. Maintain site fencing in good repair until removed, subject to applicable regulatory requirements.
- 1.4.3 Minimum height: Not less than 2.4 m (8 ft)
- 1.4.4 Material Specifications: chain-link fencing with privacy barriers
- 1.4.5 Access Gates: Provide lockable access gates as required to facilitate construction access.
- 1.4.6 Exterior Hoarding: Erect temporary exterior site hoarding to comply with applicable regulatory requirements. As a minimum, comply with the following:

- .1 Minimum height: Not less than 2.4 m (8 ft)
  - .2 Material Specifications:
    - .1 Use lumber framing and, minimum 19 mm thick exterior grade plywood.
    - .2 Paint public side of hoarding in colour selected by Consultant with one coat primer and two coats of exterior paint. Maintain public side of hoarding clean and in good repair until removed.
  - .3 Access Gates: Provide lockable access gates for Construction Equipment and lockable pedestrian doors as required to facilitate construction access.
  - .4 Pedestrian Walkways: Erect and maintain pedestrian walkways including roof and side covers, complete with pedestrian signage and electrical lighting.
- 1.4.7 Protection of Building Finishes
- .1 Provide necessary temporary barriers and enclosures to protect completed or partially completed finished surfaces from damage during performance of the Work.

**1.5 Temporary Controls**

- 1.5.1 Generally: Provide temporary controls as necessary for performance of the Work and in compliance with applicable regulatory requirements.
- .1 Maintain temporary controls in good condition for the duration of the Work.
  - .2 Remove temporary controls and Construction Equipment used to provide temporary controls from Place of the Work when no longer required.
- 1.5.2 Plant Protection:
- .1 Protect trees and other plant material designated to remain on site or on adjacent properties as indicated on Drawings.
  - .2 Protect trees and shrubs susceptible to damage during construction by encasing with protective wood framework from grade to height of at least 1 m, unless otherwise required by authorities having jurisdiction.
  - .3 For trees designated to remain, protect roots inside dripline from disturbance or damage during excavation and grading. Avoid traffic, dumping and storage of materials over root zones.
  - .4 Minimize stripping of topsoil and vegetation.
- 1.5.3 Dust and Particulate Control:
- .1 Implement and maintain dust and particulate control measures in accordance with applicable regulatory requirements.

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- .2 Execute Work by methods that minimize dust from construction operations and spreading of dust on site or to adjacent properties.
  - .3 Provide temporary enclosures to prevent extraneous materials resulting from sandblasting or similar operations from contaminating air beyond immediate work area.
  - .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.
  - .5 Use appropriate covers on trucks hauling fine, dusty, or loose materials.
- 1.5.4 Dewatering:
- .1 Provide temporary drainage and pumping as necessary to dewater excavations, trenches, foundations, and other parts of the Work. Maintain such areas free of water arising from groundwater or surface run-off, as required to keep them stable, dry, and protected from damage due to flooding.
  - .2 Maintain standby equipment necessary to ensure continuous operation of dewatering system.
  - .3 Do not pump water containing suspended materials or other harmful substances into waterways, sewers or surface drainage systems. Treat or dispose of such water in accordance with applicable regulatory requirements.
- 1.5.5 Site Drainage:
- .1 Maintain grades to ensure proper site drainage.
  - .2 Prevent surface water runoff from leaving the site except as otherwise provided by site grading and stormwater management plan.
  - .3 Prevent precipitation from infiltrating or from directly running off stockpiled materials. Cover stockpiled materials with an impermeable liner during periods of work stoppage including at end of each Working Day.
  - .4 Control surface drainage from cuts and fills, from borrow and waste disposal areas, from stockpiles, staging areas, and other work areas as required to prevent erosion and sedimentation.
  - .5 Control surface drainage by ensuring that gutters are kept open and water is not directed across or over pavements or sidewalks, except through pipes or properly constructed troughs. Ensure that runoff from unfinished areas is intercepted and diverted to suitable outlets.
- 1.5.6 Erosion and Sediment Control:
- .1 Minimize amount of bare soil exposed at one time. Stabilize disturbed soils as quickly as practical to minimize erosion. Remove accumulated sediment resulting from construction



activity from adjoining surfaces, drainage systems, and watercourses, and repair damage caused by soil erosion and sedimentation.

- .2 Provide and maintain appropriate temporary measures such as silt fences, straw bales, ditches, geotextiles, drains, berms, terracing, riprap, temporary drainage piping, sedimentation basins, vegetative cover, dikes, and other measures that may be required to prevent erosion and migration of silt, mud, sediment, and other debris.
- .3 Do not disturb existing embankments or embankment protection.
- .4 Periodically inspect erosion and sediment control measures to detect evidence of erosion and sedimentation. Promptly take corrective measures when necessary.
- .5 If soil and debris from site accumulate in ditches or other low areas, remove accumulation and restore area to original condition.

1.5.7 Pollution Control:

- .1 Take measures to prevent contamination of soil, water, and atmosphere through uncontrolled discharge of noxious or toxic substances and other pollutants, potentially causing environmental damage.
- .2 Be prepared, by maintaining appropriate materials, equipment, and trained personnel on site, to intercept, clean up, and dispose of spills or releases that may occur. Promptly report spills and releases that may occur to:
  - .1 authority having jurisdiction,
  - .2 person causing or having control of pollution source, if known, and
  - .3 Owner and Consultant.
- .3 Contact manufacturer of pollutant, if known and applicable, to obtain safety data sheets (SDS) and ascertain hazards involved and precautions and measures required in cleanup or mitigating actions.
- .4 Take immediate action to contain and mitigate harmful effects of the spill or release.

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2 . PRODUCTS

2.1 Not Used

3 . EXECUTION

3.1 Not Used

END OF SECTION

## **1. GENERAL**

### **1.1 General**

- 1.1.1 Provide Products that are not damaged or defective, and suitable for purpose intended, subject to specified requirements. If requested by Consultant, furnish evidence as to type, source and quality of Products provided.
- 1.1.2 Unless otherwise specified, maintain uniformity of manufacture for like items throughout.
- 1.1.3 Permanent manufacturer's markings, labels, trademarks, and nameplates on Products are not acceptable in prominent locations, except where required by regulatory requirements or for operating instructions, or when located in mechanical or electrical rooms.

### **1.2 Product Options**

- 1.2.1 Subject to the provisions of Section 01 25 00 – Substitution Procedures:
  - .1 Wherever a Product or manufacturer is specified by a single proprietary name, provide the named Product only.
  - .2 Wherever more than one Product or manufacturer is specified by proprietary name for a single application, provide any one of the named Products.
- 1.2.2 Wherever a Product is specified by reference to a standard only, provide any Product that meets or exceeds the specified standard. If requested by Consultant, submit information verifying that the proposed Product meets or exceeds the specified standard.
- 1.2.3 Wherever a Product is specified by descriptive or performance requirements only, provide any Product that meets or exceeds the specified requirements. If requested by Consultant, submit information verifying that the proposed Product meets or exceeds the specified requirements.

### **1.3 Product Ingredient Disclosure And Environmental Transparency**

- 1.3.1 Environmental Product Declarations (EPD): When available, submit Product-specific Type III EPD or industry-wide (generic) EPD conforming to ISO 14025 or other recognized environmental product declaration framework.
- 1.3.2 Material Ingredient Reporting: When available, submit documentation demonstrating chemical inventory of materials to at least 0.1% (1000ppm) and conforming to one of the following:
- 1.3.3 Health Product Declaration open Standard,

- 1.3.4 Cradle to Cradle v2 Basic level or Cradle to Cradle v3 Bronze level,
- 1.3.5 International Living Future Institute Declare
- 1.3.6 Other approved framework.
- 1.3.7 When multiple Products are specified, give preference to Products with compliant documentation.

**1.4 Product Availability And Delivery Times**

- 1.4.1 Promptly upon Contract award and periodically during construction, review and confirm Product availability and delivery times. Order Products in sufficient time to meet the construction progress schedule and the Contract Time.
- 1.4.2 If a specified Product is no longer available, promptly notify Consultant. Consultant will take action as required.
- 1.4.3 If delivery delays are foreseeable, for any reason, promptly notify Consultant.
  - .1 If a delivery delay is beyond Contractor's control, Consultant will provide direction.
  - .2 If a delivery delay is caused by something that was or is within Contractor's control, Contractor shall propose actions to maintain the construction progress schedule for Consultant's review and acceptance.

**1.5 Storage, Handling, And Protection**

- 1.5.1 Store, handle, and protect Products during transportation to Place of the Work and before, during, and after installation in a manner to prevent damage, adulteration, deterioration and soiling.
- 1.5.2 Comply with manufacturer's instructions for storage, handling and protection.
- 1.5.3 Store packaged or bundled Products in original and undamaged condition with manufacturer's seals and labels intact. Do not remove from packaging or bundling until required in Work.
- 1.5.4 Comply with the requirements of the workplace hazardous materials information system (WHMIS) regarding use, handling, storage, and disposal of hazardous materials, including requirements for labeling and the provision of material safety data sheets (MSDS).
- 1.5.5 Store Products subject to damage from weather in weatherproof enclosures.
- 1.5.6 Store sheet Products on flat, solid, supports and keep clear of ground. Slope to shed moisture.
- 1.5.7 Remove and replace damaged Products.

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**1.6     Indoor Air Quality**

- 1.6.1 Select Products for use in the Work that affect indoor air quality as little as possible. Provide adequate ventilation during installation of finishing materials to avoid deleterious effects on indoor air quality. Specifically, select Products for installation within air-handling and distribution systems to minimize the introduction of pollutants into building's fresh air supply.
- 1.6.2 Choose odourless Products wherever possible. Where odourless Products are not available, provide additional ventilation during construction period to encourage off-gassing of materials to their minimum levels prior to occupancy of building.
- 1.6.3 Products and materials incorporated in the Work must be as free as possible of VOCs and emissions. Products emitting benzene, mercury, lead, or other known toxic compounds are not permitted.
- 1.6.4 Adhesives, sealants, paints and coatings applied on site and used in the building's interior must be tested and determined compliant in accordance with California Department of Public Health (CDPH) Standard Method v1.2–2017, using the applicable exposure scenario.
- 1.6.5 In addition to emissions criteria specified above, adhesives, sealants, paints and coatings applied on site and used in the building's interior must meet VOC limits established by authorities having jurisdiction and following VOC content limits:
  - .1 Paints and Coatings:
    - .1 Flat Paints and Coatings: 50 g/L.
    - .2 Nonflat Paints and Coatings: 50 g/L.
    - .3 Dry-Fog Coatings: 150 g/L.
    - .4 Primers, Sealers, and Undercoaters: 100 g/L.
    - .5 Rust-Preventive Coatings: 100 g/L.
    - .6 Zinc-Rich Industrial Maintenance Primers: 100 g/L.
    - .7 Pretreatment Wash Primers: 420 g/L.
    - .8 Clear Wood Finishes, Varnishes: 275 g/L.
    - .9 Clear Wood Finishes, Lacquers: 275 g/L.
    - .10 Floor Coatings: 50 g/L.
    - .11 Shellacs, Clear: 730 g/L.
    - .12 Shellacs, Pigmented: 550 g/L.
    - .13 Stains: 100 g/L.
  - .2 Adhesives and Sealants:
    - .1 Wood Glues: 30 g/L.

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- .2 Metal-to-Metal Adhesives: 30 g/L.
  - .3 Adhesives for Porous Materials (Except Wood): 50 g/L.
  - .4 Subfloor Adhesives: 50 g/L.
  - .5 Plastic Foam Adhesives: 50 g/L.
  - .6 Carpet Adhesives: 50 g/L.
  - .7 Carpet Pad Adhesives: 50 g/L.
  - .8 VCT and Asphalt Tile Adhesives: 50 g/L.
  - .9 Cove Base Adhesives: 50 g/L.
  - .10 Gypsum Board and Panel Adhesives: 50 g/L.
  - .11 Rubber Floor Adhesives: 60 g/L.
  - .12 Ceramic Tile Adhesives: 65 g/L.
  - .13 Multipurpose Construction Adhesives: 70 g/L.
  - .14 Fiberglass Adhesives: 80 g/L.
  - .15 Contact Adhesive: 80 g/L.
  - .16 Structural Glazing Adhesives: 100 g/L.
  - .17 Wood Flooring Adhesive: 100 g/L.
  - .18 Structural Wood Member Adhesive: 140 g/L.
  - .19 Special-Purpose Contact Adhesive (Used to Bond Melamine-Covered Board, Metal, Unsupported Vinyl, Rubber, or Wood Veneer 1/16 Inch or Less in Thickness to Any Surface): 250 g/L.
  - .20 Top and Trim Adhesive: 250 g/L.
  - .21 Plastic Cement Welding Compounds: 250 g/L.
  - .22 ABS Welding Compounds: 325 g/L.
  - .23 CPVC Welding Compounds: 490 g/L.
  - .24 PVC Welding Compounds: 510 g/L.
  - .25 Adhesive Primer for Plastic: 550 g/L.
  - .26 Sheet-Applied Rubber Lining Adhesive: 850 g/L.
  - .27 Aerosol Adhesive, General-Purpose Mist Spray: 65 percent by weight.
  - .28 Aerosol Adhesive, General-Purpose Web Spray: 55 percent by weight.
  - .29 Special-Purpose Aerosol Adhesive (All Types): 70 percent by weight.
  - .30 Other Adhesives: 250 g/L.
  - .31 Architectural Sealants: 250 g/L.

- .32 Sealant Primers for Nonporous Substrates: 250 g/L.
  - .33 Sealant Primers for Porous Substrates: 775 g/L.
  - .34 Modified Bituminous Sealant Primers: 500 g/L.
  - .35 Other Sealant Primers: 750 g/L.
- 1.6.6 Install HVAC system filtration media in accordance with Mechanical Specifications. Ensure that the filtration media efficiency meets the specified minimum requirements. If Mechanical Specifications do not specify minimum filtration media efficiency, use filters with Minimum Efficiency Reporting Value (MERV) of 13 or better. If system cannot accommodate MERV 13 due to functional requirements, use highest MERV rating possible acceptable for the system.
- 1.6.7 Take measures to prevent entry of dust into HVAC system throughout construction phase.
- 1.6.8 Consider using electrically powered equipment on-site in lieu of gas or propane powered equipment to reduce possibility of carbon monoxide sickness and odours of gas or propane spreading throughout building.

## **2 . PRODUCTS**

### **2.1 Not Used**

## **3 . EXECUTION**

### **3.1 Not Used**

END OF SECTION

**1 . GENERAL**

**1.1 Submittals**

- 1.1.1 Submit name and address of registered land surveyor performing survey work.
- 1.1.2 Submit to Owner and Consultant the survey of the Work prepared and issued by a registered land surveyor on completion of the building footings and foundations, as required by authorities having jurisdiction, and on completion of the Work.

**1.2 Survey Reference Points**

- 1.2.1 Locate and confirm permanent reference points prior to starting site work. Preserve and protect permanent reference points on site during construction.
- 1.2.2 Do not change or relocate reference points without prior written notice to Consultant.
- 1.2.3 Report to Consultant when a reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations. Require registered land surveyor to replace reference points in accordance with original survey.

**1.3 Survey Requirements**

- 1.3.1 Establish sufficient permanent benchmarks on site, referenced to established benchmarks by survey control points.
- 1.3.2 Confirm that existing survey reference points are in accordance with Owner's survey and property limits.
- 1.3.3 Establish initial lines and levels for building layout.
- 1.3.4 Maintain a complete, accurate log of control and survey work as it progresses. Record locations with horizontal and vertical data in project record documents.

**1.4 Existing Utilities And Structures**

- 1.4.1 Before commencing excavation, drilling or other earthwork, establish or confirm location and extent of all existing underground utilities and structures in work area.
- 1.4.2 Promptly notify Consultant if underground utilities, structures, or their locations differ from those indicated in Contract Documents or in available project information. Consultant will provide appropriate direction.



- 1.4.3 Record locations of maintained, re-routed and abandoned utility lines.

**1.5 Verification Of Existing Conditions**

- 1.5.1 Where work specified in any Section is dependent on the work of another Section or Sections having been properly completed, verify that work is complete and in a condition suitable to receive the subsequent work. Commencement of work of a Section that is dependent on the work of another Section or Sections having been properly completed, means acceptance of the existing conditions.
- 1.5.2 Verify that ambient conditions are suitable before commencing the work of any Section and will remain suitable for as long as required for proper setting, curing, or drying of Products used.
- 1.5.3 Ensure that substrate surfaces are clean, dimensionally stable, cured and free of contaminants.
- 1.5.4 Notify Consultant in writing of unacceptable conditions.

**2 . PRODUCTS**

**2.1 Not Used**

**3 . EXECUTION**

**3.1 Not Used**

END OF SECTION

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**1. GENERAL**

**1.1 Summary**

- 1.1.1 Except where otherwise specified in technical Specifications or otherwise indicated on Drawings, comply with requirements of this Section.

**1.2 Manufacturer's Instructions**

- 1.2.1 Install, erect, or apply Products in strict accordance with manufacturer's instructions.
- 1.2.2 Notify Consultant, in writing, of conflicts between Contract Documents and manufacturer's instructions where, in Contractor's opinion, conformance with Contract Documents instead of the manufacturer's instructions may be detrimental to the Work or may jeopardize the manufacturer's warranty.
- 1.2.3 Do not rely on labels or enclosures provided with Products. Obtain written instructions directly from manufacturers.
- 1.2.4 Provide manufacturer's representatives with access to the Work at all times. Render assistance and facilities for such access so that manufacturer's representatives may properly perform their responsibilities.

**1.3 Concealment**

- 1.3.1 Conceal pipes, ducts, and wiring in floors, walls and ceilings in finished areas:
- .1 after review by Consultant and authority having jurisdiction, and
  - .2 where locations differ from those shown on Drawings, after recording actual locations on as-built drawings.
- 1.3.2 Provide incidental furring or other enclosures as required.
- 1.3.3 Notify Consultant in writing of interferences before installation.

**1.4 Fastenings - General**

- 1.4.1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials.
- 1.4.2 Prevent electrolytic action and corrosion between dissimilar metals and materials by using suitable non-metallic strips, washers, sleeves, or other permanent separators to avoid direct contact.
- 1.4.3 Use non-corrosive fasteners and anchors for securing exterior work and in spaces where high humidity levels are anticipated.

- 1.4.4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage.
- 1.4.5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- 1.4.6 Do not use fastenings or fastening methods that may cause spalling or cracking of material to which anchorage is made.

**1.5 Fastenings - Equipment**

- 1.5.1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- 1.5.2 Bolts shall not project more than one diameter beyond nuts.

**1.6 Fire Rated Assemblies**

- 1.6.1 When penetrating fire rated walls, ceiling, or floor assemblies, completely seal voids with fire-stopping materials, smoke seals, or both, in full thickness of the construction element as required to maintain the integrity of the fire rated assembly.

**1.7 Location Of Fixtures, Outlets And Devices**

- 1.7.1 Consider location of fixtures, outlets, and devices indicated on Drawings as approximate.
- 1.7.2 Locate fixtures, outlets, and devices to provide minimum interference, maximum usable space, and as required to meet safety, access, maintenance, acoustic, and regulatory, including barrier free, requirements.
- 1.7.3 Promptly notify Consultant in writing of conflicting installation requirements for fixtures, outlets, and devices. If requested, indicate proposed locations and obtain approval for actual locations.

**1.8 Protection Of Completed Work And Work In Progress**

- 1.8.1 Adequately protect parts of the Work completed and in progress from any kind of damage.
- 1.8.2 Promptly remove, replace, clean, or repair, as directed by Consultant, work damaged as a result of inadequate protection.
- 1.8.3 Do not load or permit to be loaded any part of the Work with a weight or force that will endanger the safety or integrity of the Work.

**1.9 Remedial Work**

- 1.9.1 Notify Consultant of, and perform remedial work required to, repair or replace defective or unacceptable work. Ensure that properly qualified workers perform remedial work. Coordinate adjacent affected work as required.

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2 . PRODUCTS

2.1 Not Used

3 . EXECUTION

3.1 Not Used

END OF SECTION

**1 . GENERAL**

**1.1 Request For Cutting, Patching And Remedial Work**

- 1.1.1 Submit written request in advance of cutting, coring, or alteration which affects or is likely to affect:
  - .1 Structural integrity of any element of the Work.
  - .2 Integrity of weather-exposed or moisture-resistant elements.
  - .3 Efficiency, maintenance, or safety of any operational element.
  - .4 Visual qualities of sight-exposed elements.
  - .5 Work of Owner or other contractors.
  - .6 Warranty of Products affected.
- 1.1.2 Include in request:
  - .1 Identification of Project.
  - .2 Location and description of affected work, including drawings or sketches as required.
  - .3 Statement on necessity for cutting or alteration.
  - .4 Description of proposed work, and Products to be used.
  - .5 Alternatives to cutting and patching.
  - .6 Effect on work of Owner or other contractors.
  - .7 Written permission of affected other contractors.
  - .8 Date and time work will be executed.

**1.2 Products**

- 1.2.1 Unless otherwise specified, when replacing existing or previously installed Products in the course of cutting and patching work, use replacement Products of the same character and quality as those being replaced.
- 1.2.2 If an existing or previously installed Product must be replaced with a different Product, submit request for substitution in accordance with Section 01 25 00 - Substitution Procedures.

**1.3 Preparation**

- 1.3.1 Inspect existing conditions in accordance with Section 01 71 00 - Examination and Preparation.
- 1.3.2 Provide supports to ensure structural integrity of surroundings; provide devices and methods to protect other portions of the Work from damage.
- 1.3.3 Provide protection from elements for areas that may be exposed by uncovering work.

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**1.4     Existing Utilities**

- 1.4.1 When breaking into or connecting to existing services' utilities, execute the Work at times directed by local governing authorities, with a minimum of disturbance to the Work, pedestrian and vehicular traffic, and ongoing Owner operations.
- 1.4.2 Where the Work involves breaking into or connecting to existing services, give authority having jurisdiction and Owner at least 48 hours notice for necessary interruption of mechanical or electrical services.
- 1.4.3 Maintain excavations free of water.
- 1.4.4 Keep duration of interruptions to a minimum.
- 1.4.5 Carry out interruptions after regular working hours of occupants, preferably on weekends, unless Owner's prior written approval is obtained.
- 1.4.6 Protect and maintain existing active services. Record location of services, including depth, on as-built drawings.
- 1.4.7 Construct or erect barriers in accordance with Section 01 50 00 – Temporary Facilities and Controls as required to protect pedestrian and vehicular traffic.

**1.5     Cutting, Patching, And Remedial Work**

- 1.5.1 Coordinate and perform the Work to ensure that cutting and patching work is kept to a minimum.
- 1.5.2 Perform cutting, fitting, patching, and remedial work including any required excavation and fill, to make the affected parts of the Work come together properly and complete the Work.
- 1.5.3 Provide openings in non-structural elements of the Work for penetrations of mechanical and electrical work.
- 1.5.4 Perform cutting by methods to avoid damage to other work
- 1.5.5 Provide proper surfaces to receive patching, remedial work, and finishing.
- 1.5.6 Perform cutting, patching, and remedial work using competent and qualified specialists familiar with the Products affected, in a manner that neither damages nor endangers the Work.
- 1.5.7 Do not use pneumatic or impact tools without Consultant's prior approval.
- 1.5.8 Ensure that cutting, patching, and remedial work does not jeopardize manufacturers' warranties.
- 1.5.9 Refinish surfaces to match adjacent finishes. For continuous surfaces refinish to nearest intersection. For an assembly, refinish entire unit.

- 1.5.10 Fit work to pipes, sleeves, ducts, conduit, and other penetrations through surfaces with suitable allowance for deflection, expansion, contraction, acoustic isolation, and firestopping.
- 1.5.11 Maintain fire ratings of fire rated assemblies where cutting, patching, or remedial work is performed. Completely seal voids or penetrations of assembly with firestopping material to full depth or with suitably rated devices.

## **2 . PRODUCTS**

### **2.1 Not Used**

## **3 . EXECUTION**

### **3.1 Not Used**

END OF SECTION

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**1. GENERAL**

**1.1 Regulatory Requirements**

- 1.1.1 Comply with applicable regulatory requirements when disposing of waste materials.
- 1.1.2 Obtain permits from authorities having jurisdiction and pay disposal fees where required for disposal of waste materials and recyclables.

**1.2 General Cleaning Requirements**

- 1.2.1 Provide adequate ventilation during use of volatile or noxious substances. Do not rely on building ventilation systems for this purpose.
- 1.2.2 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- 1.2.3 Prevent cross-contamination during the cleaning process.
- 1.2.4 Notify the Consultant of the need for cleaning caused by Owner or other contractors.

**1.3 Progressive Cleaning And Waste Management**

- 1.3.1 Maintain the Work in a tidy and safe condition, free from accumulation of waste materials and construction debris.
- 1.3.2 Provide appropriate, clearly marked, containers for collection of waste materials and recyclables.
- 1.3.3 Remove waste materials and recyclables from work areas, separate, and deposit in designated containers at end of each Working Day. Collect packaging materials for recycling or reuse.
- 1.3.4 Remove waste materials and recyclables from Place of the Work at least daily.
- 1.3.5 Clean interior building areas prior to start of finish work and maintain free of dust and other contaminants during finishing operations.
- 1.3.6 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly finished surfaces nor contaminate building systems.
- 1.3.7 Clear snow and ice from public sidewalks as required to comply with applicable municipal regulatory requirements.



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**1.4 Final Cleaning**

- 1.4.1 Before final cleaning, arrange a meeting at Place of the Work to determine the acceptable standard of cleaning. Ensure that Owner, Consultant, Contractor and cleaning company are in attendance.
- 1.4.2 Remove from Place of the Work surplus Products, waste materials, recyclables, Temporary Work, and Construction Equipment not required to perform any remaining work.
- 1.4.3 Provide professional cleaning by a qualified, established cleaning company.
- 1.4.4 Lock or otherwise restrict access to each room or area after completing final cleaning in that area.
- 1.4.5 Re-clean as necessary areas that have been accessed by Contractor's workers prior to Owner occupancy.
- 1.4.6 Remove stains, spots, marks, and dirt from finished surfaces, electrical and mechanical fixtures, furniture fitments, walls, and floors.
- 1.4.7 Clean and polish finishes and equipment, including but not limited to glass, mirrors, hardware, tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and other finished surfaces, as well as mechanical and electrical fixtures. Replace broken, scratched, or otherwise damaged glass.
- 1.4.8 Remove dust from lighting reflectors, lenses, lamps, bulbs, and other lighting surfaces.
- 1.4.9 Vacuum clean and dust exposed wall, floor, and ceiling surfaces, behind grilles, louvres and screens, above suspended ceiling tiles.
- 1.4.10 Clean mechanical, electrical, and other equipment. Replace filters for mechanical equipment if equipment is used during construction.
- 1.4.11 Remove waste material and debris from crawlspaces and other accessible concealed spaces.
- 1.4.12 Remove stains, spots, marks, and dirt from exterior facades.
- 1.4.13 Clean and sweep roofs, clear roof drains, and clean gutters and downspouts.
- 1.4.14 Clean exterior sidewalks, steps, driveways, roads, and other paved surfaces as applicable. Remove snow and ice if required.
- 1.4.15 Use leaf blowers to clean landscaped surfaces.

**1.5 Waste Management And Disposal**

- 1.5.1 Dispose of waste materials and recyclables at appropriate municipal landfills and recycling facilities in accordance with applicable regulatory requirements.
- 1.5.2 Do not burn or bury waste materials at Place of the Work.

- 1.5.3 Do not dispose of volatile and other liquid waste such as mineral spirits, oil, paints and other coating materials, paint thinners, cleaners, and similar materials together with dry waste materials or on the ground, in waterways, or in storm or sanitary sewers. Collect such waste materials in appropriate covered containers, promptly remove from Place of the Work, and dispose of at recycling facilities or as otherwise permitted by applicable regulatory requirements.
- 1.5.4 Cover or wet down dry waste materials to prevent blowing dust and debris.

## **2 . PRODUCTS**

### **2.1 Not Used**

## **3 . EXECUTION**

### **3.1 Not Used**

END OF SECTION

## **1. GENERAL**

### **1.1 Summary**

- 1.1.1 Purpose of Section: Section details integrated testing of fire protection and life safety systems in accordance with OBC and CAN/ULC S1001 to verify performance and interconnectivity of integrated systems to ensure they function cohesively in emergency situations.
- .1 Scope of Section is limited to testing of interconnections between life safety and/or fire protection systems as required by OBC Division B, Subsection "Integrated Fire Protection and Life Safety Systems". Refer to technical Specification Sections for individual testing and commissioning requirements for systems.
- 1.1.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

### **1.2 Definitions**

- 1.2.1 Commissioning: Owner-driven process ensuring that all building systems and components operate according to project requirements and construction documents.
- 1.2.2 Integrated Systems Testing: a code requirement specifically for fire protection and life safety systems to verify and document their interconnections and operational performance in accordance with design criteria.
- 1.2.3 FPLS: Fire Protection and Life Safety.

### **1.3 Preinstallation Meetings**

- 1.3.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.
- 1.3.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
- .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.
- .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.
- .3 Agenda:

- .1 Review progress of related construction activities and preparations for particular activity under consideration.
- .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
- .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
- .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

**1.4      Coordination**

- 1.4.1 Collaborate with Subcontractors responsible for equipment or systems subject to testing under this Section, to ensure comprehensive testing and documentation of interface and integration between various fire protection and life safety systems provided under those divisions.

**1.5      Submittals**

- 1.5.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.5.2 Proposed Integrated Testing Plan: Submit detailed test plan prepared by Integrated Testing Coordinator and complying with CAN/ULC S1001, highlighting testing protocols, schedules, and identifying involved parties. As a minimum, integrated testing plan must include:
  - .1 Functional objectives of system integrations
  - .2 Sequence of operations – normal and off-normal
  - .3 Test protocol and procedures
  - .4 Procedure for notifying building occupants.
  - .5 Alternative measures – notifications and safety protocols for ensuring occupant safety during testing.
  - .6 Phased occupancy requirements, where applicable.
  - .7 Where required, submit testing plan to Authorities Having Jurisdiction for review.
- 1.5.3 Pre-Testing Confirmation: Submit confirmation from design professionals and installing contractors indicating that systems are installed correctly and functional.
  - .1 Where required, sufficient notification to Authorities Having Jurisdiction to witness integrated systems testing.

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**1.6 Closeout Submittals**

- 1.6.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.
- 1.6.2 Final Integrated Systems Testing Report:
  - .1 Submit documentation providing results of implementation of integrated testing plan final in accordance with section 7 of CAN/ULC-S1001. Report must include:
    - .1 Integrated testing plan,
    - .2 Completed initial integration testing forms with test results,
    - .3 Re-test integration testing forms, if necessary,
    - .4 Pre-integration testing verification documentation for relevant systems.
  - .2 Distribute copies of the final report as follows:
    - .1 One copy to each relevant authority having jurisdiction,
    - .2 One copy to Consultant,
    - .3 One copy to Owner.

**1.7 Quality Assurance**

- 1.7.1 Integrated Testing Coordinator: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that indicated, and whose work has resulted in construction with a track record of successful in-service performance.
  - .1 Integrated Testing Coordinator must be a knowledgeable and experienced individual, firm, corporation, or organization responsible for developing and implementing the integrated testing plan. Where a firm, corporation, or organization is responsible for integrated fire protection and life safety systems testing, a representative of that firm, corporation, or organization shall be designated as the integrated testing coordinator.

**1.8 Preparation Of Integrated Testing Plan**

- 1.8.1 Develop integrated test plan as described in section 5 of CAN/ULC-S1001.
- 1.8.2 Collaborate with relevant Consultants to obtain necessary design performance criteria for integrating fire protection and life safety systems. This includes, but is not limited to :
  - .1 building floor plans,
  - .2 details of control sequences for different systems,

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- .3 mechanical and electrical riser diagrams, if relevant,
  - .4 operating and testing instructions from the trade contractors involved,
  - .5 alternative solutions to prescribed requirements of OBC or standards from the relevant Consultant.
- 1.8.3 Develop integrated testing plan to include, but not be limited to, following:
- .1 Objectives for the functionality of system integrations,
  - .2 Operational sequence for the integrated elements of the fire protection and life safety systems, including:
    - .1 Normal operating conditions,
    - .2 Fire condition operations,
    - .3 Procedures for informing occupants about the testing of integrated systems,
  - .3 Safety management protocols, including safety guidelines and notifications, to ensure the safety of occupants and workers during system testing,
  - .4 For phased building testing, include additional procedures for:
    - .1 Testing each area of the building at different times for staged occupancy permits,
    - .2 Final testing of whole building once phased areas are complete, including scenarios where areas may be occupied concurrently.
  - .5 Append test procedures for each system-to-system integration as separate sections or as appendix.
  - .6 Provide workflow diagram in test plan to depict system dependencies, clearly showing sequence and relationships between different systems.
  - .7 Provide testing schedule with overall construction schedule, marking important dates for potential participation of parties in witnessing tests.
  - .8 Present initial draft of test plan to Consultant(s) for review. Following feedback and necessary revisions, submit revised draft to Authority Having Jurisdiction.
  - .9 In case of design changes in fire protection and life safety equipment or systems affecting integration, revise integrated test plan accordingly and submit for Consultant review before implementation.

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**1.9     Testing Procedures**

- 1.9.1 Develop test procedures and test forms in accordance with requirements of section 6 and section 7 of CAN/ULC-S1001 and as specified herein or in technical specifications.
- 1.9.2 Testing must include functional objectives of system integrations and sequence of operations under normal and off-normal conditions in accordance with CAN/ULC S1001.
- 1.9.3 Use simulations for tests for non-restorable systems or situations where actual testing could be hazardous.

**1.10    Execution**

- 1.10.1 Execute integrated testing program according to sections 6 and 7 of CAN/ULC-S1001.
- 1.10.2 Prior to starting tests, ensure necessary documentation for installation verification, acceptance testing, notifications, and required inspections by authorities of individual life safety equipment and systems are in place.
- 1.10.3 Notify relevant authorities having jurisdiction about testing schedule and invite them to participate or witness tests.
- 1.10.4 Employ temporary installation measures needed for testing. Maintain log detailing each temporary measure, its installation date, and specific integration test it is meant to support.
- 1.10.5 Planning Phase:
  - .1 Installing Subcontractors for each integrated system to submit documents detailing integration performance of systems.
  - .2 Identified deficiencies are to be documented and forwarded to respective installing Subcontractors for resolution.
- 1.10.6 Implementation Phase:
  - .1 Execute test protocol and procedures as established in planning phase.
  - .2 Ensure procedure for notifying building occupants is in place, considering alternative measures for occupant safety during testing.
  - .3 Consider phased occupancy plans and safety of personnel during testing, as applicable.
- 1.10.7 Pre-Testing Requirements: Prior to actual integrated systems testing, complete following pre-testing steps:
  - .1 Obtain written confirmation from installing Subcontractors that they acceptance testing and integrity of installation is confirmed.
  - .2 Secure confirmation from installing contractors regarding correct installation of systems.

- .3 Establish and document occupant notification procedures.
- .4 Provide sufficient notification to authorities having jurisdiction to witness integrated systems testing, where required.

1.10.8 Sequence of Testing Events

- .1 Ensure sequence of testing events aligns with integrated testing plan developed during planning phase.
- .2 Start with functional testing of individual systems to ensure their independent operability.
- .3 Proceed to integrated system tests, where interoperation and collective response of systems to various scenarios is to be verified.
- .4 In event of test failure, initiate corrective measures and re-test affected systems until compliance is achieved.

**1.11 Adjusting**

- 1.11.1 Restore systems to standard operational state after successful integrated testing. If temporary measures were used, remove such measures and update log to record removal date. Include log in final test report.

**1.12 Demonstration And Training**

- 1.12.1 Train Owner's maintenance personnel to adjust, operate, and maintain life safety systems integration. Demonstration and training must include:
- .1 Function of integration,
  - .2 Integration method – whether hardwired, network communication, or operating protocols,
  - .3 Type of information – data, commands, monitoring,
  - .4 Temporary measures for future retesting.

**1.13 Schedule Of Integrated Systems Testing**

- 1.13.1 Applicable portions of the Work subject to testing include, but are not limited to:
- .1 Division 08 - Openings
    - .1 Electromagnetic Locking Devices
    - .2 Door hold-open devices
    - .3 Automatic Fire Shutters
  - .2 Division 14 - Conveying Equipment
    - .1 Elevators
    - .2 Emergency Elevators
  - .3 Division 11 - Equipment



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- .1 Dust Collection Systems
  - .2 Spark Arrest Systems.
  - .4 Division 21 - Fire Suppression
    - .1 Sprinkler Systems
    - .2 Standpipe Systems
    - .3 Fire Pumps
    - .4 Water Supply Control Valves
    - .5 Freeze Protection Systems
    - .6 Fixed Fire Suppression Systems
    - .7 Cooking Equipment Fire Suppression Systems
  - .5 Division 22 - Plumbing
    - .1 Water Supply
  - .6 Division 23 - Heating, Ventilating, and Air Conditioning (HVAC)
    - .1 Smoke dampers,
    - .2 Motorized fire dampers,
    - .3 Smoke Control Pressurization Systems
    - .4 Smoke Control Smoke Exhaust Systems
    - .5 Freeze protection systems (for water-based fire protection piping)
  - .7 Division 25 - Integrated Automation
    - .1 Building Automation System
  - .8 Division 26 – Electrical
    - .1 Emergency power distribution systems.
    - .2 Emergency lighting control systems.
  - .9 Division 27 - Communications
    - .1 Audio/Visual Control System
  - .10 Division 28 - Electronic Safety and Security
    - .1 Fire Alarm System (including sequence of operation)
    - .2 Smoke alarm systems
    - .3 Security systems
    - .4 Notification systems,
    - .5 Hazardous protection monitoring.

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2 . PRODUCTS

2.1 Not Used

3 . EXECUTION

3.1 Not Used

END OF SECTION

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**1. GENERAL**

**1.1 Summary**

- 1.1.1 Purpose of Section: Section specifies administrative procedures for contract closeout.
- 1.1.2 Read in conjunction with: CCDC 2-2020, Part 12, Owner Takeover and Supplementary Conditions.

**1.2 Ready-For-Takeover**

- 1.2.1 The prerequisites to attaining Ready-for-Takeover of the Work are described in the General Conditions of the Contract.

**1.3 Inspection And Review Before Ready-For-Takeover**

- 1.3.1 Contractor's Inspection: Before applying for the Consultant's review to establish Ready-for-Takeover of the Work:
  - .1 Ensure that the specified prerequisites to Ready-for-Takeover of the Work are completed.
  - .2 Conduct an inspection of the Work to identify defective, deficient, or incomplete work.
  - .3 Prepare a comprehensive and detailed list of items to be completed or corrected.
  - .4 Provide an anticipated schedule and costs for items to be completed or corrected.
- 1.3.2 Consultant's Review: Upon receipt of the Contractor's application for review, together with the Contractor's list of items to be completed or corrected, the Consultant will review the Work. The Consultant will advise the Contractor whether or not the Work is Ready-for-Takeover and will provide the Contractor with a list of items, if any, to be added to the Contractor's list of items to be completed or corrected. Provide the Consultant with a copy of the Contractor's revised list.
- 1.3.3 Consultant's Review: Upon receipt of the Contractor's application for review, together with the Contractor's list of items to be completed or corrected, the Consultant and the Contractor shall arrange a mutually satisfactory agreed date and time to jointly review the Work. The Consultant will advise the Contractor whether or not the Work is Ready-for-Takeover. Add additional items, if any, to the Contractor's list of items to be completed or corrected. Provide the Consultant with a copy of the revised list.
- 1.3.4 Maintain the list of items to be completed or corrected and promptly correct or complete defective, deficient and incomplete work. The

Contractor's inspection and Consultant's review procedures specified above shall be repeated until the Work is Ready-for-Takeover and no items remain on the Contractor's list of items to be completed or corrected.

- 1.3.5 When the Consultant determines that the Work is Ready-for-Takeover, the Consultant will notify the Contractor and the Owner in writing to that effect.

**1.4 Prerequisites To Final Payment**

- 1.4.1 After Ready-for-Takeover of the Work and before submitting an application for final payment in accordance with the General Conditions of Contract:

- .1 Correct or complete all remaining defective, deficient, and incomplete work.
- .2 Remove from the Place of the Work all remaining surplus Products, Construction Equipment, and Temporary Work.
- .3 Perform final cleaning and waste removal necessitated by the Contractor's work performed after Ready-for-Takeover, as specified in Section 01 74 00 – Cleaning and Waste Management.

**1.5 Partial Owner Occupancy**

- 1.5.1 Owner reserves right to occupy and use portions of premises, whether partially or entirely completed, or whether completed on schedule or not, Provided such occupancy does not interfere with Contractor's continuing the Work. Partial occupancy or installation of equipment by Owner does not imply acceptance of the Work in whole or in part, nor shall it imply acknowledgment that terms of Contract are fulfilled.
- 1.5.2 If partial Owner occupancy of a part of the Work is required before the date of Ready-for-Takeover of the entire Work of the Contract, the provisions of this Section shall apply, to the extent applicable, to that part of the Work that the Owner intends to occupy.

**1.6 Substantial Performance Of The Work**

- 1.6.1 The prerequisites to, and the procedures for, attaining substantial performance of the Work, or similar such milestone as provided for in the The Construction Act, shall be:
- .1 independent of those for attaining Ready-for-Takeover of the Work, and
  - .2 in accordance with the The Construction Act.
- 1.6.2 Procedures: Comply with requirements of The Construction Act and generally with the following:

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- .1 Notification: Provide written notice to Owner and Consultant at least 60 days in advance of anticipated date of Substantial Performance of the Work.
  - .2 Contractor Self-Inspection: conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents. Notify Consultant in writing of satisfactory completion of Contractor's inspection and submit verification that corrections have been made. Request Consultant's inspection.
  - .3 Consultant / Contractor Joint Inspection: Consultant and Contractor will inspect Work and identify defects and deficiencies and record such deficiencies on a deficiency list. Contractor must correct Work as directed.
  - .4 Deficiency List Submission: Prepare and submit a list of items that have been completed and items that remain to be corrected indicating value of each item on list and reasons why the Work is incomplete.
  - .5 Submittals Prior to Substantial Performance: Verify contractual requirements for Substantial Performance certification and submit necessary documents at least 10 days prior to established date for Substantial Performance. As a minimum, the following must be submitted:
    - .1 Certificates from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar documentation.
    - .2 Closeout submittals specified in Section 01 78 00, including operation and maintenance manuals necessary for immediate operation and maintenance of the Work.
    - .3 Copy of as-built Drawings completed to date.
    - .4 Testing, adjusting, and balancing records.
  - .6 Completion Tasks: As a minimum the following must be completed prior to requesting Consultant's final inspection. Submit written certificates that following tasks have been performed:
    - .1 Work: completed and inspected for compliance with Contract Documents.
    - .2 Defects: corrected and deficiencies completed.
    - .3 Equipment and systems: tested, adjusted, and balanced and fully operational.
    - .4 Certificates required by Authorities Having Jurisdiction (e.g. Boiler Inspection Branch, Fire Marshall, Utility companies etc.): submitted.

- .5 Operation of systems: demonstrated to Owner's personnel.
- .6 Commissioning of systems: completed and copies of final Commissioning Report submitted to Consultant .
- .7 Work: complete and ready for final inspection.
- .7 Final Inspection:
  - .1 Upon finishing of completion tasks above, request final inspection of the Work by Consultant.
  - .2 If in Owner's or Consultant's opinion, Work remains incomplete, complete outstanding items and request re-inspection.
- .8 Declaration of Substantial Performance: If Consultant considers deficiencies and defects corrected and requirements of Contract substantially performed, make application for Certificate of Substantial Performance.
- .9 Commencement of Lien and Warranty Periods: date of Owner's acceptance of submitted declaration of Substantial Performance to be date for commencement for warranty period and commencement of lien period unless required otherwise by The Construction Act.
- .10 Final Payment:
  - .1 When Consultant considers final deficiencies and defects corrected and requirements of Contract met, make application for final payment.
  - .2 If Work remains deemed incomplete by Consultant , complete outstanding items and request re-inspection.
- .11 Payment of Holdback: after issuance of Certificate of Substantial Performance of Work, submit application for payment of holdback amount in accordance with requirements of the Contract.

**1.7 Final Cleaning**

- 1.7.1 Read in conjunction with: Section 01 74 00.
- 1.7.2 Perform final cleaning and waste-removal operations in accordance with local laws and ordinances, as well as Federal and Provincial and local environmental regulations.
- 1.7.3 Cleaning Personnel: Use experienced workers or professional cleaners for final cleaning tasks.
- 1.7.4 Cleaning Standards: Each surface or unit must be cleaned to condition expected in an average commercial building cleaning and maintenance program.

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- 1.7.5 Manufacturer's Instructions: Comply with manufacturer's written instructions for cleaning processes.
  - 1.7.6 Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of surface being cleaned. Do not use cleaning agents that are potentially hazardous to health, property, or that could damage finished surfaces.
    - .1 Toxicity: Products must be labeled as 'low-hazard' or 'safer' by an ISO 14024-compliant (Type 1) Ecolabel, or other recognized third-party certification.
    - .2 Compliance with Green Seal GS-37: Generally, use cleaning products that comply with Green Seal GS-37. If GS-37 is not applicable to specified cleaning product, select products that comply with the California Code of Regulations regarding maximum allowable VOC levels.
    - .3 Ingredient Disclosure and Safety: Products must have ingredients disclosed through a Safety Data Sheet (SDS). No ingredients should be present at 100 ppm (0.01%) or above that are classified with GHS codes and hazard statements: H311, H312, H317, H334, H340, H350, H360, H372.

## 2 . **PRODUCTS**

### 2.1 **Not Used**

## 3 . **EXECUTION**

### 3.1 **Not Used**

END OF SECTION

## 1. **GENERAL**

### 1.1 **Definitions**

1.1.1 For the purposes of this Section, the following definitions as defined by the Ontario Association of Architects Practice Tip – PT.14 Version 1.1 apply:

- .1 As-built drawings: drawings usually prepared by Contractor as it constructs the project and upon which it documents the actual locations of building components and changes to the original contract documents. These, or a copy of same, are typically turned over to the Consultant or Owner at completion of the project.
- .2 Record drawings: drawings usually prepared by the Consultant when contracted to do so. These are usually a composite of the original drawings, changes known to the Consultant and information taken from the Contractor's as-built drawings. Responsibility for preparation of record drawings may be delegated to Contractor if indicated as such in this Section.

### 1.2 **Operation And Maintenance Manual**

1.2.1 Preparation: Prepare a comprehensive operation and maintenance manual, in the language(s) of the Contract, using personnel qualified and experienced for this task.

1.2.2 Submission Timing: Submit an initial draft of the operation and maintenance manual for Consultant's review. If required by Consultant's review comments, revise manual contents and resubmit for Consultant's review. If required, repeat this process until Consultant accepts the draft manual in writing.

1.2.3 Operation And Maintenance Manual Format:

- .1 Organize data in the form of an instructional manual.
- .2 Hard Copies:
  - .1 Number of Copies: Submit 2 of final version to Owner.
  - .2 Binders: vinyl, hard covered, three D-rings, loose leaf, 216 x 279 mm, with spine and face pockets. When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.
  - .3 Cover: Identify each binder with typed or printed title "Operation and Maintenance Manual for Dockstader PRPS", and subject matter of contents.



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- .4 Arrange content by systems or process flow, under Section numbers and sequence of Table of Contents.
  - .5 Provide tabbed fly leaf for each separate Product or system, with typed description of Product and major component parts of equipment.
  - .6 Text: Manufacturer's printed data, or typewritten data.
  - .7 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
  - .3 Electronic Copies:
    - .1 Submission Media: Submit final version to Owner on electronic media acceptable to Owner. When permitted by Owner, digitally transfer files using a secure cloud storage system.
    - .2 Format: Provide electronic copy of Operation and Maintenance Manual in PDF format.
      - .1 Use electronic files prepared by manufacturer where available. If scanning of paper documents is necessary, configure scanned file for minimum readable file size.
      - .2 Bookmarking: Individual documents must be bookmarked based on file names. Name document files to correspond to system, subsystem, and equipment names used on table of contents.
      - .3 Group documents for each system and subsystem into bookmarked files.
    - .3 Shop Drawings: Provide electronic copy of Shop Drawings in manual as 1:1 scaled files in both .dxf and PDF format.
- 1.2.4 Operation And Maintenance Manual Contents:
- .1 General Contents:
    - .1 Table of contents for each volume.
    - .2 Introductory information including:
      - .1 Date of manual submission.
      - .2 Complete contact information for Consultant, subconsultants, other consultants, and Contractor, with names of responsible parties.
      - .3 Schedule of Products and systems indexed to content of volume.
    - .3 For each Product or system, include complete contact information for Subcontractors, Suppliers and manufacturers, including local sources for supplies and replacement parts.

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- .4 Product Data: mark each sheet to clearly identify specific products, options, and component parts, and data applicable to installation. Delete or strike out inapplicable information. Supplement with additional information as required.
  - .5 Reviewed Shop Drawings.
  - .6 Permits, certificates, letters of assurance and other relevant documents issued by or required by authorities having jurisdiction.
  - .7 Warranties.
  - .8 Operating and maintenance procedures, incorporating manufacturer's operating and maintenance instructions, in a logical sequence.
  - .9 Training materials as specified in Section 01 79 00 - Demonstration and Training.
  - .2 Equipment And Systems:
    - .1 Each Item of Equipment and Each System: include description of unit or system and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
    - .2 Panel Board Circuit Directories: provide electrical service characteristics, controls, and communications.
    - .3 Include installed colour coded wiring diagrams.
    - .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
    - .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
    - .6 Provide servicing and lubrication schedule, and list of lubricants required.
    - .7 Include manufacturer's printed operation and maintenance instructions.
    - .8 Include sequence of operation by controls manufacturer.
    - .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

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- .10 Provide installed control diagrams by controls manufacturer.
  - .11 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.
  - .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
  - .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
  - .14 Include testing and balancing reports.
  - .15 Include additional content as specified in technical Specifications sections.
  - .3 Products And Finishes:
    - .1 Include Product data, with catalogue number, options selected, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured Products.
    - .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
    - .3 Include an outline of requirements for routine and special inspections and for regular maintenance to ensure that on-going performance of the building envelope will meet the initial building envelope criteria.
    - .4 Include additional content as specified in technical Specifications sections.
  - .4 Warranties:
    - .1 Separate each warranty with index tab sheets keyed to Table of Contents listing.
    - .2 List each warrantor with complete contact information.
    - .3 Verify that documents are in proper form and contain full information. Ensure that warranties are for the correct duration and are in Owner's name.
    - .4 Include maintenance bond(s), if any.

### **1.3 Contractor's As-Built Drawings**

- 1.3.1 Submit final as-built drawings as specified in Section 01 32 00 – Construction Progress Documentation to Consultant.
  - .1 Hard Copies: Submit 2 of as-built drawings to Consultant.

- .2 Electronic Copies: Submit electronic copy of As-Built Drawings in PDF format on electronic media acceptable to Owner. When permitted by Owner, digitally transfer files using a secure cloud storage system.

#### **1.4 Project Record Drawings**

- 1.4.1 Include cost of preparing record Drawings in Contract Price.
- 1.4.2 Consultant's Review: Consultant will review as-built Drawings to determine if general scope of changes, additional information recorded, and quality of drafting are generally acceptable.
- 1.4.3 Transfer of Information: After Consultant's review and acceptance, transfer information marked up on as-built drawings during progress of work to a master set of record drawing files as provided by Consultant. Incorporate Consultant's comments provided during Consultant's review of as-built drawings. Mark revised drawings as "RECORD DRAWINGS for Dockstader PRPS".
- 1.4.4 Format: Submit completed record drawings as follows:
  - .1 Hard Copies: Submit of record drawings to Consultant.
  - .2 Electronic Copies: Submit electronic copy of record drawings in PDF format on electronic media acceptable to Owner. When permitted by Owner, digitally transfer files using a secure cloud storage system.

#### **1.5 Spare Parts, Maintenance Materials, And Special Tools**

- 1.5.1 Supply spare parts, maintenance materials, and special tools in quantities specified in technical Specifications sections.
- 1.5.2 Ensure spare parts and maintenance materials are new, not damaged nor defective, and of same quality, manufacturer, and batch or production run as installed Products.
- 1.5.3 Provide tags for special tools identifying their function and associated Product.
- 1.5.4 Deliver to and store items at location directed by Owner at Place of the Work. Store in original packaging with manufacturer's labels intact and in a manner to prevent damage or deterioration.
- 1.5.5 Catalogue all items and submit to Consultant an inventory listing organized by Specifications section. Include Consultant reviewed inventory listing in operation and maintenance manual.

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2 . **PRODUCTS**

2.1 **Not Used**

3 . **EXECUTION**

3.1 **Not Used**

END OF SECTION

## **1 . GENERAL**

### **1.1 WPAM Project Handover Requirements**

- 1.1.1 Upon project completion, the Vendor will provide a summary of information related to new or modified changes to the building and/or property in the form of:
  - .1 Record drawings;
  - .2 Space statistics;
  - .3 Building component list;
  - .4 Equipment list; and
  - .5 Asbestos abatement documentation (if applicable).
- 1.1.2 The listed deliverables will be submitted to the Agency's project manager, no later than 5 weeks following project substantial completion of each Phase. If the deliverables are not completed as described herein, they will be returned to the Vendor for correction and resubmission to the Agency, at no additional cost to the Agency
- 1.1.3 The Phases are as described below:
  - .1 Stage 1: Substantial Performance (Building occupancy), this includes the new building, site services and completed landscape works.
  - .2 Stage 2: Park phase completion covering the balance landscape works, demolition & park works.

### **1.2 Record Drawings**

- 1.2.1 Provide 'record' drawings' for all affected building systems.
- 1.2.2 For major renovations or new builds, provide a full drawings set complete with all building systems;
- 1.2.3 The drawings shall be provided as follows:
  - .1 In AutoCAD (2013) and PDF formats to protect professional stamps,
  - .2 Via flash drive,
  - .3 Indicating a revision line and date (mm/dd/yy).
  - .4 Without protection, and
  - .5 Including all X-ref drawings
  - .6 AutoCAD drawings shall be provided with professional stamps removed for the use of the Agency.
- 1.2.4 AutoCAD drawings will be in AutoCAD (2013) format and will follow a prescribed Agency standard:

- 
- .1 Metric drawing templates (see "Standard ACAD Drawings Package") containing:
    - .1 Text standards & font styles
    - .2 Layer states
    - .3 Layers
    - .4 Line types
    - .5 Metric title blocks (216 x 279, 279 x 432, 609 x 914, 914 x 1219)
  - .2 All submitted electronic drawings must follow the master layering list provided ( see "Standard ACAD Drawings Package") in order to be accepted into the ROP environment.
  - .3 Plot style files (see "Standard ACAD Drawings Package")
  - .4 AutoCAD drawings shall contain a company logo of the author in the drawings' title block. The title block and its format and contents shall be provided in accordance with the sample provided by the Agency (see "Standard ACAD Drawings Package").
  - .5 Drawing files are to be named using the following naming convention:

DOCTYPE - SUBJECT - YYYYMMDD

EX: A1 - LEGEND, GENERAL NOTES & DRAWING

LIST - 20170314.dwg

### **1.3 Space Statistics**

- 1.3.1 Provide a table of Gross Building Areas (GBA) calculated to 1996BOMA standards for all new or modified spaces.

### **1.4 Building Components**

- 1.4.1 Obtain a copy of the template ("Project Components and Costs.xls") from the Owner, Provide the following on the template:
  - .1 Provide an itemized MS Excel list of building components that have been installed or replaced. This same list will require any applicable warranties for each component;
  - .2 Components are categorized by Unifomat Code, and have a pre-defined drop-down list;
  - .3 Provide a description of the scope of work with respect to each component. This includes a detailed scope of final work, location of installation, percent replaced or number of units replaced;
  - .4 Provide the associated expected life cycle;

- .5 Provide associated component quantity and cost. Base construction cost is to be entered, not including any markups or premiums.

**1.5 Building Equipment**

- 1.5.1 Obtain a copy of the template ("Equipment Template for Consultants.xls") from the Owner, Provide the following on the template:
- .1 Provide an itemized list of existing equipment to be replaced;
  - .2 Provide an itemized list of new equipment;
  - .3 Complete all fields for each equipment (ie. building name, address, location within the building, model, serial number, specifications, warranties).

**1.6 Asbestos Abatement**

- 1.6.1 Provide a completed Asbestos Abatement Form for each abated building component.
- 1.6.2 Provide an asbestos test report, if performed as part of the project.

**1.7 Appendices**

- 1.7.1 Refer to Real Property Asset Management – Master Drawings Management documents appended to this Section. Requirements indicated therein form an integral part of this Section.

**2 . PRODUCTS – NOT APPLICABLE**

**3 . EXECUTION – NOT APPLICABLE**

END OF SECTION



## Real Property Asset Management Master Drawings Management

### Drawings Standard

#### Record Drawings

All drawings submitted to the Region of Peel, Real Property Asset Management Division will follow a prescribed Agency standard. The Vendor is not to stray from the Agency's drawing standards.

Drawings shall be submitted as follows:

- In AutoCAD (2013) and in PDF format;
- Via flash drive;
- Without protection.

Drawings shall include:

- A revision line and date (yyyy / mm / dd);
- All external references (X-Ref), drawings and image files;
- AutoCAD drawings shall be provided with professional stamps removed for the use of the Agency;
- PDF drawings shall be provided with professional stamps.

The prescribed standard includes the following:

- Metric drawing templates ("*ROPTitleblocksMetric\_Revised2017.dwg*") containing:
  - Text standards & font styles
  - Layer states
  - Layers
  - Line types
  - Metric title blocks (216 x 279, 279 x 432, 609 x 914, 914 x 1219)
- All submitted electronic drawings must follow the master layering list provided in order to be accepted by the Agency.
- Plot style files to be used are Presentation.ctb, ROP-WkgDwgStd - Full Size.ctb, ROP-WkgDwgStd - Half Size.ctb
- AutoCAD drawings shall contain the company logo of the author in the drawings' title block. The title block and its format and contents shall be provided in accordance with the sample provided by the Agency. ("*ROPTitleblocksMetric\_Revised2017.dwg*")
- Record Drawing files are to be named using the following naming convention:

*DOCTYPE- SUBJECT- YYYYMMDD.dwg*

YYYYMMDD is the year, month and day of the last revision or issue of the drawing.

Examples: A1 - LEGEND\_GENERAL NOTES & DRAWING LIST- 20170314.dwg

### General Layers

<u>Layer</u>	<u>Weight</u>	<u>Colour</u>	<u>Line</u>	<u>Content / Notes</u>
0	L	8	Continuous	Xref's and mixed layer blocks
DEFPOINTS	n/a		Continuous	ROP non-plot layer
G-BORDER	TEXT - M	5	Continuous	Title sheet borders - this layer is always on
G-BORDTXT	TEXT - M	4	Continuous	Title block text - this layer is always on
G-NORTH	TEXT - M	5	Continuous	Freeze this layer when north arrow is not required

### Grid Layers

<u>Layer</u>	<u>Weight</u>	<u>Colour</u>	<u>Line</u>	<u>Content / Notes</u>
GRID-COLS	XL	254	Centre	Structural Grid lines
GRID- DIM	TEXT - M	4	Continuous	Grid bubbles and dimensions

### Details, Elevations and Sections Layers

<u>Layer</u>	<u>Weight</u>	<u>Colour</u>	<u>Line</u>	<u>Content / Notes</u>
DET-XL	XL	14	Continuous	Extra light lines
DET-L	L	8	Continuous	Light lines
DET-M	M	4	Continuous	Medium lines
DET-H	H	7	Continuous	Heavy lines
DET-XH	XH	3	Continuous	Extra heavy lines
DET-XLHID	XL	6	Hidden	Extra light hidden lines
DET-LHID	L	32	Hidden	Light hidden lines
DET-LHID2	L	1	Hidden2	Light hidden lines 2
DET-HATCH	XL	6	Continuous	Hatching
DET-HATCHSCR	SCR	11	Continuous	Screened hatching
DET-REF	TEXT - L	1	Boundary2	Detail section and detail cross ref.
DET-SYM	TEXT - L	8	Continuous	bubbles and lines
DET-TXT	TEXT - M	42	Continuous	Detail symbols
DET-DIM	TEXT - M	12	Continuous	Detail text
				Detail dimensions

Note: for building sections, use the Envelope and Interior Groups layering systems for the section cut. For information beyond, use the following Elevation and Detail layers.

### Architectural Layers - Envelope Layers

<u>Layer</u>	<u>Weight</u>	<u>Colour</u>	<u>Line</u>	<u>Content / Notes</u>
A-ENCURT	XL	6	Continuous	Building envelope curtain walls
A-ENDOOR	L	1	Continuous	Building envelope doors, jambs and interior metal screens
A-ENEQPM	M	4	Continuous	Building envelope equipment
A-ENSILL	L	32	Continuous	Building envelope sill lines
A-ENSTAIR	L	8	Continuous	Building envelope exterior stairs and railings

A-ENSTAIRH	XL	254	Hidden2	Building envelope stair height, Face of stair riser
A-ENWALL	H	7	Continuous	Building envelope wall profile lines
A-ENWALLC	XL	14	Continuous	Building envelope wall composition or cavity lines
A-ENWALLH	L	8	Hidden	Building envelope slab openings, soffits & bulkheads over
A-ENWALLP	M	5	Continuous	Building envelope partial height wall profile lines (off on ceiling plans)
A-ENWIN	L	62	Continuous	Building envelope windows
A-ENHATCH	XL	14	Continuous	Building envelope hatching
A-ENHATCHSCR	SCR	11	Continuous	Building envelope screened hatching
A-ENREF	TEXT - L	8	Boundary2	Section and detail cross ref. bubbles and lines
A-ENSYM	TEXT - L	1	Continuous	Building envelope symbols
A-ENDIM	TEXT - M	12	Continuous	Building envelope dimensions
A-ENTXT	TEXT - M	74	Continuous	Building envelope text

#### Architectural Layers - Roof Layers

A-RFEQPM	L	8	Continuous	Roof top equipment, condensers, exhaust hoods
A-RFOUTL	L	32	Continuous	Roof parapet, perimeter below light line weight
A-RFOUTM	M	5	Continuous	Roof parapet, perimeter medium line weight
A-RFSTAIR	M	12	Continuous	Stairs, railings and guards on roof
A-RFSTAIRH	XL	14	Hidden2	Roof Stair height, Face of stair riser
A-RFWALK	L	1	Continuous	Pavers and walkways on roof/balcony, heli-pads

#### Architectural Layers - Interior Layers

A-ACC	L	8	Continuous	Washroom accessories and toilet partitions
A-APP	L	62	Continuous	Appliances
A-APPHID	L	32	Hidden2	Appliances below counter
A-DOOR	L	1	Continuous	Interior doors and jambs
A-EQPM	M	5	Continuous	Equipment, elevator cars
A-FIRE	M	12	Various	Fire related separations
A-GLAZ	M	4	Continuous	Full height partitions with glazing
A-MILL	M	74	Continuous	Millwork lines
A-MILLH	L	62	Continuous	Millwork above
A-MILLH2	XL	254	Continuous	Millwork below counters
A-STAIR	L	8	Continuous	Interior stairs
A-STAIRH	XL	254	Continuous	Interior Stair height, Face of stair riser
A-WALL	H	7	Continuous	Full height partition profile lines
A-WALLC	XL	14	Continuous	Wall composition or cavity lines (off on rcp's)
A-WALLH	L	8	Continuous	Interior slab openings, soffits & bulkheads over
A-WALLP	M	5	Continuous	Interior partial height wall profile lines (off on ceiling plans)
A-HATCH	XL	14	Continuous	Interior hatching
A-HATCHSCR	SCR	30	Continuous	Interior screened hatching

A-REF	TEXT - L	62	Boundary2	Section and detail cross ref. bubbles and lines
A-SYM	TEXT - L	32	Continuous	Interior symbols
A-DIM	TEXT - M	74	Continuous	Interior dimensions
A-TXT	TEXT - M	12	Continuous	Interior text
A-RMNAM	TEXT - M	4	Continuous	Room names
A-RMNUM	TEXT - M	4	Continuous	Room numbers

#### Architectural Layers - Ceiling Layers

A-CACC	L	32	Continuous	Ceiling access panel
A-CBULK	M	5	Continuous	Soffits and bulkheads
A-CEQPM	M	4	Continuous	Ceiling equipment (tv's, interior signage)
A-CHEAD	H	2	Continuous	Door and window headers (interior and envelope)
A-CL	L	62	Continuous	Edges of finishes and skylights
A-CLHID	L	1	Hidden	Hidden lines
A-CTBAR	L	8	Continuous	T-bar suspension or ceiling tiles
A-CHATCH	XL	191	Continuous	Ceiling hatching
A-CHATCHSCR	SCR	11	Continuous	Ceiling screened hatching
A-CREF	TEXT - L	1	Boundary2	Section and detail cross ref. bubbles and lines
A-CSYM	TEXT - L	8	Continuous	Ceiling symbols
A-CDIM	TEXT - M	5	Continuous	Ceiling dimensions
A-CTXT	TEXT - M	74	Continuous	Ceiling text
A-CRMNUM	TEXT - M	12	Continuous	Room numbers

Note: Room names not required for Ceiling Plans. Use room numbers only.

#### Architectural Layers - Area Layers

A-AREAGROSS	H	142	Continuous	Gross floor area
A-AREARENT	M	12	Continuous	Rentable area
A-AREAUSE	M	4	Continuous	Useable area
A-AREACORE	M	74	Continuous	Building core area
A-AREACONST	H	9	Continuous	Construction area, building outline or footprint
A-AREACOMN	M	5	Continuous	Common area
A-AREAATCH	XL	191	Continuous	Area hatching
A-AREAATCHSCR	SCR	11	Continuous	Area screened hatching
A-AREATXT	TEXT - M	4	Continuous	Area text
A-AREADIM	TEXT - M	12	Continuous	Area dimensions
A-AREA RMNUM	TEXT - M	74	Continuous	Area room numbers

#### Furniture Layers

<u>Layer</u>	<u>Weight</u>	<u>Colour</u>	<u>Line</u>	<u>Content / Notes</u>
FRN-ACCESS	L	8	Continuous	Keyboards, surfboards, tackboards, accessories
FRN-CHAIRS	L	32	Continuous	Task and guest Chairs
FRN-EQPM	M	4	Continuous	Equipment
FRN-FILE	M	4	Continuous	Filing cabinets, high density file systems, storage cabinets

FRN-FREE	M	12	Continuous	Desks, tables, credenzas, bookcases - non system furniture
FRN-PANL	H	142	Continuous	Panels, posts, caps
FRN-SIGN	TEXT-L	62	Continuous	Furniture & Room Signage
FRN-STOR	XL	191	Hidden	Overhead bins, pedestals, 2 drawer lateral files
FRN-WSURF	M	5	Continuous	System furniture work surfaces
FRN-HATCH	XL	6	Continuous	Furniture hatching
FRN-HATCHSCR	SCR	30	Continuous	Furniture screened hatching
FRN-100RMNAM	TEXT - M	74	Continuous	Room names
FRN-100RMNUM	TEXT - M	74	Continuous	Room numbers
FRN-100REF	TEXT - L	62	Boundary2	section and detail cross ref. bubbles and lines
FRN-100SYM	TEXT - L	32	Continuous	Furniture symbols
FRN-100DIM	TEXT - M	12	Continuous	Furniture dimensions
FRN-100TXT	TEXT - M	74	Continuous	Furniture text, works'n numbers
FRN-100PANTXT	TEXT - L	62	Continuous	Panel text
FRN-100STFNAM	TEXT - M	12	Continuous	Staff names

### Finishes Layers

<u>Layer</u>	<u>Weight</u>	<u>Colour</u>	<u>Line</u>	<u>Content / Notes</u>
FIN-FLR	L	1	Continuous	Floor finishes
FIN-WALL	L	62	Continuous	Wall finishes (use symbols to differentiate)
FIN-HATCH	XL	191	Continuous	Finishes hatching <b>OR</b> screened hatching
FIN-HATCHSCR	SCR	11	Continuous	Finishes screened hatching
FIN-100REF	TEXT - L	8	Boundary2	Section and detail cross ref. bubbles and lines
FIN-100SYM	TEXT - L	1	Continuous	Finishes symbols
FIN-100DIM	TEXT - M	74	Continuous	Finishes dimensions
FIN-100TXT	TEXT - M	4	Continuous	Finishes text
FIN-100RMNUM	TEXT - M	12	Continuous	Room numbers

### Existing Construction Layers

<u>Layer</u>	<u>Weight</u>	<u>Colour</u>	<u>Line</u>	<u>Content / Notes</u>
EX-DOOR	XL	14	Continuous	Existing doors
EX-EQPM	XL	6	Continuous	Existing equipment
EX-FIXT	XL	6	Continuous	Existing plumbing fixtures
EX-HEAD	XL	191	Continuous	Existing door headers (appears on ceiling plans)
EX-MILL	XL	6	Continuous	Existing millwork
EX-STAIR	XL	254	Continuous	Existing stair
EX-STRUCT	XL	14	Continuous	Existing structure - columns, concrete
EX-WALL	XL	254	Continuous	Existing wall
EX-WALLC	XL	191	Continuous	Existing wall cavity lines
EX-WIN	XL	6	Continuous	Existing window and sills
EX-HATCH	XL	191	Continuous	Existing hatching
EX-HATCHSCR	SCR	30	Continuous	Existing screened line type
EX-DIM	XL	14	Continuous	Existing dimensions

### Demolition Layers

<u>Layer</u>	<u>Weight</u>	<u>Colour</u>	<u>Line</u>	<u>Content / Notes</u>
D-BUILD	H	7	Hidden2	Building foot print (entire building on site plan) to be demolished
D-CLG	H	9	Hidden2	Ceilings to be demolished (appears on RCP's)
D-DOOR	H	2	Hidden2	Doors to be demolished
D-FENCE	H	142	Hidden2	Fence to be demolished
D-FLR	H	9	Hidden2	Floors to be demolished
D-GAS	H	2	Hidden2	Gas lines to be demolished (clarify with notes)
D-HEAD	H	142	Hidden2	Door headers to be demolished (appears on RCP's)
D-LAND	H	2	Hidden2	Landscaping to be demolished (clarify with notes)
D-LIT	H	7	Hidden2	Lighting to be demolished (appears on RCP's)
D-MEC	H	9	Hidden2	Mechanical to be demolished (clarify with notes)
D-MILL	H	2	Hidden2	Millwork to be demolished
D-PARK	H	142	Hidden2	Parking to be demolished
D-PTC	H	2	Hidden2	Power and telecommunications to be demolished
D-PLUM	H	142	Hidden2	Plumbing to be demolished (clarify with notes)
D-ROAD	H	7	Hidden2	Roads to be demolished (clarify with notes)
D-SITE	H	142	Hidden2	Site items to be demolished (clarify with notes)
D-THRES	H	2	Hidden2	Thresholds to be demolished
D-TRAF	H	9	Hidden2	Traffic signals and signs to be demolished (clarify with notes)
D-WALL	H	9	Hidden2	Walls to be demolished
D-WATER	H	142	Hidden2	Manholes, pump stations, water storage tanks, storm systems, sewer systems to be demolished, streams, ditches to be filled in.
D-HATCH	XL	254	Continuous	Demolition hatching
D-HATCHSCR	SCR	11	Continuous	Demolition screened hatching
D-DIM	TEXT - M	4	Continuous	Demolition dimensions
D-TXT	TEXT - M	5	Continuous	Demolition text

### Landscape Layers

<u>Layer</u>	<u>Weight</u>	<u>Colour</u>	<u>Line</u>	<u>Content / Notes</u>
L-BEDS	L	62	Continuous	Landscaping beds
L-BRIDGE	L	8	Continuous	Decorative bridges
L-DECK	L	32	Continuous	Decks
L-EQPM	L	1	Continuous	Irrigation equipment
L-FENCE	M	12	Fence2	Decorative fencing
L-FURN	L	8	Continuous	Site furnishings
L-GRND	L	62	Continuous	Ground cover and vines

L-HARD	L	1	Continuous	Walkways, steps, terraces
L-IRIG	L	32	Irig	Irrigations systems and sprinklers
L-IRIGCOV	XL	191	Scr	Irrigation coverage
L-PLAY	L	1	Continuous	Play structures
				Pools, reflecting pools, fountains,
L-POOL	L	8	Continuous	Jacuzzis, spas
L-SPORT	L	32	Continuous	Site related sport fields, courts, etc.
L-TREE	M	74	Continuous	New and existing trees
L-TURF	XL	254	Continuous	Lawn areas
L-WALL	L	1	Continuous	Walls (non-retaining)

### Landscape - Reference Layers

Use architectural - envelope layers

### Site Layers

<u>Layer</u>	<u>Weight</u>	<u>Colour</u>	<u>Line</u>	<u>Content / Notes</u>
				Property lines and survey
SITE-PROP	L	62	CENTER	benchmarks
SITE-PARK NEW	L	62	Continuous	New Parking
SITE-PARK				
EXISTING	L	62	Continuous	Existing Parking
SITE-PARK NEW				
WCHAIR	L	62	Continuous	Wheelchair Accessible Parking
SITE-PARK EXIST.				
WCHAIR	L	62	Continuous	Wheelchair Accessible Parking
SITE-PARK HATCH	XL	254	Continuous	Hatching
SITE-LOTNUM	TEXT - M	74	Continuous	Lot numbers
SITE-HATCH	XL	254	Continuous	Hatching, Patterns
SITE-VECH	XL	254	Continuous	Cars, Trucks
SITE-DIM	TEXT - M	5	Continuous	Dimensions
SITE-TXT	TEXT - M	4	Continuous	Text
SITE-SPOT	TEXT - H	7	Continuous	Spot elevations
				Section and detail cross ref. bubbles
SITE-REF	TEXT - L	1	Continuous	and lines
SITE-SYM	TEXT - L	8	Continuous	Symbols
				Building foot print (entire building on
SITE-BUILD	H	7	Continuous	site plan)
SITE-DOOR	L	1	Continuous	Doors
SITE-FENCE	M	74	Fence2	Fence
SITE-GRADE	L	62	Continuous	Grade line
SITE-CURB NEW	L	1	Continuous	New Curb
SITE-CURB				
EXISTING	L	1	Continuous	Existing Curb
SITE-RFWALK NEW	L	62	Continuous	Pavers and walkways
SITE-RFWALK				
EXISTING	L	62	Continuous	Pavers and walkways
SITE-GAS	L	32	Continuous	Gas lines
SITE-LAND	L	62	Continuous	Landscaping (clarify with notes)
SITE-GRASS	L	62	Continuous	Grass
SITE-LITE	M	4	Continuous	Lighting
SITE-STAIR	L	8	Continuous	Stairs
SITE-PTC	H	2	Hidden2	Power and telecommunications
SITE-ROAD	L	1	Continuous	Roads/Street (clarify with notes)



SITE-ROADLINE	XL	6	Various	Roadway painted markings and centre lines
SITE-STM	L	1	Continuous	Catchbasin, manholes and equipment
SITE-STMB	L	32	Continuous	Underground storm lines/piping
SITE-STMDRAIN	L	62	Continuous	Storm drain
SITE-TRAF	H	7	Continuous	Traffic signals and signs (clarify with notes)
SITE-WALL	H	7	Continuous	Walls
SITE-WATER	L	8	Continuous	Manholes, pump stations, water storage tanks, storm systems, sewer systems

### Structural Layers

<u>Layer</u>	<u>Weight</u>	<u>Colour</u>	<u>Line</u>	<u>Content / Notes</u>
S-BEAM	M	4	Continuous	Beams, Lintels plan/elevation view
S-BRDG	L	62	Continuous	Bridging & Bracing
S-COMP	M	12	Continuous	Composite Beam/Floor Systems
S-CONC	H	7	Continuous	Structural concrete profile line, bearing walls, conc stairs
S-DECK	L	8	Continuous	Decking - c/w concrete
S-EOS	M	74	Continuous	Edge of Slab
S-FND	H	9	Continuous	Foundation lines
S-FOOT	H	2	Dashed	Spread Footings
S-GRADE	XH	3	Continuous	Grade lines
S-JOIST	L	1	Continuous	Joists, Purlins
S-PILE	H	142	Continuous	Piles, Caissons
S-REBAR	L	1	Continuous	Slab reinforcing
S-STEEL	M	5	Continuous	Structural steel cut profile lines, anchor bolts
S-TEE	M	12	Continuous	Concrete precast Tee's
S-WAFFLE	L	32	Continuous	Waffle Slab
S-HATCH	XL	6	Continuous	Structural hatching
S-HATCHSCR	SCR	30	Continuous	Structural screened hatching
S-REF	TEXT - L	1	Boundary2	Section & detail cross ref. bubbles & lines
S-SYM	TEXT - L	8	Continuous	Structural symbols
S-DIM	TEXT - M	5	Continuous	Structural dimensions
S-TXT	TEXT - M	4	Continuous	Structural text

Note: Use architectural room name and room number layers.  
 Use detail, elevation and section layers for any structural details.

### Electrical Layers

<u>Layer</u>	<u>Weight</u>	<u>Colour</u>	<u>Line</u>	<u>Content / Notes</u>
E-AUX	M	5	Continuous	Auxiliary power systems
E-BUS	L	8	Continuous	Busways
E-CARB	M	4	Continuous	C02 detection equipment
E-CARP	M	74	Continuous	Undercarpet wire
E-CLG	M	12	Continuous	Ceiling mounted outlets (appears on rcp's)
E-CLOCK	M	4	Continuous	Clock systems
E-COMM	L	32	Continuous	Communications intercoms, PA sys.



E-COVE	H	2	Continuous	Cove lighting
E-DUCT	M	4	Continuous	Ductwork and conduit
E-EQPM	M	5	Continuous	Floor mounted equipment
E-FEED	L	8	Continuous	Systems furniture power cable/power pole
E-FIRE	M	12	Continuous	Fire protect. systms -fire alarms, mag locks, fire related equip
E-FLR	M	74	Continuous	Floor mounted outlets
E-FRNVDP	L	1	Continuous	Voice, data and power outlets for systems furniture
E-GROUND	M	74	Continuous	Grounds systems
E-LEXIT	H	142	Continuous	Exit lights (appears on rcp's)
E-LEQPM	M	4	Continuous	Ceiling mounted equipment (appears on rcp's)
E-LFLU	H	2	Continuous	Fluorescent lighting (appears on rcp's)
E-LINC	H	9	Continuous	Incandescent lighting (appears on rcp's)
E-LRELOC	M	74	Hidden	Relocated ceiling mounted lighting fixtures (appears on rcp's)
E-MECH	M	12	Continuous	Mechanical -Electrical system
E-MOLD	L	62	Continuous	Wire mold
E-NURSE	M	5	Continuous	Nurse call
E-PAN	M	12	Continuous	Electrical Panel
E-RACE	L	32	Continuous	Raceways
E-ROOF	M	4	Continuous	Rooftop power
E-SECURE	M	5	Continuous	Security systems
E-SPK	M	74	Continuous	Ceiling mounted speakers (appears on rcp's)
E-SWBD	M	12	Continuous	Switchboard
E-SWICH	L	1	Continuous	Switches and dimmers- light, power, fan, A/V swithces etc..
E-TRANS	M	5	Continuous	Transformers
E-TRAY	L	32	Continuous	Cable trays
E-TV	M	12	Continuous	CCTV, Television cable. Tv antenna sys.
E-WALL	L	8	Continuous	Wall mounted outlets - electrical and voice/Lan/Fax
E-ZAP	M	4	Continuous	Lightning protection system
E-HATCH	XL	254	Continuous	Electrical hatching <b>OR</b> screened hatching
E-HATCHSCR	SCR	11	Continuous	Electrical screened hatching
E-REF	TEXT - L	1	Boundary2	Section and detail cross ref. bubbles and lines
E-SYM	TEXT - L	8	Continuous	Electrical symbols
E-DIM	TEXT - M	12	Continuous	Electrical dimensions
E-TXT	TEXT - M	74	Continuous	Electrical text
E-RMNUM	TEXT - M	4	Continuous	Room numbers

### Mechanical Layers

<u>Layer</u>	<u>Weight</u>	<u>Colour</u>	<u>Line</u>	<u>Content / Notes</u>
M-CARB	L	62	Continuous	CO2 Fire suppression systems
M-COMP	L	8	Continuous	Compressed air systems
M-CWR	H	2	Cwr	Chilled water return

M-CWS	H	142	Cws	Chilled water supply
M-DIFF	H	9	Continuous	Supply and return diffusers at ceiling (appears on RCP's)
M-DIFFB	M	12	Hidden	Supply and return diffusers at floor
M-DUCT	L	1	Continuous	Ductwork (appears on RCP's)
M-DUCTB	M	4	Hidden	Ductwork below floor
M-ENC	L	8	Continuous	Enclosures, radiant panel systems at ceiling
M-ENCL	L	32	Continuous	Enclosures at floor
M-FAN	H	7	Continuous	Exhaust fans
				Elec. heating equip., baseboard heaters, unit heaters, air handling units
M-EQPM	M	5	Continuous	
M-FLEX	L	62	Continuous	Flexible ducts (appears on RCP's)
M-GAS	L	32	Gas	Gas lines
M-HWR	H	7	Hwr	Heating return piping
M-HWS	H	9	Hws	Heating supply piping
M-MED	L	1	Continuous	Medical systems
M-NRG	L	62	Continuous	Energy management systems
M-REFR	L	8	Continuous	Refrigeration systems
M-RET	L	1	Continuous	Return line
M-RISE	L	32	Continuous	Duct riser up or down
M-SUP	L	8	Continuous	Supply line
M-THERM	L	62	Continuous	Thermostats and controls
M-VAV	M	4	Continuous	VAV boxes
M-HATCH	XL	254	Continuous	Mechanical hatching
M-HATCHSCR	SCR	30	Continuous	Mechanical screened hatching
M-REF	TEXT - L	1	Boundary2	Section and detail cross ref. bubbles and lines
M-SYM	TEXT - L	8	Continuous	Mechanical symbols
M-DIM	TEXT - M	12	Continuous	Mechanical dimensions
M-TXT	TEXT - M	74	Continuous	Mechanical text
M-RMNUM	TEXT - M	4	Continuous	Room numbers

### Plumbing Layers




<u>Layer</u>	<u>Weight</u>	<u>Colour</u>	<u>Line</u>	<u>Content / Notes</u>
P-DCW	M	142	Cwr	Domestic cold water
P-DHW	M	142	Cws	Domestic hot water
P-DRECW	M	9	Recirc	Domestic water recirculation
P-DRAIN	L	4	Continuous	Drains
P-EQMP	L	1	Continuous	Equipment
P-FHC	L	62	Continuous	Fire hose cabinets
P-STAND	L	12	Continuous	Fire protection stand pipe
P-FIXT	L	4	Continuous	Plumbing fixtures
P-GAS	L	32	Gas	Gas lines
P-LIQ	L	8	Liq	Liquids
P-PUMP	M	5	Continuous	Pumps, sump pumps
P-RISE	M	74	Continuous	Riser
P-SAN	H	2	Continuous	Sanitary above floor
P-SANB	H	9	Dashed	Sanitary below floor
P-SOFT	M	4	Sof	Softened water

P-SPDUCT	L	62	Hidden	Sprinkler ducts below
P-SPHEAD	H	7	Continuous	Sprinkler heads
P-SPLINE	L	1	Sprink	Sprinkler lines, brnaches and main lines
P-SPRELOC	H	2	Continuous	Relocated sprinkler components
P-VENT	M	5	Vent	Vent line
P-HATCH	XL	6	Continuous	Plumbing hatching <b>OR</b> screened hatching
P-HATCHSCR	SCR	11	Continuous	Plumbing screened hatching
P-REF	TEXT - L	8	Boundary2	Section and detail cross ref. bubbles and lines
P-SYM	TEXT - L	1	Continuous	Plumbing symbols
P-DIM	TEXT - M	74	Continuous	Plumbing dimensions
P-TXT	TEXT - M	12	Continuous	Plumbing text
P-RMNUM	TEXT - M	5	Continuous	Room numbers

### Civil Layers

<u>Layer</u>	<u>Weight</u>	<u>Colour</u>	<u>Line</u>	<u>Content / Notes</u>
C-BASE	XH	10	Continuous	Base building footprint
C-BEAR	TEXT - L	1	Continuous	Bearing and distance labels
C-BORE	H	2	Continuous	Test borings
C-BRIDGE	L	32	Continuous	Site bridges as part of roadways
C-COMM	M	12	Tel/ Contin.	Site comm'tions - phone poles, boxes, towers, overhead lines
C-COMMB	XL	254	Tel	Site communications - Underground lines
C-CONTROL	L	1	Continuous	Construction controls - gates, fences, stop traffic, hoardings
C-CONSLINE	SCR	30	Continuous	Construction lines
C-CURB	L	1	Continuous	Curbs
C-EASE	L	62	Dashedx2	Easements, R.O.W. and set back lines (clarify with notes)
C-ELEC	M	4	Elec	Electrical site substations, transformers, overhead lines, equipment
C-ELECB	L	8	Hidden	Electrical site underground lines
C-ELEV	TEXT - M	5	Continuous	Survey elevations
C-FENCE	M	74	Fence2	Fencing at property boundaries and gates
C-FIRE	M	12	Continuous	Fire hydrants, connections and pumps
C-GAS	L	32	Continuous	Natural gas - manholes, meters, storage tanks, equipment
C-GASB	XL	191	Gas2	Natural gas underground lines
C-GEO	M	4	Dashed	Geothermal wells and site work
C-GRADE	L	62	Continuous	Grade line
C-LITE	M	4	Continuous	Site lighting
C-PARK	L	62	Continuous	Parking lot painted markings, striping and handicap symbols
C-PAVE	L	32	Continuous	Edge of pavement
C-PNUM	TEXT - L	8	Continuous	Survey points and numbers
C-PROP	M	5	Phantom	Property lines and survey benchmarks

C-RAIL	L	8	Continuous	Railroad lines
C-RETWALL	L	1	Continuous	Retaining walls
C-STREAM	L	62	Continuous	Rivers, streams, ditches, creeks etc
C-ROAD	L	1	Continuous	Roads and drives
C-ROADLINE	XL	6	Various	Roadway painted markings and centre lines
C-SEW	L	32	Continuous	Sanitary sewers - related manholes and pumping stations
C-SEWB	XL	191	Continuous	Sanitary sewers - underground lines
C-SIGN	L	1	Continuous	Site signage, pylon signs, street signs, etc... (clarify with notes)
C-SPOT	TEXT - H	7	Continuous	Spot elevations
C-SPORT	L	8	Continuous	Sports courts, sports fields and playing lines
C-STM	L	1	Continuous	Catchbasin, manholes and equipment
C-STMB	L	32	Continuous	Underground storm lines/piping
C-STMDRAIN	L	62	Continuous	Storm drain
C-STMRELOC	H	142	Continuous	Relocated storm lines or drains
C-SWALK	L	62	Continuous	Sidewalks
C-TOPO	XL	14	Continuous	Contour lines - major
C-TOPO2	SCR	11	Continuous	Contour lines - minor
C-TOTO	TEXT - L	32	Continuous	Embankment TOP/TOE
C-TRAF	H	7	Continuous	Traffic lights, traffic controls, equipment
C-WATER	L	8	Continuous	Water related manholes, pump stations, storage tanks, equip.
C-HATCH	XL	254	Continuous	Hatching
C-HATCHSCR	SCR	11	Continuous	Screened hatching
C-REF	TEXT - L	1	Boundary2	Section and detail cross ref. bubbles and lines
C-SYM	TEXT - L	8	Continuous	Symbols
C-TXT	TEXT - M	4	Continuous	Text
C-DIM	TEXT - M	5	Continuous	Dimensions
C-LOTNUM	TEXT - M	74	Continuous	Lot numbers

KEY PLAN	ISSUES AND REVISIONS	
	NO.	ISSUE OR REVISION TO DRAWING
	DATE	BY
	MM/DD/YY	
 10000 CENTRE DRIVE BAMFORD, ONTARIO L7R 4K6 TEL: (905) 701-7000		
CONSULTANT		
PROJECT TITLE AND ADDRESS PROJECT TITLE PROJECT ADDRESS		
DRAWING TITLE DRAWING TITLE		
TRUE NORTH 	CONSTRUCTION NORTH 	
DRAWN BY XX	CHECKED BY XX	
SCALE 123	DATE MM/DD/YYYY	
CONSULTANT PROJECT NUMBER 123	REGION OF PEEL PROJECT NUMBER E14-XXXX	
PURCHASER/DOCUMENT NUMBER 2014-XXXXP	DRAWING NUMBER A#	



**1 . GENERAL**

**1.1 General**

- 1.1.1 Comply with CCDC-2 and GC 12.3 / SC.49 Warranty and Supplementary Conditions.
- 1.1.2 Unless indicated otherwise, standard one-year warranty must commence from the date of Ready-for-Takeover.
- 1.1.3 Owner will notify Consultant in writing immediately upon discovering defects during warranty period.
- 1.1.4 During month prior to conclusion of one-year warranty period, inspection of project must be conducted the Owner's representative, Consultant, and Contractor. Contractor must address defects arising from faulty materials or workmanship without delay.
- 1.1.5 Upon expiry of one-year warranty period, Contractor must transfer all extended warranties provided by Subcontractors to Owner, with formal notification of this assignment to relevant Subcontractors.

**1.2 Extended Warranties**

- 1.2.1 Provide extended warranties outlined in Technical Specifications. Extended warranties must begin immediately after expiry of contractual one-year warranty and must be co-signed by the manufacturers or suppliers. Submission of extended warranties is responsibility of Contractor.
- 1.2.2 If validity of extended warranties is contingent upon proper maintenance and servicing of specified elements, provide comprehensive maintenance and servicing plan to Owner in Operation and Maintenance Manuals specified in Section 01 78 00.

**2 . PRODUCTS**

**2.1 Not Used**

**3 . EXECUTION**

**3.1 Not Used**

END OF SECTION

**1. GENERAL**

**1.1 Summary**

- 1.1.1 Demonstrate and provide training to Owner's personnel on operation and maintenance of equipment and systems prior to scheduled date of Ready-for-Takeover.
- 1.1.2 Owner will provide list of personnel to receive training and will coordinate their attendance at agreed upon times.
- 1.1.3 Coordinate and schedule demonstration and training provided by Subcontractors and Suppliers.

**1.2 Submittals**

- 1.2.1 Submit proposed dates, times, durations, and locations for demonstration and training of each item of equipment and each system for which demonstration and training is required. Allow sufficient time for training and demonstration for each item of equipment or system, or time as may be specified in technical Specifications.
- 1.2.2 Consultant and Owner will review submittal and advise Contractor of any necessary revisions.
- 1.2.3 Submit report(s) within 5 Working Days after completion of demonstration and training:
  - .1 identifying time and date of each demonstration and training session,
  - .2 summarizing the demonstration and training performed, and
  - .3 including a list of attendees.
- 1.2.4 Training video: Submit video record of demonstration and training together with report.

**1.3 Prerequisites To Demonstration And Training**

- 1.3.1 Testing, adjusting, and balancing has been performed in accordance with Contract Documents.
- 1.3.2 Equipment and systems are fully operational.
- 1.3.3 Copy of completed operation and maintenance manual is available for use in demonstration and training.
- 1.3.4 Conditions for demonstration and training comply with requirements specified in technical Specifications.



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**1.4     Demonstration And Training**

- 1.4.1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment and system.
- 1.4.2 Review operation and maintenance manual in detail to explain all aspects of operation and maintenance.
- 1.4.3 Prepare and insert additional information in operation and maintenance manual if required.

**2 .     PRODUCTS**

**2.1     Not Used**

**3 .     EXECUTION**

**3.1     Not Used**

END OF SECTION

## **1. GENERAL**

### **1.1 Summary**

- 1.1.1 Work Included: Provide labour, materials, products, equipment and services to complete the exterior enclosure performance and testing work specified herein. This includes, but is not necessarily limited, to:
- .1 Below-grade construction, including foundation walls and slabs-on-grade.
  - .2 Above-grade construction, including:
    - .1 exterior opaque wall materials and assemblies;
    - .2 roofing systems, including steep-slope and low-slope roofing;
    - .3 outdoor plazas, planters and plaza paving systems and assemblies over occupied spaces; and
    - .4 openings and glazed assemblies including windows, doors, curtain wall and sloped glazing systems.
  - .3 Interface and penetration conditions (flashings, expansion joints and sealants) between each of the materials, components and systems that comprise the above and below-grade building exterior enclosure.
- 1.1.2 This Section includes the general design and performance requirements for the work of Sections which comprise the building enclosure portion of the Work. The requirements specified in this Section shall be read in conjunction with other requirements specified in Contract Documents.
- 1.1.3 This Section also outlines the process for independent, third-party verification that the installed performance of the building enclosure meets or exceeds the minimum performance requirements stipulated in the Contract Documents for this Project.
- .1 Provision of inspection and testing services do not relieve Contractor of responsibility for compliance with Contract Document requirements.
  - .2 Specified inspections, tests, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with Contract Document requirements.
  - .3 Use of testing to discover deficiencies will not be permitted where Contractor's quality-control procedures would make these tests unnecessary.

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## 1.2 **References**

### 1.2.1 The following definitions apply to this Section:

- .1 "Post-Disaster Building": means a building that is essential to provision of services in event of a disaster. This facility is classified as post disaster as defined in the OBC.
- .2 "Operational and Functional Component" and "OFC": means components within building which are directly associated with the function and operation of the facility. OFCs consist of architectural components, building services components, and building contents. Items specified herein may be designated as OFCs and may need to be designed in accordance with performance requirements specified herein and in Section 13 48 50.
- .3 "Building enclosure" and "Building Enclosure": means the part of the building that physically separates the exterior environment from the interior environment. It includes above-grade walls and openings, below-grade walls, slabs, roofs, and the various components and accessories used to achieve continuity and physical connections and transitions between various assemblies.
- .4 "Air Barrier Assembly": means a collection of Air Barrier Materials (i.e. self-adhered sheet air barriers, liquid applied membranes, medium density sprayed polyurethane foam, mechanically fastened commercial building wraps and boardstock air barriers) and Air Barrier Accessories (i.e. sealants, tapes and transition membranes) assembled together to form a continuous barrier to air infiltration into the environmental separator.
- .5 "Air Barrier Material": means a primary material that controls the movement of air into and out of a building.
- .6 "Air Barrier Accessory": means the materials or products which are used to connect different Air Barrier Materials to form a continuous air barrier assembly.
- .7 "Vapour Retarder": means a membrane that reduces the rate at which water vapor can move through a material. The materials the ability to retard the diffusion of water vapor is measured in units known as "perms" or permeability.
- .8 "Vapour Barrier": means material or system within the building construction assembly that impedes water vapour transmission to less than 72 ng/(s-sq.m-Pa) when tested in accordance with ASTM E96 to prevent the accumulation of moisture having potential to cause deterioration of the Building Enclosure.

- .9 "Class 1 Vapour Barrier": means material or system within the building construction assembly that impedes water vapour transmission to less than 5.72 ng/(s-sq.m-Pa) when tested in accordance with ASTM E96 to prevent the accumulation of moisture having potential to cause deterioration of the Building Enclosure.
  - .10 "Testing with Sealed Openings": means testing with intentional openings sealed means that mechanical openings are purposely closed off. Mechanical systems that are intended to be sealed with dampers are only sealed by closing the damper, with no additional sealing provided. Windows and doors are left in the closed and locked position.
  - .11 "Enclosure-Only Testing": similar to sealed openings approach, except all mechanical penetrations are temporarily masked to completely prevent air leakage through them.
  - .12 "Guarded Testing": means a compartmentalized version of a Whole Building Air Test in order to permit testing during the construction phase. All parameters required in a Whole Building Air Test apply.
  - .13 "Whole Building Air Testing": means the testing of the airtightness of a building by means of an air pressure test (airtightness test or "blower door test") which determines the overall remaining leakage of a building.
- 1.2.2 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.3 Administrative Requirements**

- 1.3.1 Pre-Installation Meetings: arrange pre-installation meetings attended by third-party inspection and testing company, Consultant, and Subcontractors whose work is directly associated with or impacted by Building Enclosure activities prior to starting work on the Building Enclosure.
- .1 Quality Management Plan: review Contractor's quality control plan, and confirm that approaches to quality control and quality assurance procedures are coordinated with third-party inspection and testing company monitoring and testing requirements.
  - .2 Document and Product Review: review Contract Documents and confirm compatibility between overlapping and adjacent components supplied and installed by multiple parties who are contributing different Products associated with the assembly of the Building Enclosure.

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- 1.3.2 Scheduling: Schedule construction of sample panels, mock-ups, associated pre-construction and during construction and post-construction testing thereof to account for site-specific installation conditions. Ensure sufficient time is accounted for notifying witnesses of testing, and to permit corrections to proposed construction methods without negatively impacting the Construction Schedule.
- 1.3.3 Role of the Consultant: Consultant is the registered professional of record and is responsible for responding to the Owner's stated project requirements and providing statements of compliance to the Authorities Having Jurisdiction indicating that the objectives of building code functional statements for Building Enclosure performance are met.
- .1 Consultant will rely on third-party inspection and testing company reports in conjunction with the Contractor's field quality control reports to provide opinion on Building Enclosure performance.
- 1.3.4 Role of the third-party inspection and testing company:
- .1 Third-party inspection and testing company will schedule and arrange testing during construction of the Building Enclosure and provide observation during installation of Building Enclosure components in accordance with their contract with Owner.
- .2 Third-party inspection and testing company must assist in establishing best-practice installation procedures for Products forming the Building Enclosure.
- .3 Third-party inspection and testing company must assist in establishing methods for corrective action where site conditions or actual installation result in non-conforming Building Enclosure performance.
- .4 Third-party inspection and testing company will perform testing as directed by the Owner and Consultant and will schedule with Contractor mutually agreed timing for access to site and performance of their activities.
- .5 Third-party inspection and testing company will make recommendations for correction to observed deficiencies to Consultant. Consultant will make final recommendation for any assembly modifications to Contractor.
- 1.3.5 Role of the Contractor:
- .1 Provision and coordination of trades, and sequence of construction to ensure total performance of Building Enclosure from substructure to walls and to roof, including proper insulation depths, continuity of air barrier system joints,

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- junctures and transitions between materials, assemblies of materials, and products.
- .2 Identify a site supervisor to fulfill the "Air Boss" role at Construction Start-Up meeting from the Contractor team. This individual to be solely responsible to ensure continuity of the air barrier is maintained, communicating requirements of airtightness to trades on site and addressing concerns or inquiries back to Consultant or Testing & Inspection team via Request for Information process.
  - .3 Organize trades training for any individuals working on, adjacent to, or penetrating through the air barrier. Training to be repeated on an ongoing basis when new trades working within proximity of the air barrier join the subject development.
  - .4 Organize preconstruction meetings between trades involved in, working adjacent to, or running services through any portion of the entire Building Enclosure system to discuss where each trade scope begins and ends, responsibility and sequence of installation for proper insulation, waterproofing, air-tight joints, junctures, and transitions between materials, products and assemblies of products specified in different sections.
  - .5 Build mock-ups satisfactory to Consultant and third-party inspection and testing company of each assembly type including, junctures, and transitions between products, materials and assemblies.
  - .6 Cooperate with agencies performing required inspections, tests, and similar services, and provide reasonable auxiliary services as requested. Notify Consultants required to review and third-party inspection and testing company a minimum of 10 Business Days in advance of operations to permit assignment of personnel.. Auxiliary services required include, but are not limited to, following:
    - .1 Provision of access to the Work.
    - .2 Provision of incidental labour and facilities necessary to facilitate inspections and tests.
    - .3 Provision of adequate quantities of representative samples of materials that require testing or assistance in taking samples.
    - .4 Delivery of samples to testing laboratories.
    - .5 Provision of security and protection of samples and test equipment at Project Site.

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**1.4 Submittals**

**1.4.1 Product Data:**

- .1 Submit manufacturer's instructions, printed product literature and data sheets for the exterior enclosure commissioning work and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Include recommendations for product application and use.
- .3 Include test data substantiating that products comply with requirements.

**1.4.2 Shop Drawings:** Submit Shop Drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.

- .1 Energy Simulation: Submit energy simulation data conforming to the following:
  - .1 Performance of Glazing: simulated using WINDOW (latest edition) software by Lawrence Berkley Laboratories ("LBL").
  - .2 Performance of Framing (opaque and glazed assemblies): simulated using THERM software by LBL.
- .2 Simulations must be carried out by a qualified simulator and summary reports must bear seal of a Professional Engineer and clearly demonstrate materials used to reduce thermal bridging in the field and at the interfaces of Building Enclosure assemblies.
- .3 Alternatively test results based on testing in accordance with AAMA 1503.1 may be submitted in lieu of energy simulation to verify performance.

**1.4.3 Contractor's Quality Control Plan:** submit quality control plan before pre-construction conference, describing approach to maintaining material and installation quality including the following:

- .1 Lists of third-party standards, guidelines or reference documents forming part of proposed construction best-practices used to achieve specified performance requirements;
- .2 Substrate preparation and installation of air barrier and vapour retarding membranes;
- .3 Treatment of transitions between Building Enclosure components and their penetrations (including doors, frames, glazing, flashings, louvers and other penetrations);
- .4 Confirmation of compatibility between Building Enclosure components;

- .5 Proposed list of observations and tests forming a part of Contractor's quality assurance and quality control activities;
  - .6 Methods for addressing corrective action plans and addressing deficient or incompatible installation procedures;
  - .7 Format and frequency of reports, records of pre-construction meetings and site modifications; and
  - .8 Proposed construction schedule indicating stages of Building Enclosure construction and potential dates for Consultant's, and third-party inspection and testing company's review activities.
- 1.4.4 Manufacturer's Certificates: Submit third-party verification stating conformance with Project requirements, including any material compatibility or limitations specific to Project conditions.
- 1.4.5 Test and Evaluation Reports: Submit reports indicating test methods and results, and stating specifically which attributes apply to the products supplied to the Project.
- 1.4.6 Manufacturer's Installation Instructions: Submit written installation requirements stating required workmanship practices to achieve assembly performance required for the Project.

## **1.5 Closeout Submittals**

- 1.5.1 Maintenance Schedule: Submit summary table that indexes Building Enclosure components requiring maintenance and indicates frequency at which each component requires repair or replacement (i.e. replacement of sealants, gaskets, glazing units, paints or coatings and similar components).
- 1.5.2 Operation and Maintenance Data: Submit operation and maintenance data for each component listed in aforementioned schedule including the following as a minimum:
- .1 Product Data Sheets as specified in this Section.
  - .2 Extended Warranty Information: Include warranties for products, equipment, components, and sub-components whose duration exceeds one year. Include warranties on components with the system they are a part of. Reference all specific operation and maintenance procedures that must be performed to keep warranty valid.
  - .3 Sources of Material: Include reference to contact information where specific materials can be obtained.
  - .4 Installation and Maintenance Instructions: Submit information for each material, component or system.



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**1.6      Quality Assurance**

- 1.6.1 Mock-Ups: Construct mock-ups of each assembly as specified in this Section, including junctures, transitions and interfaces to establish baseline quality for installation and workmanship, and to evaluate enclosure-related constructability and performance, with a specific emphasis on required coordination of Subcontractors and sequencing necessary to ensure that performance of enclosure materials, components, systems, assemblies, and interfaces meets or exceeds requirements of Contract Documents.
- .1 Required Mock-ups: Provide “first installation” in-situ or on site mock-up (as determined by Consultant) of each major Building Enclosure system, including:
    - .1 Each below grade underslab and vertical waterproofing system.
    - .2 Each type of horizontal waterproofing system enclosing occupied space below.
    - .3 Each substantially different type of vertical enclosure assembly (including associated air barriers, insulation, and support materials) including, but not limited to precast concrete assemblies, masonry assemblies, curtain wall and glazed assemblies, and rain screen cladding assemblies.
    - .4 Each low-slope and each steep-slope roofing assembly.
  - .2 Extent of Mock-ups: Ensure extent of each mock-up includes interface of various materials and systems, both between various major assemblies (e.g. foundation waterproofing connection to wall assembly) and between various materials in the same assembly (e.g. interface between window and wall).
    - .1 Wall mock-ups must be minimum of 10 sq. m (100 sq. ft.) and extend one full structural bay wide by one full story high plus additional height as required to connect to assemblies below and above. Ensure mock-up includes typical exterior wall-to-interior floor slab connection. In addition, conform to the following:
    - .3 Curtain Wall Systems, Entrances and Windows: minimum of two full sized unit within rough opening demonstrating installation of transition membranes, sealants and flashings.
    - .4 Masonry Unit Panels: assemble a test panel including placement of a single opening (window and/or door) demonstrating installation of joint sealants and flashings, and placement of vents and weeps.

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- .5 Air Barrier Membranes: apply air barrier membrane to minimum area of 36 sq.m (390 sq. ft), including placement of a single opening (window and/or door) demonstrating overlaps, adhesion to substrates, and compatibility with adjacent materials.
  - .6 Cladding Panels (each type): assemble a test panel including placement of a single opening (window and/or door) demonstrating progressive installation, attachment to substrate, installation of insulation, joint sealants, and placement of flashings and closure strips.
    - .1 Roof mock-ups must be minimum of 10 sq. m (100 sq. ft.) and include parapet or roof edge conditions, as well as typical pipe, supports, and similar penetrations.
    - .2 Horizontal below-grade waterproofing or slab-on-grade vapour retarder mock-ups must be minimum of 10 sq. m (100 sq. ft.) and include edge conditions and typical penetration details.
    - .3 Vertical below-grade waterproofing (foundation wall waterproofing) mock-ups must include typical edge, termination, and penetration details.
    - .4 Solar wall assembly mock-ups must be minimum of 10 sq. m (100 sq. ft.) and include penetration details, installation of insulation, attachment to substrate, installation of insulation, joint sealants, and placement of flashings and closure strips.
  - .7 Sequencing Requirements: Stage each component within mock-ups so that each layer of construction can be reviewed and tested as required to verify performance before succeeding layers of materials are applied.
  - .8 Post Mock-Up Debrief: arrange for post mock-up debrief meetings attended by Contractor, Owner, third-party inspection and testing company, Consultant, and Subcontractors whose work is directly associated or impacted by Building Enclosure activities.
    - .1 Schedule debrief meeting immediately after testing results and observations of the mock-ups is completed.
    - .2 Incorporate lessons-learned arising from observed conditions and testing into Contractor's quality control plan.
  - .9 Modifications to Mock-Ups: mock-ups may require modifications to account for site conditions and compatibility between adjacent materials and assemblies.

- .1 Provide corrective actions as required to obtain acceptance. Repair mock-ups which are permitted to form a part of the final construction that have been damaged or that failed testing.

## **2 . PRODUCTS**

### **2.1 Design And Performance Requirements**

2.1.1 Statement of Building Enclosure Design Intent: The design intent of this building's enclosure is to provide exterior floor, wall, and roof assemblies which prevent uncontrolled air and vapour infiltration into the building; eliminate water infiltration (including condensation) into conditioned spaces; and provide thermal insulation continuity to minimize cold bridging. Products and assemblies used to perform these functions must be technically sound, durable and serviceable.

.1 Design Assumptions:

- .1 Climate Zone: ASHRAE Climate Zone 6a
- .2 Ambient Interior Air Temperature:
  - .1 Occupied Spaces:
    - .1 Heating: 21°C (70°F)
    - .2 Cooling: 23°C (73°F)
  - .2 Vehicle/Supervisor Bay:
    - .1 Heating: 21°C (70°F)
    - .2 Cooling: 26°C (78°F)
  - .3 Electrical/Mechanical Rooms:
    - .1 Cooling: 25°C (77°F)

2.1.2 General Assembly Performance:

- .1 Assemblies described in Contract Documents are expected to achieve the minimum performance requirements specified in this Section as verified by inspection and testing. Performance criteria identified in this Section shall supersede other criteria identified in other parts of Contract Documents.
- .2 Comply with applicable building code, and other regulations and requirements of Authorities Having Jurisdiction, in design, engineering, fabrication and installation of the Work.
- .3 Drawings and details are diagrammatic and are only intended to show design concept, aesthetics, interfacing requirements, configuration, components and arrangements. They are not intended to identify or solve completely problems of thermal and structural movements, assembly framing, engineering design, fixings and anchorages.

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- .4 When difficult-to-construct material connections occur within Building Enclosure construction, advise Consultant at once so that details can be reviewed and installation methodologies confirmed. Poor installation of difficult-to-construct detail is not acceptable.
  - .5 Building Enclosure assemblies shall comply with requirements of OBC Supplementary Standard SB-10 and Region of Peel Net Zero Emissions Building Standard for New Construction.
  - .6 Design of Building Enclosure assemblies is based on "Rain Screen" principle. The definition of the rain screen principle for the purpose of these Specifications is "as advocated by National Research Council of Canada".
    - .1 This approach is founded on the premise that multiple-element protection is necessary in most situations to achieve effective control, by means of a first line of defense that minimizes rainwater passage into wall by minimizing number and size of holes and managing driving forces acting on wall; a second line of defense that intercepts all water that gets past first line of defense and effectively dissipates it to exterior.
    - .2 All voids between assembly components as well as those between components and structure shall have:
      - .1 Gaskets, baffles, overlaps, seals and compartmentalization as required to provide a barrier "Rain Screen" to effectively prevent excessive rain water entry into any of Building Enclosure cavities but allow pressure moderation of cavity air spaces.
      - .2 Low permeability Vapour Barriers to minimize vapour diffusion, where required.
      - .3 Air barriers and seals as required to prevent entry of interior building air into Building Enclosure cavities, and exterior air into building. Air barriers and seals shall be able to withstand wind design pressures.
      - .4 Thermal separators, isolators and seals placed to eliminate direct contact between interior humid air and a cold surface or structural component to prevent condensation and ice build-up on surfaces during cold weather.
  - .7 Air Barrier Continuity:
    - .1 This Project incorporates design principles of positive air and vapour leakage control at Building Enclosure line. Drawing details illustrate continuity of air barrier/vapour

retarder at penetrating elements such as door, window and louver frames.

- .2 In order to maintain continuity of Air Barrier Assemblies, interfacing of various building elements requires close coordination by all trades involved with exterior building elements.
- .3 Air-barrier assembly extends nominally from foundation line, vertically along exterior walls and to positively contact with roof air barrier/vapour retarder or roofing membrane as applicable. Continuity also extends to waterproofing at podium areas, and to inner surface of glazing units. Provide a continuous, unbroken and non-perforated air and vapour seal to totally enclose Building Enclosure and to separate interior and exterior environments.
- .4 Manufacturers of window and door frames must ensure correctly designed and positioned metallic legs, extensions or recesses are provided at thermal break line to facilitate connections of rigid or flexible transition materials prior to setting these elements in their allotted openings.
- .5 Penetrations of air barrier and paths of air infiltration / exfiltration must be sealed.
- .6 Air barrier system shall have following characteristics:
  - .1 It must be continuous, with all joints sealed.
  - .2 It must be structurally supported to withstand positive and negative air pressures applied to Building Enclosure.
  - .3 Connection shall be made between:
    - .1 Foundation and walls.
    - .2 Walls and windows or doors.
    - .3 Different wall systems.
    - .4 Wall and roof.
    - .5 Wall and roof over unconditioned space.
    - .6 Walls, floor and roof across construction, control and expansion joints.
    - .7 Walls, floors and roof to utility, pipe and duct penetrations.
  - .4 Materials: materials used for air barrier system in opaque wall assemblies shall comply with CAN/ULC S741 and shall have an air permeance not exceeding  $0.02 \text{ L}/(\text{s}\cdot\text{m}^2)$  ( $0.004 \text{ cfm}/\text{ft}^2$ ) under

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a pressure differential of 75 Pa (1.57 psf) when tested in accordance with ASTM E2178.

- 2.1.3 Whole Building ('enclosure-only testing' and with 'sealed openings' testing results): less than 0.6 air changes per hour (ACH) under a pressure differential of 50 Pa (1.04 psf).
- 2.1.4 Air Leakage Criteria (in-situ): The air leakage of individual assemblies must not exceed the criteria specified in individual technical specification sections when tested in the field in accordance with ASTM E783.
- 2.1.5 Thermal Performance Criteria: install insulation materials to maintain continuity of performance of the Building Enclosure meeting thermal resistance or thermal conductance ratings specified below:
  - .1 Values provided are imperial measurements unless indicated otherwise.
  - .2 Roofing Assemblies:
    - .1 Nominal R-Value: Minimum R45
    - .2 Assembly U-value: Maximum U-0.022
  - .3 Opaque Wall Assemblies Above-Grade:
    - .1 Nominal R-Value: Minimum R30
    - .2 Assembly U-value: Maximum U-0.033
  - .4 Curtain Wall and Glazed Assemblies:
    - .1 Maximum U-Value: 0.20 (including glass and framing)
    - .2 Solar Heat Gain Coefficient: Maximum 0.30
  - .5 Skylights:
    - .1 Maximum U-Value: 0.47 (including glass and framing)
    - .2 Solar Heat Gain Coefficient: Maximum 0.36
  - .6 Slabs-on-Grade:
    - .1 Nominal: Minimum R30
    - .2 Assembly U-value: Maximum U-0.033
- 2.1.6 Water Infiltration: There must be no water penetration beyond boundary of watertightness defined for fenestration system when following assemblies are tested in the field in accordance with the test method described in Part 3 of this Section.
- 2.1.7 Thermal Bridging: Ensure wall assembly and interface details are thermally broken and meet the OBC SB-10 requirements for continuous insulation to reduce structural connections which create thermal bridging.

- .1 As a minimum, provide materials to minimize or prevent thermal bridging at the following locations and interfaces:
  - .1 Cladding and insulation attachment at opaque wall assemblies.
  - .2 At-grade transitions.
  - .3 Slab-edges and transitions.
  - .4 Glazing-to-wall transitions.
  - .5 Interior-to-exterior wall intersections.
  - .6 Assembly corners.
  - .7 Parapets.
  - .8 Roof penetrations and transitions.
  - .9 Exterior-to-interior structural components.

## **2.2 Service Providers**

- 2.2.1 The following service providers may be acceptable subject to conformance to requirements of Contract Documents:
  - .1 Exp inc.
  - .2 Intertek Testing Services
  - .3 UL CLEB
- 2.2.2 Comparable providers to those listed herein offering equivalent services in Consultant's opinion, and subject to Consultant's review, will be considered provided they meet the requirements of this Specification.

## **3 . EXECUTION**

### **3.1 Examination**

- 3.1.1 Examine substrates, areas, and conditions, for compliance with requirements for installation tolerances, supports, and other conditions affecting performance of the Work.

### **3.2 Preparation**

- 3.2.1 Protect construction from weather and other sources of moisture that are deleterious to the tested assemblies.
- 3.2.2 Repair or replace Building Enclosure components that are damaged as a consequence of exposure to weather conditions deleterious to the final construction.

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### **3.3     Workmanship**

- 3.3.1 Install materials and systems according to best-practices relating to quality of workmanship, and coordination and installation of specified Products to maintain continuity of the Building Enclosure.
- .1 Treatment of Penetrations: Use methods for making and sealing penetrations to maintain continuity of vapour, water and air control assemblies.
    - .1 Ensure mechanical and electrical work scheduled installed/modified within exterior Building Enclosure system is properly tied into Building Enclosure and does not compromise performance of Building Enclosure.
    - .2 Ensure mechanical and electrical penetrations through Building Enclosure are sealed against air leakage and water penetration and are designed to prevent condensation within exterior Building Enclosure system.
    - .3 Ensure mechanical water piping that is installed/modified within exterior wall system is free of leaks and protected from freezing.
    - .4 All penetrations through vapour, water and air control assemblies must be fully sealed according to manufacturer instructions.
  - .2 Modification of Installation: Identify installation difficulties and make modification to installation to account for site conditions that differ from manufacturer's standard detailing or testing results. Make such modifications to reduce or eliminate potential for installation deficiencies.
  - .3 Sequencing and Compatibility: Confirm compatibility between Products provided by different parties or that are used to join dissimilar components. Sequence such transitions and overlap materials to ensure they shed water to the exterior face of the Building Enclosure.
  - .4 Workmanship: Train installers on Building Enclosure best-practices and provide them with update when modifications occur resulting from changes to site conditions and testing results.

### **3.4     Field Quality Control (Performance Testing)**

- 3.4.1 The objective of performance testing is to demonstrate that each Building Enclosure system, and system-to-system interface meets or exceeds the performance requirements of the Contract Documents and the Building Enclosure Design Intent specified in this Section.



- .1 Unless otherwise indicated, costs associated with initial performance testing shall be paid by Owner through cash allowance.
  - .2 Costs associated with re-testing caused by failure of the Building Enclosure tests, during mock-up review or during the construction phase, shall be the responsibility of the Contractor.
- 3.4.2 Contractor's Collaboration: third-party inspection and testing company will coordinate with Contractor's schedule and make themselves aware of current work. Third-party inspection will bring to attention of the Consultant and Contractor any observation or testing requirement forming a part of their scope of auditing services, but not less than those listed in this Section.
- .1 Access to Site: Contractor must provide reasonable access to the Project site, and any personnel or equipment required to assist third-party inspection and testing company in performance of their service and maintain site safety.
  - .2 Services: Contractor must provide electrical, water or other utilities or services required by third-party inspection and testing company for performance of their work.
  - .3 Scheduling and Coordination:
    - .1 Contractor must coordinate sequence of testing activities to accommodate required inspection and testing services with minimum delay.
    - .2 Contractor must coordinate construction activities to avoid removing and replacing construction to accommodate observations and tests required by third-party inspection and testing company.

### **3.5 Non-Conformance**

- 3.5.1 Non-conformance and deficiencies identified during periodic site visits or performance testing shall be resolved as follows:
- .1 Third-party inspection and testing company will record the results of the performance test or its site visit observation in a report. All deficiencies or non-conformance issues shall be noted as action items on a punch-list and reported to Contractor through Consultant.
  - .2 Corrections of identified minor deficiencies may be made during the site visit at the discretion of third-party inspection and testing company. In such cases the deficiency and associated resolution will be documented in the field report.
  - .3 As site visits or tests progress and a deficiency is identified, the third-party inspection and testing company will discuss the

issue with Contractor and Consultant for follow-up and resolution.

- .1 Third-party inspection and testing company shall document deficiency and Contractor's response.
- .2 Contractor shall correct the deficiency and notify third-party inspection and testing company and Consultant in writing that issue is resolved and/or product, material or assembly is ready to be retested.
- .3 Contractor shall reschedule the test and the test shall be repeated. This process shall be repeated until test results meet or exceed requirements of Contract Documents.
- .4 Contractor shall be responsible for costs associated with re-testing.
- .4 Conformance will only be deemed complete upon successful performance testing and review by third-party testing and inspection agent.

### **3.6 Air Infiltration Testing**

- 3.6.1 Read in conjunction with Testing Responsibility Matrix in Section 01 91 15
- 3.6.2 Glazed Assemblies (curtain wall and punched windows):
  - .1 Test Method(s): pressurized chamber testing in accordance with ASTM E783.
  - .2 Scope of Testing: Mock-up (first installation) and during construction phase.
  - .3 Frequency: minimum 3 tests per system as selected by Consultant.
  - .4 Success Criteria: Not to exceed leakage rate indicated in Section 08 44 13.
- 3.6.3 Opaque Wall Assemblies (including transitions to adjacent systems, field of air barrier and penetrations):
  - .1 Test Method(s): Refer to Testing Responsibility Matrix in Section 01 91 15
  - .2 Scope of Testing: Mock-up (first installation) and during construction phase.
  - .3 Frequency: As determined by third-party inspection and testing company.
  - .4 Success Criteria: Not to exceed leakage rate indicated in Section 07 27 14.
- 3.6.4 Whole Building Air Leakage Testing:
  - .1 Test Method(s):

- .1 Fan pressurization testing in accordance with ASTM E779 or orifice blower door testing in accordance with ASTM E1827 or EN 13829 Method A
- .2 Smoke Tracer: third-party inspection and testing company may include observations using smoke tracer or theatrical fog in accordance with ASTM E1186 in conjunction with building pressurization to confirm anomalies identified using infrared scanning or to differentiate thermal bridging effects.
- .2 Frequency:
  - .1 At completion of air barrier work, and prior to installation of insulation ('enclosure-only testing').
  - .2 At completion of mechanical systems work, upon systems start-up ('sealed openings testing').
- .3 Success Criteria: As specified in this Section.

### **3.7 Water Penetration Testing**

- 3.7.1 Read in conjunction with Testing Responsibility Matrix in Section 01 91 15
- 3.7.2 Glazed Assemblies (curtain wall and punched windows):
  - .1 Test Method(s): pressurized chamber testing in accordance with ASTM E1105
  - .2 Scope of Testing: Mock-up (first installation) and during construction phase.
  - .3 Frequency: minimum 3 tests per system as selected by Consultant.
  - .4 Success Criteria: No leakage at 720 Pa (15 psf) pressure differential.
- 3.7.3 Tubular Skylights:
  - .1 Test Method(s): Refer to Testing Responsibility Matrix in Section 01 91 15
  - .2 Scope of Testing: Mock-up (first installation) and during construction phase.
  - .3 Frequency: as selected by Consultant.
  - .4 Success Criteria: No leakage.
- 3.7.4 Opaque Wall Assemblies including auxiliary components such as louvers, expansion joints and similar components:
  - .1 Test Method(s): Water-spray test in accordance with AAMA 501.2 at transitions, corners, penetrations determined by Consultant.

- .2 Scope of Testing: Mock-up (first installation) and during construction phase.
- .3 Frequency: Minimum three (3) locations as selected by Consultant.
- .4 Success Criteria: No leakage.

### **3.8 Thermal Performance Verification**

- 3.8.1 Read in conjunction with Testing Responsibility Matrix in Section 01 91 15
- 3.8.2 Wall Assemblies including openings and auxiliary components such as louvers, expansion joints and similar components:
  - .1 Test Method(s): Thermographic scan in accordance with ASTM C1060 or CAN/CGSB 149-GP-2MP.
  - .2 Frequency: To be performed for all wall assemblies.
  - .3 Success Criteria: Insulation is at full thickness and continuous in all cavities. No unacceptable thermal bridging.
- 3.8.3 Roof Assemblies:
  - .1 Test Method(s): Thermographic scan in accordance with ASTM C1153.
  - .2 Frequency: To be performed for all roof assemblies.
  - .3 Success Criteria: Insulation is at full thickness and continuous. No thermal anomalies associated with wet insulation.

### **3.9 Adhesion Testing**

- 3.9.1 Read in conjunction with Testing Responsibility Matrix in Section 01 91 15
- 3.9.2 Air Barrier Membrane Testing:
  - .1 Test Method(s): Pull-off testing in accordance with ASTM D4541.
  - .2 Frequency: As determined by third-party inspection and testing company.
  - .3 Success Criteria: Pull-off strength of membrane conforms to manufacturer's published data.
- 3.9.3 Sealants Adhesion Tests:
  - .1 Test Method(s):
    - .1 Destructive: in accordance with Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
    - .2 Non-destructive: in accordance with ASTM C1521, using Nondestructive Spot Method.

- .3 For joints with dissimilar substrates, verify adhesion to each substrate separately.
- .2 Frequency: As determined by third-party inspection and testing company.
- .3 Success Criteria: Sealant adhesion passes sealant manufacturer's field-adhesion hand-pull test published data.

**3.10 Repair And Protection**

- 3.10.1 Repair damaged construction and restore substrates and finishes following observation, testing, sample taking and similar services. Repair surfaces immediately after testing and sampling is completed to prevent damage to assemblies resulting from moisture diffusion or air leakage.
- 3.10.2 Protection of Installed Products: take necessary precautions to prevent puncturing, tearing, weakening or damaging of Building Enclosure membranes during construction; and immediately repair damage as directed by Consultant.

**END OF SECTION**

## **1. GENERAL**

### **1.1 Section includes, but is not limited to:**

- 1.1.1 Building Enclosure Commissioning, testing and documentation.
- 1.1.2 Audit testing and the commissioning auditor.

### **1.2 Summary**

- 1.2.1 The design intent of the building enclosure is to provide exterior floor, wall, and roof assemblies which prevent uncontrolled air, vapour, and water infiltration and include products and assemblies that are technically sound, durable and serviceable. This section includes requirements for non-structural commissioning of the building enclosure, including, but not limited to the following:
  - .1 Below-grade construction, including foundation walls and slabs-on-grade.
  - .2 Above-grade construction, including: exterior wall materials and assemblies; sloped and low-slope roofing, outdoor plazas, planters and plaza paving systems and assemblies over occupied space, as well as glazed window, curtain wall and sloped glazing systems.
  - .3 Interface conditions (flashings, expansion joints, sealant) between each of the materials, components and systems that comprise the above and below- grade building exterior enclosure.
- 1.2.2 The purpose of the building enclosure commissioning (BECx) is to provide a process for independent, third-party verification that the installed performance of the building enclosure meets or exceeds the minimum performance requirements set forth by the Contract Documents for this project. The materials, components, systems, and assemblies that comprise the above and below-grade building exterior enclosure will be evaluated and tested as outlined in this Section, as well as in accordance with each of the technical Sections associated with the design and construction of the building enclosure.

### **1.3 Related Requirements**

- 1.3.1 The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.
- 1.3.2 Sections of work which may have requirements related to this Section include, but are not limited to:
  - .1 Substitution Procedures Section 01 25 00

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.2	Submittal Procedures	Section 01 33 00
.3	Quality Requirements	Section 01 40 00
.4	Closeout Procedures	Section 01 77 00
.5	Closeout Submittals	Section 01 78 00
.6	General Commissioning Requirements	Section 01 91 00
.7	Building Envelope Commissioning	Section 01 91 15
.8	Sheet Waterproofing	Section 07 13 26
.9	Foamed-In-Place Insulation	Section 07 21 19
.10	Under Slab Vapour Barriers	Section 07 26 16
.11	Self-Adhering Air Barriers/Vapour Retarders	Section 07 27 14
.12	Aluminum Composite Panels	Section 07 42 13
.13	Solid Aluminum Plate Wall Panels	Section 07 42 19
.14	PER Cementitious Panel Systems	Section 07 42 46
.15	Glass-Faced Rainscreen Cladding Systems	Section 07 44 36
.16	Steel Siding Panels and Soffits	Section 07 46 13
.17	Aluminum Interlocking Metal Systems	Section 07 46 18
.18	Modified Bituminous Membrane Roofing	Section 07 52 16
.19	Flashing and Sheet Metal	Section 07 62 00
.20	Joint Sealants	Section 07 92 00
.21	Steel Doors and Frames	Section 08 11 13
.22	High Speed Roll-Up Doors	Section 08 88 23.13
.23	Overhead Coiling Doors	Section 08 33 24
.24	Sliding Automatic Entrances	Section 08 42 31
.25	Glazed Aluminum Curtain Walls	Section 08 44 13
.26	Tubular Skylights	Section 08 63 00
.27	General Requirements for Glass and Glazing	Section 08 80 05
.28	Exterior Glass and Glazing	Section 08 81 23
.29	Fixed Louvres	Section 08 91 00

#### **1.4 References**

- 1.4.1 Owner's Project Requirements (OPR) and Basis of Design (BOD)
- 1.4.2 ASHRAE Guideline 0-2005 - The Commissioning Process
- 1.4.3 National Institute of Building Sciences Guideline 3-2012 "Exterior Enclosure Technical Requirements for the Commissioning Process"
- 1.4.4 ASTM E2813-12 – Standard Practice for Building Enclosure Commissioning
- 1.4.5 AAMA/WDMA/CSA 101/I.S.2/A440, NAFS 2011 – North American Fenestration

- 1.4.6 AAMA 501.2-15: Quality Assurance and Water Field Check of Installed Storefronts, Curtain Walls and Sloped Glazing Systems
- 1.4.7 ASTM C1060: Standard Practice for Thermographic Inspection of Insulation Installations in Enclosure Cavities of Frame Buildings
- 1.4.8 ASTM C1153: Standard Practice for Location of Wet Insulation in Roofing Systems Using Infrared Imaging
- 1.4.9 ASTM C1521-19: Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints
- 1.4.10 ASTM D7877-14: Standard Guide for Electronic Methods for Detecting and Locating Leaks in Waterproof Membranes
- 1.4.11 ASTM D4541-09: Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
- 1.4.12 ASTM D7234-19: Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers
- 1.4.13 ASTM E779: Standard Test Method for Determining Air Leakage Rate by Fan Pressurization
- 1.4.14 ASTM E783: Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors
- 1.4.15 ASTM E1105: Standard Test Method for Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference
- 1.4.16 ASTM E1186: Standard Practice for Air Leakage Site Detection in Building Enclosures and Air Retarder Systems.
- 1.4.17 ASTM E1258: Standard Test Method for Airflow Calibration of Fan Pressurization Devices.
- 1.4.18 ASTM E1827: Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door.
- 1.4.19 ASTM E3158: Standard Test Method for Measuring Air Leakage Rate of a Multizone Building.
- 1.4.20 ASTM F2170 18 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Results.

## **1.5 Definitions and Abbreviations**

- 1.5.1 Consultant: Consultant-of-Record or Architect-of-Record for this project.
- 1.5.2 Building Enclosure: The physical separator between the interior and exterior environments of a building. Typical building enclosure components include the base floor systems, below-grade wall systems, above-grade wall systems (including windows and doors), and the roof systems.



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- 1.5.3 Building Enclosure Commissioning (BECx): The process of inspecting and testing building components and assemblies to ensure the installed performance of the building enclosure meets or exceeds the minimum performance requirements set forth by the Contract Documents.
  - 1.5.4 Building Enclosure Commissioning Authority (BECxA): The Party retained by the Commissioning Authority which will manage the BECx process, develop and stipulate the BECx requirements, and validate that the components and assemblies are designed, constructed, and tested to meet requirements set forth in the in the Contract Documents.
  - 1.5.5 Building Enclosure Commissioning Plan (BECxP): Project-specific protocol developed by the BECxA, which outlines the BECx process for all related components and assemblies. This document will identify the Commissioning Team and include comprehensive checklists and general schedule of all tasks involved in the BECx, including design reviews, construction observations, mock-up construction and testing, whole building air leakage testing, and technical reports that will be produced over the course of the Project.
  - 1.5.6 Building Enclosure Commissioning Report: The final deliverable from the BECx process, this document includes a full summary report with appropriate documentation including the following information: a narrative describing the BECx items and issues found, a summary and list of enclosure systems and components included in the commissioning program, a description of non-compliant conditions noted during site observations with follow up documentation on the means and methods to resolve, and summary results of building performance testing.
  - 1.5.7 Building Enclosure Commissioning Team: Owner and their consultants, Contractor, Consultant, Commissioning Authority, Building Enclosure Commissioning Authority.
  - 1.5.8 Commissioning Authority (CxA): The Party responsible for coordinating and carrying out the entire scope of the commissioning process. The Commissioning Authority collaborates with the BECxA to accomplish the building enclosure commissioning.
  - 1.5.9 Contract Documents: Documents governing the responsibilities and relationships between Parties involved in the design and construction of this project, including (but not limited to): Agreements/Contracts, Drawings and Specifications, Addenda, Change Orders, BECx Plan (for reference only).
  - 1.5.10 Construction Documents: Refers to the Contract Documents that dictate the details of construction.
  - 1.5.11 Contractor: As used herein, 'Contractor' is a general reference to the installing Party and can therefore refer to the General

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Contractor, Project Manager, subcontractors, or vendors as inferred by its usage.

**1.6 Building Enclosure Commissioning Authority Scope of Services/Responsibilities**

- 1.6.1 CxA will engage a qualified BECxA to perform all consulting services, including design reviews, collaborative meetings, quality assurance observations, site mock-up reviews and field testing, unless specified otherwise.
- 1.6.2 Prior to commencement of construction, develop a Building Enclosure Commissioning Plan (BECxP) for this project, which outlines the BECx process for all related components and assemblies. This document will identify the Commissioning Team and include a comprehensive checklist and general schedule of all tasks involved in the BECx, with responsibilities assigned, including planning meetings, design reviews, construction observations, mock-up construction and testing, fenestration testing, and whole building air leakage testing, and technical reports that will be produced over the course of the Project.
- 1.6.3 During construction phase, deliverables to the CxA and Owner will include the following:
  - .1 Photograph-based quality assurance reports
  - .2 Technical memoranda
  - .3 Written recommendations for proposed solutions of deficiencies noted
  - .4 Checklists, completed by the Contractor and all applicable building enclosure subtrades, with annotation of deficiencies
  - .5 Submittals for all field testing to be performed
  - .6 Comprehensive technical reports for all field testing performed and witnessed at site.
- 1.6.4 Review project drawings and specifications at 90% design complete for constructability and conformance with respect to air, water, and vapor barriers of the exterior building enclosure. Prepare a written report along with marked up drawing sheets.
- 1.6.5 Review and comment on submittals from the Contractor for compliance with the building enclosure requirements set forth in the Contract Documents. Note that the BECxA does not have the authority to accept or reject submittals.
- 1.6.6 Schedule a pre-construction commissioning conference prior to start of the construction of the building enclosure, at a time convenient to the Owner, Contractor, and Consultant. The BECxA

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- will conduct the meeting to review commissioning responsibilities and personnel assignments.
- .1 Attendees: Authorized representatives of Owner, all Contractors whose work is relevant to the building enclosure, Commissioning Authority, Consultant, and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to commissioning.
  - .2 Agenda: Discuss items of significance that could affect progress including the following:
    - .1 Building Enclosure Commissioning Plan and related specifications
    - .2 Tentative construction schedule per Contractor
    - .3 Phasing
    - .4 Critical work sequencing
    - .5 Designation of key personnel and their duties
    - .6 Mock-up construction and testing
    - .7 Procedures for testing and inspecting
    - .8 Submittal procedures
    - .9 Preparation of record documents
    - .10 The process for correcting deficient work
    - .11 Maintenance requirements to maintain enclosure
  - 1.6.7 Observe construction of building enclosure work and report progress and deficiencies. Provide a report of each site visit, including a list of observed deficiencies and discrepancies, to CxA, Owner and General Contractor.
  - 1.6.8 Inspect the air barrier assembly for continuity and integrity at the follow locations in the building prior to 5% completion of each:
    - .1 Roof-wall intersections
    - .2 Fenestration flashing
    - .3 Fenestration installation
    - .4 Bottom of wall (wall-to-foundation connection)
    - .5 Connection of dissimilar wall and roof assemblies
    - .6 Isolation of interior rooms such as mechanical and paint rooms
    - .7 Wall and roof penetrations
  - 1.6.9 Facilitate, perform or observe mock-up field testing of exterior building enclosure components and assemblies, as required by the Contract Documents. Document construction of commissioned
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components at the completion of mock- up testing and provide a technical report with this information to CxA and Owner.

- 1.6.10 Participate (in person if conducted during BECxA observation of building enclosure work, or remotely if not) in periodic BECxA meetings to review and discuss issues and concerns related to the building enclosure noted by the Consultant of Record, the CxA, BECxA, and the Owner.
- 1.6.11 Facilitate, perform or observe field tests identified to be accomplished by the "Testing Agency" in the Sections identified in Part 3. After all air barrier components are installed, facilitate and perform whole building air tightness testing in accordance with the Contract Specifications. Testing shall consist of both performance and diagnostic evaluations. Document test results and provide to the CxA and Owner.
- 1.6.12 BECxA to compile submissions for the Building Enclosure Systems Manual as provided by the Contractor and Consultant. See Clause 1.7.13.
- 1.6.13 Prepare BECxA Report and deliver to CxA and Owner.

## **1.7 Contractor Responsibilities**

- 1.7.1 The Contractor shall be responsible for controlling the quality of the building system construction on a day-to-day basis.
- 1.7.2 Furnish copies of all submittals, shop drawings, manufacturer's literature, installation instructions, maintenance information, schedules, warranties, or other information as requested. Note that it is the Consultant and Contractor's responsibility to approve or reject submittals and shop drawings.
- 1.7.3 Provide access to work, including scissor/boom lifts and/or scaffolding and/or swing stages, and coordinate scheduling with the BECxA to perform BECxA tasks.
- 1.7.4 Provide qualified personnel for assistance in completing the commissioning inspections and tests for elements of the building enclosure.
- 1.7.5 Provide a power and water source for completing the commissioning tests for elements of the building enclosure.
- 1.7.6 The Contractor shall be responsible for constructing testing chambers to facilitate air and water leakage testing, at the locations and methods determined collaboratively with the project team.
- 1.7.7 Submit a copy of the General Contractor's project and site-specific Quality Assurance program to be implemented for construction for review prior to beginning of construction.

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- 1.7.8 Participate and ensure all subcontractors utilized for work on the building enclosure participate in the Preconstruction Meeting with the design and construction teams, Owner's representatives, CxA and BECxA.
  - 1.7.9 Complete and participate in the construction of on-site mock-ups including elements of the building exterior enclosure, as identified in individual sections of the specifications in Divisions 2 through 9.
  - 1.7.10 Provide personnel to be present and have a representative present from each trade and/or subcontractor associated with installing the systems during mock-up performance testing. Personnel who are to be completing work in the field are to be utilized to participate in the construction of on-site mock-ups of building enclosure assemblies as required by the Construction Documents, and to have a representative present during inspection and testing of mock-ups. If deficiencies are observed within the mock-up, provide labor and materials to repair or reconstruct the mock-up such that deficiencies do not exist and mock-up passes field testing.
  - 1.7.11 Schedule and conduct periodic BECx meetings with a representative present from each trade and/or subcontractor to review and discuss issues and concerns related to the building enclosure noted by the Consultant of Record, the CxA, BECxA, and the Owner and what action will be taken to address the noted non-conformances. Maintain a summary of non-conformances and current status.
  - 1.7.12 Reimburse Owner for additional testing and inspections if building enclosure systems and mock-ups are not constructed per Construction Documents.
  - 1.7.13 Prepare the building enclosure to be in the "Closed" position as directed by the BECxA for whole building Air Barrier Testing.
  - 1.7.14 If the building fails the Air Barrier Tests, BECxA will coordinate with the Testing Agency to perform diagnostics to identify deficiencies and sources of air leakage. Trades related to deficiencies shall provide labor and materials to adequately repair these areas.
  - 1.7.15 Contractor to coordinate with the Consultant as required to provide the Building Enclosure Systems Manual submittals. The Building Enclosure Systems manual will be included as part of the Operations and Maintenance Manual. This Systems Manual includes the following items, as related to the building enclosure:
    - .1 Identification of installed exterior enclosure components, assemblies, systems, and equipment.
    - .2 Certificate of completion, certifying that exterior enclosure assemblies, systems, equipment and associated controls are complete and ready for testing.

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- .3 As-built drawings, including a copy of all details and drawings that were installed as part of any addendums or change orders directives.
  - .4 Project specifications, including all accepted product substitutions and any additional specifications as part of addendums or change order directives.
  - .5 A copy of all accepted change orders.
  - .6 A copy of all shop drawings with the Consultant's mark-ups, showing the as- built conditions.
  - .7 A copy of all warranties, organized by product, and all product manufacturer's letters indicating the product as appropriate to the use for the application installed at this project.
  - .8 A master product list summarizing all products used on the project for construction of the building enclosure, organized by tabs in a binder, including the following:
    - .1 Product name
    - .2 Product manufacturer
    - .3 Catalog or other applicable number for ordering
    - .4 Manufacturer's contact information, including the contact information for the technical representatives
    - .5 Product color
    - .6 Supplier contact information
  - .9 Product installation instructions, including instructions supplied with any of the shop drawings
  - .10 Manufacturer's product maintenance guide
  - .11 Manufacturer's checklist for periodic review/maintenance plan
  - .12 All submittals pertinent to BECx.
- 1.7.16 The Building Enclosure Systems Manual shall be developed for each major building exterior enclosure system including, but not limited to:
- .1 Roof systems (including parapets, penetrations, curbs, etc.)
  - .2 Exterior wall systems (all types)
  - .3 Windows
  - .4 Doors
  - .5 Sealants
  - .6 Building expansion joint accessories (roof and wall)
  - .7 Flashings
  - .8 Curtain walls/window walls, storefronts

- .9 Below-grade waterproofing
- .10 Planters and planted areas adjacent to building enclosure
- .11 Floors (slab-on-grade, crawlspace, etc.)
- .12 Any other special building enclosure system, equipment and controls.

## **1.8 Consultant Responsibilities**

- 1.8.1 Provide paper and electronic copies of project drawings and specifications to the BECx A.
  - .1 Clearly illustrate the continuous air barrier boundary on additional plan and section sheets, as required. Boundary to include integrated floor/slab, walls, and roof/ceiling assemblies.
  - .2 Clearly define air barrier materials and assemblies for each component on drawings and in related specifications. Specified air barrier materials and assemblies should meet the requirements set forth in applicable Divisions of the Specification.
  - .3 Provide surface area calculations for the air barrier boundary.
  - .4 Provide details illustrating integration of air barrier materials at all transitions (e.g., roof-to-wall, wall-to-floor, building expansion joints, exterior doors and windows, etc.).
  - .5 Provide as-built drawings and specifications to the BECx A.
- 1.8.2 Provide written responses to design review comments from the CxA or other parties as requested.
- 1.8.3 Attend pre-construction commissioning conference.
- 1.8.4 Perform submittal review, construction observation, as-built drawing preparation, etc. as contracted.
- 1.8.5 Coordinate resolution of system deficiencies identified during BECx according to contract documents.

## **1.9 Consultant Responsibilities**

- 1.9.1 Submit manufacturer's product literature in accordance with Contract Documents.

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**2 . PRODUCTS – NOT USED**

**3 . EXECUTION**

**3.1 General Requirements**

3.1.1 Systems to be commissioned: Refer to the Related Documents and Sections identified in 1.3 for specific requirements. The systems and elements to be commissioned include, but are not limited to:

- .1 Roof systems (including parapets, penetrations, curbs, etc.)
- .2 Exterior wall systems (all types)
- .3 Curtain walls/window walls, storefronts
- .4 Windows
- .5 Skylights
- .6 Doors
- .7 Sealants
- .8 Building expansion joint accessories (roof and wall)
- .9 Flashings
- .10 Below-grade waterproofing
- .11 Floors (slab-on-grade)
- .12 Any other special building enclosure system, equipment and controls.

3.1.2 Contractors shall provide sufficient notice to the BECxA regarding their completion schedule for the mock-up assemblies or enclosure.

3.1.3 Mock-up Testing Requirements

- .1 Mock-up tests will be performed by the BECxA per Contract Documents in order to verify component and assembly performance prior to commencing with construction or during the first phase of construction.
- .2 Contractors shall provide sufficient notice to the BECxA regarding their completion schedule for the mock-up assemblies or exterior enclosure systems. The BECxA will schedule field testing through the Contractor and CxA.
- .3 If mock-ups do not pass initial testing, Contractor shall provide labor and materials to repair mock-up until a successful test is achieved.
- .4 Add an alternate to do testing on a partially complete building.



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### **3.2 Site Reviews and Reporting**

- 3.2.1 The Cx Authority will develop a preliminary schedule for site reviews, based on the project schedule produced and maintained by the Contractor. The schedule will include milestones for site reviews, and those which will include mock-ups.
- 3.2.2 During site reviews the Contractor shall provide to the Cx Authority access to building enclosure components and systems listed in section 3.1.1 above and to corresponding Contractor's sheets for review and copying.
- 3.2.3 The Contractor shall review this information and advise the Consultant when a project milestone is forthcoming that will require review by the Cx Authority.
- 3.2.4 The Contractor shall provide 1 weeks' notice of a pending review. The Cx Authority will schedule the review accordingly, and subsequently coordinate with the Contractor.

### **3.3 Building Enclosure Mock-Ups**

- 3.3.1 Building enclosure mock-ups specified shall be used primarily for determining interface detailing of building enclosure components, to ensure performance and durability, and to set standards with the crews performing the work. The Consultant may specify their own mock-ups to review other requirements, including appearance.
- 3.3.2 Mock-ups shall be constructed for review by the Cx Authority, Consultant, Owner, and others on the Cx Team, as deemed necessary. Locations and type of mock-ups shall be determined at site collaboratively with the project team.
- 3.3.3 Mock-Ups shall demonstrate how the pertinent components in the construction detail will interface to satisfactorily manage heat, air, and moisture to result in an assembly that is durable and performs as intended.
- 3.3.4 The Contractor shall make necessary additions and modifications to mock-ups as requested by the Cx Authority and Consultant until final acceptance is obtained. Documentation of mock-ups by the Cx Authority will be accomplished via regular site review memos.
- 3.3.5 Construction of the mock-up assemblies shall be under the supervision of the same personnel who will be employed for the subsequent work.
- 3.3.6 If a change in personnel completing the work is planned, the Contractor shall ensure the knowledge and skills obtained during the mock-up and subsequent construction are transferred effectively to new personnel.

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**3.4     Building Enclosure Testing**

- 3.4.1 Testing shall be attended by the Cx Authority, Consultant, Owner, and others on the Cx Team, as deemed necessary. Locations shall be determined at site collaboratively with the project team.
- 3.4.2 Assemblies being tested shall be complete to an extent that permits the Cx Authority and Cx Team to decide regarding whether the assembly or component will effectively and permanently control the tested phenomena. For example, an assembly being tested for water tightness must have all membranes, flashings and sealants associated with the precipitation control layer complete, but not necessarily those components associated with the thermal control layer, as the latter should not substantially impact the precipitation control function of the assembly.
- 3.4.3 Localized calibrated nozzle water penetration testing shall be completed as follows:
  - .1 All localized nozzle water penetration testing shall be performed in accordance with the most recent iteration of AAMA 501.2: Quality Assurance and Diagnostic Water Leakage Field Check of Installation Storefronts, Curtain Walls, and Sloped Glazing Systems.
  - .2 The number of tests and test locations shall be selected by the BECxA.
    - .1 Curtain Walls: Minimum of one (1) curtain wall module test specimen interfacing with adjacent wall assemblies at 10%, 25%, and 75% construction completion. Test specimen to include, head, sill and jambs interfacing with adjacent wall assemblies, minimum 50 linear feet in length.
    - .2 Tubular Skylight: Test minimum one (1) tubular skylight at 10% construction completion. Test specimen to include, head, sill and jambs interfacing with adjacent wall assemblies, minimum 50 linear feet in length.
  - .3 Testing to be performed by the 'Testing Agency'.
  - .4 The test apparatus will be provided by the 'Testing Agency'.
  - .5 Hose and water source with at least 30 psi pressure at the hose outlet shall be provided by the Contractor.
  - .6 Reporting for water penetration testing shall be done in the form of a regular site review memo. The reporting shall identify pertinent items, such as:
    - .1 Locations and photos of the testing;
    - .2 Description of the test apparatus and methodology;

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- .3 Environmental conditions during testing;
  - .4 Results of the testing ("Pass" or "Fail");
  - .5 Summary of potential reasons for "failure" (if appropriate);
  - .6 Recommendations for follow-up action.
- .7 Deficiencies or non-conformance identified in all tests will be identified and tracked in the Cx Log maintained by the CxA, as described above.
- 3.4.4 Chamber water penetration shall be performed in accordance with the most recent iteration of ASTM E1105: Standard Test Method for Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors and Curtain Walls, by Uniform or Cyclic Static Air Pressure Differential. Testing shall be completed as follows:
- .1 The number of tests and test locations shall be selected by the BECxA.
    - .1 Curtain Wall: Test minimum one (1) curtain wall module (including fixed, operable and spandrel unit) at 10%, 25%, and 75% construction completion. Curtain wall test specimen to include horizontal expansion joint.
    - .2 Tubular Skylight: Test minimum one (1) tubular skylight at 10% construction completion.
  - .2 Testing to be performed by the 'Testing Agency'.
  - .3 The test apparatus will be provided by the 'Testing Agency'.
  - .4 Testing chambers required for building enclosure pressurization shall be constructed by the Contractor at locations selected by the BECxA.
  - .5 Construct test chambers in accordance with the most recent iteration of ASTM E1105: Standard Test Method for Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.
  - .6 All localized water penetration testing shall be performed in accordance with the most recent iteration of ASTM E1105: Standard Test Method for Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.
  - .7 The procedure used for water penetration testing shall be Procedure A— Test under uniform static air pressure difference. The test apparatus used shall be an interior-

mounted depressurization chamber with exterior-mounted water spray system.

- .8 The level of pressurization for localized water penetration testing shall be determined by the BECx Authority in accordance with the Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440/NAFS 2011 - North American Fenestration Standard Specification for Windows, Doors, and Skylights.
  - .9 Additional levels of pressurization may be requested or specified by the Consultant and or Owner. If additional levels of pressurization are provided, testing shall be first performed at the lowest level of pressurization. The pressure shall be increased until completion of testing at all pressures, or failure.
  - .10 Reporting for water penetration testing shall be done in the form of a regular site review memo. The reporting shall identify pertinent items, such as:
    - .1 Locations and photos of the testing;
    - .2 Description of the test apparatus and methodology;
    - .3 Environmental conditions during testing;
    - .4 Results of the testing ("Pass" or "Fail");
    - .5 Summary of potential reasons for "failure" (if appropriate);
    - .6 Recommendations for follow-up action.
  - .11 Deficiencies or non-conformance identified in all tests will be identified and tracked in the Cx Log maintained by the BECxA, as described above.
- 3.4.5 Chamber air leakage testing shall be in completed accordance with the most recent iteration of ASTM E783: Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors. Testing to be completed as follows:
- .1 The number of tests and test locations shall be selected by the BECx. Test locations are to be coordinated with ASTM E1105 test locations.
  - .2 Testing chambers required for building enclosure pressurization shall be constructed by the Contractor. The BECxA and Contractor shall coordinate on the type of chamber required, as it varies with testing types and locations.
  - .3 Where quantitative testing of a fenestration assembly is performed, the test chamber shall be constructed in accordance with ASTM E783: Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors.

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- .4 The level of pressurization for localized air leakage testing shall be determined by ASTM E783.
  - .5 Additional levels of pressurization may be requested or specified by the Consultant and Owner. If additional levels of pressurization are provided, testing shall be first performed at the lowest level of pressurization. The pressure shall be increased until completion or failure.
  - .6 Reporting for air leakage testing shall be done in the form of a regular site review memo, where practical. The reporting shall identify pertinent items, such as:
    - .1 Locations and photos of the testing;
    - .2 Description of the test apparatus and methodology;
    - .3 Environmental conditions during testing;
    - .4 Results of the testing ("Pass" or "Fail");
    - .5 Summary of potential reasons for "failure" (if appropriate);
    - .6 Recommendations for follow-up action.
  - .7 Deficiencies or non-conformance identified in all tests will be identified and tracked in the log maintained by the Cx Authority, as described above.
- 3.4.6 Qualitative localized sealant adhesion testing shall be completed as follows:
- .1 Perform five (5) tests for every 1000 feet (305m) of joint length for each kind of sealant and joint substrate. Perform one (1) test for every 1000 feet (305m) thereafter.
  - .2 Where qualitative testing of a wall assembly is performed, the test shall be conducted in accordance with ASTM C1521-19.
  - .3 Reporting for adhesion testing shall be done in the form of a regular site review memo, where practical. The reporting shall identify pertinent items, such as:
    - .1 Locations and photos of the testing;
    - .2 Description of the test apparatus and methodology;
    - .3 Environmental conditions during testing;
    - .4 Results of the testing ("Pass" or "Fail");
    - .5 Summary of potential reasons for "failure" (if appropriate);
    - .6 Recommendations for follow-up action.
  - .4 Deficiencies or non-conformance identified in all tests will be identified and tracked in the log maintained by the BECxA, as described above.
- 3.4.7 Qualitative water leakage testing of horizontal waterproofing membrane shall be completed as follows:

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- .1 Where qualitative water leakage testing of a roof assembly is performed, Electric Field Vector Mapping (EFVM) testing shall be tested in accordance with ASTM D7877-14.
  - .2 The number of tests and test locations shall be selected by the BECxA. Minimum one (1) test per roof assembly.
  - .3 Testing to be performed by the 'Testing Agency'.
  - .4 The test apparatus will be provided by the 'Testing Agency'.
  - .5 Reporting for water leakage testing shall be provided by the testing agency. The reporting shall identify pertinent items, such as:
    - .1 Locations and photos of the testing;
    - .2 Description of the test apparatus and methodology;
    - .3 Environmental conditions during testing;
    - .4 Results of the testing ("Pass" or "Fail");
    - .5 Summary of potential reasons for "failure" (if appropriate);
    - .6 Recommendations for follow-up action.
  - .6 Deficiencies or non-conformance identified in all tests will be identified and tracked in the log maintained by the BECxA, as described above.
- 3.4.8 Quantitative localized adhesion testing of membranes and coatings shall be completed as follows:
- .1 Where quantitative testing of a wall assembly is performed, the test on a metal or gypsum substrate shall be conducted in accordance with ASTM D4541-09. Where quantitative testing of a wall assembly is performed, the test on a concrete substrate shall be conducted in accordance with ASTM D7234-19.
  - .2 The number of tests and test locations shall be selected by the BECxA. Minimum two (2) tests per membrane and substrate type.
  - .3 Reporting for adhesion testing shall be done in the form of a regular site review memo, where practical. The reporting shall identify pertinent items, such as:
    - .1 Locations and photos of the testing;
    - .2 Description of the test apparatus and methodology;
    - .3 Environmental conditions during testing;
    - .4 Results of the testing ("Pass" or "Fail");
    - .5 Summary of potential reasons for "failure" (if appropriate);
    - .6 Recommendations for follow-up action.

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- .4 Deficiencies or non-conformance identified in all tests will be identified and tracked in the log maintained by the BECxA, as described above.
- 3.4.9 Whole Building Pressurization Testing shall be performed as follows:
- .1 Testing to be performed by the 'Testing Agency'.
  - .2 The appropriate apparatus and test method shall be chosen by the 'Testing Agency'.
  - .3 To acquire meaningful test data, it may be necessary to subdivide subsections of the building. Test enclosures that are entirely composed of subsections separated by interior partitions, floors, or both may be tested as a single zone by maintaining baseline relationships between subsections throughout testing.
  - .4 All whole building air testing shall be performed as outlined in the following standards:
    - .1 ASTM E1827 - Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door
    - .2 ASTM E779 - Standard Test Method for Determining Air Leakage Rate by Fan Pressurization
    - .3 ASTM E1258 - Standard Test Method for Airflow Calibration of Fan Pressurization Devices
    - .4 ASTM E1186 - Standard Practices for Air Leakage Site Detection in Building Enclosures and Air Barrier Systems
  - .5 The testing agency to submit a building specific testing plan based on the test specifications for the project. Plan to identify the purpose for the test. Testing plan to reference any air tightness requirements for the building.
  - .6 Reporting for Whole Building Pressurization Testing shall be done in the form of a testing report. The reporting shall identify pertinent items, such as:
    - .1 Locations and photos of the testing;
    - .2 Phasing/sub-dividing the building
    - .3 Description of the test apparatus, gauges and other equipment
    - .4 Testing methodology;
    - .5 Identify areas of masking for 'intentional openings'
    - .6 Interior and exterior environmental conditions during testing;

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- .7 Differential pressure measurements across the building enclosure;
  - .8 Criteria and Results of the testing ("Pass" or "Fail");
  - .9 Summary of potential reasons for "failure" (if appropriate);
  - .10 Recommendations for follow-up action.
  - .11 Deficiencies or non-conformance identified in all tests will be identified and tracked in the log maintained by the BECxA, as described above.
- .7 Testing agency to co-ordinate with BECxA authority and Contractor during Construction phase.
- 3.4.10 Qualitative full-building thermography testing shall be performed as follows:
- .1 Infrared thermography shall be conducted on the building after the building enclosure and HVAC system has been completed.
  - .2 The initial thermographic scan shall be performed when the building is positively pressurized. A second thermographic scan shall be performed when the building is negatively pressurized. The level of pressurization will be determined by the project team.
  - .3 The Contractor is responsible for operating the HVAC systems as required to provide the necessary pressurization during thermographic scanning activities.
  - .4 Infrared thermography will be the primary method used to qualitatively identify air barrier and insulation issues and will also help to identify other problematic hygrothermal phenomena.
  - .5 All thermography shall be performed as outlined in the following standards:
    - .1 ASTM C1060 Standard Practice for Thermographic Inspection Insulation Installations in Enclosure Cavities of Frame Buildings.
    - .2 ASTM C1153: Standard Practice for Location of Wet Insulation in Roofing Systems Using Infrared Imaging
  - .6 Reporting for thermography will be included in the regularly issued Commissioning Logs.
  - .7 Deficiencies or non-conformance identified during thermography will be identified and tracked in the log maintained by the BECxA, as described above.
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3.4.11 The Contractor shall support the BECxA and CxA in performing additional testing during regular site reviews, which will be documented in the form of regular site review memos.

#### 3.4.12 Testing Responsibility Matrix

<b>System:</b>	<b>Test:</b>	<b>Testing Agency to be retained by:</b>	<b>Testing Agency Name:</b>	<b>Test to be performed when:</b>
Fenestration systems (Windows, doors, curtain walls, storefront systems)	AAMA 501.2 Calibrated nozzle water penetration testing.	Owner	TBC & Contractor	Mock-ups are constructed.
Fenestration systems (Windows, doors, curtain walls, storefront systems)	ASTM E1105: Chamber water penetration testing.	Owner	TBC & Contractor	Mock-ups and testing chambers are constructed.
Fenestration systems (Windows, doors, curtain walls, storefront systems)	ASTM E783: Chamber air leakage testing.	Owner	TBC & Contractor	Mock-ups and testing chambers are constructed.
Horizontal Waterproofing	ASTM D7877-14: Electro Field Vector Mapping	Owner	TBC	Horizontal waterproofing is fully/partially completed
Exterior Sealants	ASTM C1521-19: Sealant Adhesion Test	Owner	TBC & Contractor	Regular progress of sealant installation
Wall Membrane	ASTM D4541-09: Adhesion of membrane to metal/gypsum Substrate ASTM D7234-19: Adhesion of membrane to	Owner	TBC & Contractor	Regular progress of membrane installation

	concrete substrate			
Building Air Barrier	ASTM E779, ASTM E1186, ASTM E1258, ASTM E1827: Whole Building Pressurization Test	Owner	TBC & Contractor	Regular progress of building enclosure construction or at full building enclosure construction completion
Building Air Barrier, Thermal Insulation and Horizontal Waterproofing	ASTM C1060: Infrared thermography scan	Owner	Entuitive & Contractor	Building enclosure and HVAC systems are fully completed.

### **3.5 Final Report**

- 3.5.1 Reporting for identification, correction and close-out of deficiencies will be like that described above for regular field reviews.
- 3.5.2 This report will be provided to the Consultant, Owner, Contractor, and other project team members, as required.
- 3.5.3 The Consultant and Contractor shall review the Final Cx Report and carry out action items as deemed necessary to ensure compliance with the Contract Documents.
- 3.5.4 An additional review may be required to confirm close-out of remaining deficiencies. If this is required, the BECx and Cx Authority shall advise the project team.

### **3.6 Final Report**

- 3.6.1 The commissioning authority will compile the maintenance manual from information provided by the entire commissioning team. The maintenance manual to include all the information necessary to operate, maintain, and re-commission all envelope systems. Specifically, the Systems Manual will include:
  - .1 Executive Summary – developed by the BECxA
  - .2 Owner's project requirements – Final update provided by the Owner.
  - .3 Basis of design – Final update provided by the design team.
  - .4 System Description – Final update provided by the design team.
  - .5 Construction record documents and specifications – Final update provided by the design team.

- .6 Approved submittals – Final digital copies provided by the Contractor.
- .7 As-built drawings – Provided by the Contractor.
- .8 Operations and Maintenance manuals – Provided by the Contractor.
- .9 Preventative Maintenance Plan – Provided by the Contractor.
- .10 Final Cx Report – Provided by the CxA.

END OF SECTION

**1. GENERAL****1.1 Scope of Work**

1.1.1 The intent of the commissioning process is to verify that the project's systems are installed, calibrated and perform according to the owner's project requirements, basis of design, and construction documents. Commissioning is a quality control process that enhances the delivery of a project. It is comprised of a series of functional steps and associated deliverables; it is not an event that can be shown on a schedule. The Commissioning Process does not relieve any contractors from their obligations to complete all portions of work in a satisfactory manner. Systems include those identified in each respective section of this project's construction documents and at minimum the following:

- .1 Mechanical Systems
  - .1 Heating systems
  - .2 Cooling systems
  - .3 HVAC
  - .4 Domestic cold water
  - .5 Domestic hot water and recirculation
  - .6 Sanitary waste and venting
  - .7 Storm drainage
  - .8 Compressed air
  - .9 Natural Ventilation
  - .10 Environmental Monitoring Systems
  - .11 Fire Protection
- .2 Electrical Systems
  - .1 Grounding
  - .2 Electrical distribution – general, life safety & non-life safety
  - .3 Lighting, and lighting controls
  - .4 Digital Power Metering
  - .5 EV Charging
  - .6 Lightning Protection
  - .7 Emergency lighting
  - .8 Communications – cabling, racks, rooms & environment, audio visual
  - .9 Electronic Safety and Security – Access control, intercom, video surveillance, fire alarm, panic/duress systems

**1.2 Related Documents**

- 1.2.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
- 1.2.2 OPR (Owner Project Requirements) prepared by Owner
- 1.2.3 BOD (Basis of Design) documentation prepared by the Consultant respectively contain requirements that apply to this Section.
- 1.2.4 Industry standards and guidelines are a guide to the commissioning process and are hereby incorporated and will be applied as appropriate. Reference standards and guidelines include, but are not limited, to the following:
- 1.2.5 References:
  - .1 Commissioning Plan

**1.3 Commissioning Plan**

- 1.3.1 The Commissioning Process Specification outlines the roles and responsibilities of the Contractors. As a separate document, the Commissioning Plan will provide a broader outline of the entire commissioning process. The Cx Authority (CxA) will post the Commissioning Plan on a document share site for review and use by the Cx Team.
- 1.3.2 Impact on Contractor Responsibility: The Cx Process does not reduce the responsibility of the installing contractors to provide a finished and fully functioning product.

**1.4 Contractor's Responsibilities**

- 1.4.1 General
  - .1 Contractors providing and/or installing equipment and systems included but not limited to the 'Scope of Work' above are required to participate fully in the Commissioning Process.
  - .2 Participating Contractors shall include all costs to complete the Cx requirements in their contract price including all costs for Sub-Contractors, vendors, suppliers, materials, meetings, lifts, ladders, safety equipment, radios.
  - .3 Participating Contractors shall ensure acceptable representation, with the means and authority to prepare, coordinate and execute the Commissioning Process as described in the contract documents.
  - .4 Contractors shall participate in the resolution of system deficiencies identified during the commissioning process,

according to the contract documents and the Cx Authority's project Cx Requirements.

- .5 The Contractor works with the Sub-Contractor in each discipline in developing, coordinating and scheduling start-up plans
- .6 The Contractor coordinates the Sub-Contractor's work schedules and staffing to ensure that the qualified technician(s) are available and present during the agreed upon schedules and for enough duration to complete procedures, tests, adjustments, and/or problem resolutions, during Performance Verification.

#### 1.4.2 Contractor's Commissioning Representative (CCR)

- .1 Each Contractor participating in the Cx Process will each designate a single-point contact person to work with the Cx Authority and the Commissioning Team to coordinate Installation, Testing, Startup, Proving/Testing and Functional Verification activities, ensure timely execution of Cx Procedures and prompt resolution of issues.
- .2 Contractor Commissioning Representative shall submit names of sub-contractors (Mechanical, Electrical, TAB and BAS) commissioning representatives to Cx Authority in the early months of construction start.
- .3 Contractor and Subcontractor commissioning representatives will attend and fully participate in Commissioning, Integrated Systems Testing (IST) and TAB related meetings.
- .4 The CCR shall be the Contractor's Project Manager, Field Superintendent or similar with authority to do the following:
  - .1 Make decisions regarding commissioning activities and issues
  - .2 Schedule technicians for participation in commissioning activities
  - .3 Interface between the Commissioning Team and the Contractor's, vendors and suppliers.
- .5 The CCR will be responsible for coordinating the Contractor's participation in the Cx Process. As part of this role, the CCR shall:
  - .1 Schedule, facilitate and coordinate all Commissioning Meetings
  - .2 Keep the Consultant, and/or Cx Authority apprised of the Contractor's progress, schedules and other matters impacting execution of the Commissioning Procedures.

- .3 Coordinate the Contractor's work schedules and staffing to ensure that the qualified technician(s) are available and present during the agreed upon schedules and for enough duration to complete procedures, tests, adjustments, and/or problem resolutions.

#### 1.4.3 Field Technicians/Tradespersons

- .1 Each Contractor shall provide qualified field technicians who are trained and familiar with installation, operation and troubleshooting of systems and equipment being commissioned for participation in the commissioning activities outlined in this document.
- .2 Contractors shall arrange for and provide technicians from their Sub-Contractors, vendors and suppliers where specified and where Contractor's own personnel lack the required training or experience necessary to ensure that all commissioned equipment and systems are correctly installed and fully functional.
- .3 System performance problems and discrepancies may require additional technician time, Cx Authority time, reconstruction of systems, and/or replacement of system components. The additional technician time shall be made available for subsequent Cx periods at no cost to the Cx Authority until the required system performance is obtained
- .4 The Cx Authority reserves the right to question the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians shall include expert knowledge relative to the specific equipment involved.

#### 1.4.4 Manufacturer's Involvement

- .1 The Contractor shall obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems.
  - .1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
  - .2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.
- .2 Integrity of warranties:
  - .1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.

.2 Verify with manufacturer that testing as specified will not void warranties.

.3 Qualifications of manufacturer's personnel:

.1 Experienced in design, installation and operation of equipment and systems.

.2 Ability to interpret test results accurately.

.3 Ability to report results in clear, concise, logical manner.

## **1.5 Contractor Coordination & Scheduling**

### **1.5.1 Commissioning Meetings**

.1 Commissioning Orientation (Kick-Off) Meeting

.1 This meeting will be scheduled by the Contractor and coordinated with the Consultant and Cx Authority after awarding of contracts but prior to the start of construction of the systems included in the commissioning scope.

.2 The Cx Authority will work with the Contractor who coordinates this initial Commissioning Orientation Meeting for the Prime Contractors and selected Sub-Contractors to familiarize all parties with the Cx process, and to ensure that the roles and responsibilities of each party are clearly understood.

.2 On-going Commissioning Progress Meetings

.1 These meetings will be scheduled by the Contractor and coordinated with the Consultant and Cx Authority. The purpose of these meetings will be to coordinate and schedule Contractor Cx activities, review Contractor Cx activity status, verify Cx Authority's Project Requirement achievements, and discuss status and resolution of Cx issues. Meeting frequency will be determined by the CxA. Minutes from the commissioning meetings will be recorded and distributed by the Contractor to the full commissioning team.

## **1.6 Commissioning Authority Responsibilities**

1.6.1 The CxA works with the Cx team which typically has representation from the following:

.1 Owner

.2 Project Manager

.3 Facilities Manager

.4 Architectural Consultant



- .5 Mechanical Consultant
- .6 Electrical Consultant
- .7 Contractors Commissioning Representative
- .8 Mechanical Subcontractor
- .9 Electrical Subcontractor
- .10 TAB Subcontractor
- .11 BAS Subcontractor
- 1.6.2 Prepare an initial Commissioning Plan. The Commissioning Plan (Cx Plan) is a dynamic document that is continuously updated through Design, Construction and Warranty. Updates shall be provided by the Consultant / Contractor during and post construction. The Cx Plan shall identify commissioning team member(s) / their responsibilities, by name, firm, and trade specialty, for performance of each commissioning task. Scheduled commissioning process activities shall be coordinated with overall Project schedule.
- 1.6.3 Participate in the commissioning team meetings for monitoring progress, coordination and communication. The Contractor responsibilities include arranging for facilities, preparing agenda and attendance lists, and notifying participants. The Contractor shall prepare and distribute minutes to commissioning team members and attendees within 5 workdays of the commissioning meeting.
- 1.6.4 At the beginning of the construction phase, the Cx Authority shall coordinate through the Contractor and may conduct an initial construction-phase coordination meeting for reviewing the commissioning process activities and establishing tentative schedules for operation and maintenance submittals; operation and maintenance training sessions; TAB Work; and Project completion.
- 1.6.5 The Cx Authority will observe and review construction for compliance with the OPR, BoD, and Contract Documents, and report deficiencies. In addition to inspect systems and equipment installation for adequate accessibility for maintenance and component replacement or repair.
- 1.6.6 The Cx Authority will review the Mechanical and Electrical schematics, drawings and specifications for the inclusion of electrical, fuel, water, and thermal energy meters. Meters should be shown on the schematic and tracked on a metering list with an ID reference. All meters will be required to have their own specific reference.
- 1.6.7 The Cx Authority will review submittals associated with building's energy related systems including but not limited to meters, energy analysis software and control drawings for compliance to OPR.

- 1.6.8 The Cx Authority develops equipment and systems functional performance test procedures. Items of non-compliance in material, installation, or setup are corrected at the Contractor's expense, and the system is retested.
- 1.6.9 The Cx Authority may assist with problem solving, non-conformance or deficiencies, but ultimately that responsibility resides with the Contractor and the Consulting Engineers.
- 1.6.10 The Cx Authority will assemble the interim & final commissioning documentation, including the commissioning report.
- 1.6.11 Review contractors training plan, training schedule, demonstration session(s) for Owner.
- 1.6.12 The Cx Authority will review equipment or systems deferred due to Seasonal conditions
- 1.6.13 The Cx Authority will submit final report at end of warranty period.

## **2 . PRODUCTS**

### **2.1 Test Equipment – General**

- 2.1.1 The Contractor /Sub-contractor responsible for each Test Procedure shall provide all tools, equipment and instrumentation required for execution of that Procedure.
- 2.1.2 A list of all tools and equipment with valid calibration certificates to be used during Cx shall be submitted to the Cx Authority for review and approval prior to the start of execution.
- 2.1.3 Standard tools, testing equipment and instrumentation required for execution of Pre-Functional Procedures, Pre-startup Testing, Startup Procedures, and Post-startup Testing shall be provided by the Contractor responsible for the equipment being tested.
- 2.1.4 Testing equipment and instrumentation used for execution of Test Procedures shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances with specified in the Specifications. If not otherwise noted, the following minimum requirements apply:
  - .1 Temperature sensors and digital thermometers: certified calibration within the past year to an accuracy of 0.5°C and a resolution of + or - 0.1 °C. Pressure sensors: accuracy of + or - 2.0% of the value range being measured (not full range of meter) and calibrated within the last year.
  - .2 Electrical meters (voltage, current, etc.) shall be true RMS and shall have been calibrated within the last year.
  - .3 Other sensors (RH, CO, CO<sub>2</sub>, etc.) shall have been calibrated within the last 6 months.

2.1.5 All test equipment and instrumentation used for testing procedures shall be calibrated according to the manufacturer's and/or calibrator recommended intervals and when dropped or damaged.

2.1.6 Calibration tags shall be affixed or certificates readily available.

## **2.2 Test Equipment - Special, Proprietary, or Unique**

2.2.1 Equipment and software including that for testing required by any contractor, vendor or equipment manufacturer for programming, start-up, or other testing activity whether specified or not, shall be provided for use during verification and at no additional cost to the Cx Authority.

## **2.3 BAS Hardware and Software Support**

2.3.1 The BAS Contractor shall provide the Cx Authority with hardware & software needed to connect to, communicate with and command the BAS from both the front-end operator workstation and the field panels and controllers at no additional charge to the Cx Authority. Use of hardware and software provided under this section may be limited to the duration of the Cx Process at the BAS Contractor's discretion but shall not be terminated until completion of the Cx Process including resolution of all outstanding construction phase issues and successful execution of Post-Occupancy phase commissioning activities.

2.3.2 Hardware and software covered under this requirement includes, but is not limited to:

- .1 Communication modules, software keys, remote access and similar hardware needed for communication from a laptop computer or PDA to field panels or controllers
- .2 Proprietary cables required for communication between laptop computers or PDAs to field panels or controllers
- .3 Proprietary software needed to communicate to field panels or controllers such as HVAC Pro, Metasys, Commissioning Tool, etc.
- .4 Passwords, access levels and similar software permissions necessary for execution of the Cx Process.
- .5 Software and hardware manuals for all control system hardware and software provided to the Cx Authority.

2.3.3 The BAS Contractor shall adhere to the client's naming convention standard for labelling monitoring points.

2.3.4 The BAS Contractor shall also provide technical support to the Cx Authority as reasonably requested by the Cx Authority regarding BAS hardware and software.

**2.4 Data Collection**

- 2.4.1 The BAS system must be configured for collection of trend log data for all measured and calculated monitoring points. Data shall be provided in Comma Separated Value (.CSV) for Excel file format (.xls).
- 2.4.2 Control points such as temperature, pressure, Change of Value (COV) requiring automatic trending and logging on the server for a minimum of one year will detailed once a points list is available from the design team.

**3 . EXECUTION****3.1 Commissioning Process - Construction Phase:**

- 3.1.1 The documented procedures which comprise the construction-phase commissioning process activities includes the following:
- .1 Contractors shall provide access to the shop drawings, coordination drawings, equipment cut-sheets, schematics, in-progress record drawings, etc. to assist the CxA in execution of the Cx process.
  - .2 Contractor installation QA/QC monitoring is conducted during the installation of equipment to verify that equipment is installed per the contract documents and is ready for startup. Construction checklists are provided by the Cx Authority and completed/filled in by the Contractors.
    - .1 Installed equipment matches the specifications and approved submittals
    - .2 Equipment is installed per the specifications, drawings and manufacturer's recommendations
    - .3 Utility connections to equipment, such as electrical, steam, chilled water, etc. have been successfully completed
    - .4 Equipment is ready for start-up
    - .5 The Cx Authority will provide oversight to the Contractors during the execution of the Construction Checklists and will periodically review the Contractors' in-progress Checklists for accuracy, completeness and to verify that checklists are being kept up to date
    - .6 The Contractors shall regularly review and update the appropriate Checklists so that installation issues are identified early in the construction process.
    - .7 Construction Checklists shall be substantially complete and reviewed by the Cx Authority prior to

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- equipment start-up. Exceptions to this requirement will be at the Cx Authority's discretion.
- .8 The Contractor shall provide all tools, test equipment and instrumentation required for completion of the Construction checklists.
- .3 Contractor Pre-Startup Testing consists of normally specified Contractor testing such as hydrostatic or pneumatic leak testing of ductwork and piping and megger and bump testing of electrical equipment. Documentation submissions will be per the specific M&E specification sections.
- .4 Start-up checklists ensure that startup is performed per the equipment manufacturer's recommended procedures and those startup activities and data are documented for future reference.
- .1 Contractor equipment installation and Contractor Pre-startup Testing has been fully completed and documented prior to startup.
- .2 Ensuring that all required utilities are available prior to startup.
- .3 Ensuring that the appropriate personnel have been identified and scheduled to participate including vendors, manufacturer's representatives, other trades, etc.
- .4 Tools, test equipment and/or instrumentation required for startup will be available
- .5 Startup procedures meet the equipment manufacturer's recommendations. Complete Construction checklists provided by the Cx Authority.
- .6 For equipment requiring startup by the equipment manufacturer, vendor or representative submit reports to the Cx Authority. Attached reports to the Construction Checklist provided by the Cx Authority.
- .7 The contractor will submit documentation for all equipment which has had a Factory Testing prior to on site startup. Attached reports to the Construction Checklist provided by the Cx Authority.
- .8 All Startup Forms will be submitted to the Engineer & Cx Authority for review and acceptance upon completion
- .5 Contractor TAB (Test Adjust and Balance) Plan to be developed in accordance with AABC or NEBB standards and submitted to the Cx Authority (via the CM) no later than

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30 days prior to scheduled Start up shall include a narrative and technical detail identifying the relevant systems, components, instrumentation, and sequence of work. This Plan shall also indicate evidence of all presets in preparation.

- .1 Participate in verification of the TAB report, which will consist of repeating any selected measurement contained in the TAB report where required by the Cx Authority for sampling or diagnostic purposes.
- .2 TAB Contractor shall comply with the requirements listed in the Controls & Instrumentation paragraph below. The TAB Contractor shall coordinate with the controls Contractor to ensure that changes made to the control system during TAB (flow coefficients, duct areas, Temperatures, pressure differentials etc.) are archived and become the default or initial values for these parameters. Both Preliminary Reports for approval and final TAB Reports shall provide physical evidence of Point-to-Point Checkouts
- .3 All DDC Points commands and responses reporting properly and values reflect calibrated adjustments. Final reported values, when accepted by the Cx Authority, will serve as Functional Performance Testing evidence.
- .4 The TAB Contractor will provide technicians and instrumentation to support the field verification
- .6 Contractor Functional Performance Test (CFPT) consists of normally specified contractor testing activities occurring after startup including test, adjust and balance (TAB) of ventilation and hydronic systems, control system point-to-point testing and testing of BAS sequences of operation. The Cx Authority provides oversight during the execution and documentation of these tests to ensure successful system operation.
  - .1 Cx Authority activities and requirements related to Contractor Functional Performance Testing / procedures are in addition to the testing / procedure's requirements specified in other Divisions of these specifications. These do not reduce the Contractor's responsibility for successfully completing and documenting all testing / procedures requirements outlined elsewhere in these specifications.

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- .2 All test forms will be fully completed and maintained by the Contractor per the requirements of this specification.
  - .3 Control Sequence Checkout. Contractor shall verify that the control system programming matches the specified sequences of operation. For these checkouts, the Contractor shall simulate actual operating conditions for the various operating modes being tested (heating, cooling, etc.) by false-loading systems, adjusting setpoints and similar techniques.
  - .4 Tune all Control Loops to obtain the fastest stable response without unreasonable hunting, offset or overshoot. Record tuning parameters and response test results for each control loop and provide trend reports to document results. Trend logs shall show both steady-state operation and response to setpoint changes.
  - .5 Test All Alarms and Safeties. Record all alarm parameters and alarm messages. Document all alarms and safeties have been tested and are functioning properly.
  - .6 The Contractor responsible for the BAS shall work with the TAB Contractor(s) to make sure that changes to the BAS made during TAB, such as flow coefficients, flow setpoints and duct areas, pressure differentials are permanently archived in the BAS and become the initial or default values for their respective controllers.
  - .7 Proving procedures and tests which are rejected by the Cx Authority due to incomplete or illegible Contractor documentation shall be repeated by the Contractor and new Contractor Documents shall be prepared to the CxA satisfaction at no additional costs to the Owner.
  - .8 The Contractor shall provide all tools, test equipment and instrumentation required for completion of the Post-startup Testing / Procedures.
  - .9 The Contractor shall provide a written list of instrumentation which will be used for Post-startup Testing / Procedures indicating instrument make, model number, serial number, range, accuracy and calibration date to the Owner prior to the start of testing.

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- .10 Contractors shall be responsible for maintaining a tracking system to monitor the progress of their installation, start-up & proving/testing activities. This tracking system will be submitted to the CxA and will include spreadsheet-based tracking forms and/or sets of drawings which will be marked-up by the contractor to indicate status of specified activities.
- .7 Functional Performance Test (FPT) consists of determining if equipment, sub-systems and major systems operate in accordance with the design intent. Specific issues, which will be evaluated in these procedures, include equipment capacity & efficiency, operation of safeties and interlocks, control system operation, stability and tuning. All Contractor Functional Performance Testing work including debugging is to be completed prior to Functional Performance Test verification by the Cx Authority.
- .1 The role of the Cx Authority is to sample witness systems functional operation by documenting the performance. During this phase of Construction, the systems are to have been fully contractor verified through all sequences and operations normal to the Project.
- .2 Equipment-level functional operation will be used to verify operation and capacity of selected equipment such as boilers, chillers cooling towers, pumps, exhaust fans, air handling units, etc.
- .3 System-level functional operation will verify the following aspects of system operation:
- .1 System operation under both normal and alternate operating conditions and modes
- .2 Interactions between equipment and sub-systems
- .3 Operation of safeties and interlocks
- .4 Control system operation, response time, stability and tuning
- .5 System response to abnormal and/or emergency conditions such as fire, equipment failure and power outages
- .4 The Cx team will, in a joint effort, coordinate and schedule FPT activities.
- .5 Scheduling of FPTs shall be contingent on notification from the Contractor(s) to the Cx Authority that equipment and systems are ready for checkout.
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- .6 Other prerequisites for execution of FPTs shall include the following
    - .1 All Construction Checklists, Contractor Pre-startup Testing and Startup Checklists and Procedures have been completed and documented
    - .2 TAB has been completed and reports submitted
    - .3 Issues Log items affecting equipment or system performance, or operation have been resolved
  - .7 Prior to executing of Functional Performance Test script, the controls Contractor shall ensure that the following items are completed, debugged, validated and forward all documentation:
    - .1 Point-to-point checkouts listing command and response values
    - .2 Verify that network communication between all devices and systems is established
    - .3 Sequence of Operation checkouts
    - .4 Printed and annotated trend logs and histories establishing acceptable operation including
      - .1 Stable control
      - .2 Recovery from upset/changes (e.g., from setback)
      - .3 Special and/or seasonal modes
      - .4 Emergency and alarm modes including loss/restoration of power.
  - .8 FPT on individual equipment shall be completed by the Cx Authority. FPTs on complete systems (i.e. chilled water system, hot water heating system, etc.) and sub-systems (i.e. terminal unit controls, etc.) shall be completed by the Cx Authority and the Contractor responsible for providing the BAS in collaboration.
  - .9 The Cx Authority will lead the execution of the FPTs and will document and provide results of the testing.
  - .10 Contractor activities during FPT execution will include the following:
    - .1 Starting/stopping equipment
    - .2 Energizing/de-energizing electrical distribution gear

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- .3 Opening/closing valves and dampers
  - .4 Manipulating BAS inputs, outputs and setpoints
  - .5 Setup, collection and downloading of BAS trend data
  - .6 Taking measurements and recording data and observed issues (deviations from the design documents) onto the Test checklists provided by the Cx Authority.
  - .11 Contractors shall conduct seasonal FPTs. This includes performing FPTs on equipment during the season it is intended to operate (i.e. test cooling equipment during the peak cooling season and test heating equipment during the peak heating season, etc.).
  - .12 Tools, test equipment and instrumentation required for completion of the FPTs shall be provided by the Contractor except for special-purpose or proprietary tools, test equipment and instrumentation which will be provided by the manufacturer of the equipment being tested.
  - .8 Non-conformance to performance verification requirements
    - .1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within the unfunctional system, including related systems as deemed required by the Owner, to ensure effective performance.
    - .2 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.
  - .9 Owner Demonstration and Instruction (Training) will be provided and coordinated by the Contractor and overseen by the Cx Authority to help ensure that the Owner is adequately prepared to operate and maintain the facility at turnover.
  - .10 Refer to related Mechanical specification division
  - .11 Refer to related Electrical specification division
  - .12 Provide one electronic pdf copy of operation and maintenance data, to the Commissioning Authority
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**3.2 Integrated Systems Testing (IST) of Fire Protection And Life Safety Systems**

- 3.2.1 The testing will be carried in in accordance with Integrated Testing Plan, Matrix and:
- .1 The Ontario Building Code
  - .2 CAN/ULC S1001-11 Standard for Integrated Systems Testing of Fire Protection and Life Safety Systems
  - .3 Individual Contractor and Consultant, Test Certificates, Letters and Reports
- 3.2.2 The integrated testing will demonstrate proper operation and inter-relationship between the Life Safety systems per original design but not limited to;
- .1 Fire alarm systems
  - .2 Sprinkler & standpipes systems
  - .3 Fire pumps
  - .4 Elevator recalls
  - .5 Emergency power
  - .6 Emergency lighting
  - .7 Smoke and fire shutters and dampers
- 3.2.3 Integrated Systems Testing will be executed under guidance of the Prime Consultant who will assume the responsibility of the testing and will confirm the procedure was carried per the approved design intent.

**3.3 Demonstration and Training**

- 3.3.1 Operator and Occupant Training will be provided and coordinated by the Contractor and overseen by the Owner/CxA to help ensure that the Owner is adequately prepared to manage and interact with the complex HVAC control system, including demand control ventilation, natural ventilation with automatic window operation, and continuous optimization for energy consumption at turnover. This training will support the long-term performance and sustainability goals of the building, particularly in achieving and maintaining Net-Zero Emission (NZE) standards. Scheduling of Training is to be confirmed in writing no later than the earlier of either Substantial Completion or as this Project requires.
- 3.3.2 Building Operators Training:
- .1 Comprehensive System Overview: Provide detailed training sessions on the HVAC system's design, operation, and control logic, including demand control ventilation and natural ventilation systems. The training should cover all

system components and their integration into the Building Management/Automation System (BMS/BAS).

- .2 Simulation-Based Training: Conduct training using simulation tools that model various environmental conditions (e.g., temperature, humidity, air quality) to demonstrate how the system responds. Operators should be able to simulate and predict system behavior under different scenarios.
- .3 Control System Management: Train operators on the BMS/BAS interface, including monitoring, data interpretation, and making adjustments. Focus on how to optimize energy use and indoor environmental quality while maintaining comfort and safety.
- .4 Continuous Monitoring and Retro-Commissioning: Develop and deliver training on the procedures for continuous system monitoring, including data logging, performance analysis, and periodic retro-commissioning. Operators should learn how to re-test and fine-tune the system to ensure ongoing compliance with NZE standards.
- .5 Emergency Response Training: Include scenario-based drills or simulations that prepare operators to handle sudden changes in environmental conditions (e.g., high winds, poor outdoor air quality) and the corresponding system responses.

#### 3.3.3 Occupant Training:

- .1 System Interaction Education: Educate building occupants on how to interact with the HVAC system, emphasizing the impact of their actions on system performance and energy efficiency. Provide clear guidelines on optimal use of the system.
- .2 Indoor Environmental Quality Awareness: Offer training that highlights the importance of maintaining good indoor air quality and how the HVAC system's automatic functions, such as window operations, are designed to enhance comfort and safety.
- .3 Feedback Mechanisms: Establish and train occupants on how to use feedback mechanisms to report comfort levels and system performance issues. This feedback will be crucial for ongoing adjustments and system improvements.

#### 3.3.4 Development of Training Materials and Documentations:

- .1 Simulation and Procedure Documentation: Create detailed training materials, including simulation procedures that building operators can follow. These materials should

outline step-by-step instructions for testing the system under various conditions and making necessary adjustments.

- .2 Record-Keeping Protocols: Provide guidelines for maintaining thorough documentation of all training sessions, simulations, system adjustments, and performance data. This documentation should be structured for easy access and future reference during retro-commissioning.

3.3.5 The contractor shall carry the following:

- .1 Thoroughly instruct Facilities Manager in safe operation of systems and equipment after installation of Work.
- .2 Coordinate with Owner and arrange training program and schedule for instruction times. Submit training schedule to Owner and Cx Authority one week prior to training of each system.
- .3 Hire qualified service engineers and manufacturers' representatives to instruct Facilities Manager on specialized portions of installation, such as the following;
  - .1 Air Handling Units/Ventilation Systems
  - .2 Cooling systems
  - .3 Exhaust Air Systems
  - .4 Pumps
  - .5 VFD'S
  - .6 Electric Boiler
  - .7 Air Source Heat Pump System
  - .8 Radiant Slab System
  - .9 Building Automation System
  - .10 BAS Sequences of Operation
  - .11 Fire Protection systems
  - .12 Chemical treatment system
  - .13 Gas Monitoring (CO/Hydrogen)
  - .14 Refrigerant Detection
  - .15 Domestic Water Heaters
  - .16 Domestic Water Booster Pumps
  - .17 Life Safety Systems
  - .18 Security Systems
  - .19 Lighting Controls
  - .20 Electrical systems
  - .21 Fire alarm systems
  - .22 Power Distribution and Emergency Power.
  - .23 Audio Visual System

3.3.6 Submit to Cx Authority complete record of instructions as part of maintenance instructions and data book given. For each instructional period, include:

- .1 Date
- .2 System and equipment involved
- .3 Names of persons giving instructions
- .4 Names of persons being instructed
- .5 Other persons present.
- .6 Carry out training of staff and instruction of Facilities Manager within a period of 30 days.
- .7 Permit the Cx Authority and Owner usage of systems prior to Substantial Performance for testing and learning operational procedures.
- .8 At the end of training, obtain and submit to Commissioning Authority, signed statement of Facilities Manager stating they understand system and equipment installation, operation, and maintenance requirements.

#### 3.3.7 Training agendas

- .1 For each piece of equipment or system a written training agenda shall be provided by the contractors. The agenda shall cover the following elements:
  - .1 Equipment (included in training).
  - .2 Intended audience
  - .3 Location of training
  - .4 Objectives
  - .5 Subjects covered (description, duration of discussion, special methods, etc.)
  - .6 Duration of training on each subject
  - .7 Instructor for each subject
  - .8 Methods (classroom lecture, video, site walk-through, actual operational demonstrations, written handouts, etc.)
  - .9 Instructor and qualifications.

#### 3.3.8 Training process and content shall

- .1 As appropriate, normally start with classroom-type sessions followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.
- .2 During any demonstration, should the system fail to perform in accordance with the requirements of the operation and maintenance (O&M) manuals or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.

- .3 Follow the outline in the table of contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.

3.3.9 Training Shall Include the Following:

- .1 Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.
- .2 A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover, as applicable, and any emergency procedures.
- .3 The Mechanical contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.
- .4 Discussion of relevant health and safety issues and concerns.
- .5 Discussion of warranties and guarantees.
- .6 Common troubleshooting and maintenance issues, problems and solutions.
- .7 Explanatory information included in the O&M manuals and the location of all related plans and manuals in the facility.
- .8 Discussion of any peculiarities of equipment installation or operation.
- .9 Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and preventative maintenance for all pieces of equipment.
- .10 Training shall occur after functional testing and piping and equipment labeling are complete.

**3.4 Acceptance Phase**

- 3.4.1 Satisfactory completion and documentation of the Commissioning Process Activities described in this specification shall be considered prerequisites for system acceptance.
- 3.4.2 At no time will acceptance be made for individual pieces of equipment. Final acceptance will only be for systems that will operate as intended in the basis of design and the design intent.

### 3.5 Occupied Phase

- 3.5.1 Cx Authority will return to site at 10 months into the 12-month period and review with facility staff the current building operation and condition of outstanding issues related to the original and seasonal commissioning.

## END OF SECTION

### EXHIBIT 01 91 00-1, COMMISSIONING PROCESS DEFINITIONS

Commissioning Authority (CxA): An independent person or firm retained by the owner and not otherwise associated with the Consultant team members or contracting team members. The CxA initiates the overall commissioning process and observes the tasks necessary to complete the commissioning process. The Contractor performs the duties associated with the commissioning for this Project.

Project Manager (PM): The contracting and managing authority for the Owner over the design and/or construction of the project.

Consultant: The prime consultant (architect) and/or sub-consultants who comprise the design team, generally the mechanical engineer and the electrical engineer.

Construction Manager (CM): The firm responsible for day-to-day overall management of the project, serving as the bridge between the Owner and the Prime Contractors.

Contractor's Commissioning Representative (CCR): An individual or a firm that is hired by the contractor to manage the contractor's commissioning process related activities.

Prime Contractor: Any Contractor contracted directly to the Owner and responsible for coordinating commissioning requirements the Sub-Contractors, vendors, suppliers, etc. contracted through the respective Prime Contractor.

Sub-Contractors: The subcontractors to the Contractor(s) or vendors who provide and/or install building components and systems.

Test Adjust and Balancing (TAB) Contractor: A Sub of the mechanical and/or piping contractor, responsible for the testing and balancing of the systems.

Vendor: Supplier of equipment.

Commissioning Team: Those people responsible for working together in carrying out the commissioning process.

Owner's project requirements (OPR) a written document that details the ideas, concepts, and criteria determined by the owner to be important to the success of the project

Basis of Design (BOD) the information necessary to accomplish the owner's project requirements, including system descriptions, indoor environmental quality criteria, design assumptions, and references to applicable codes, standards, regulations, and guidelines

Acceptance Phase: Final phase of the construction occurring after successful execution of all required Cx Procedures and Final Operational Testing during which



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system installation and operation is demonstrated to the Owner and Authority Having Jurisdiction for the purposes of achieving occupancy and accreditation.

**Commissioning Plan:** A document developed by the CxA that provides the structure, schedule, coordination and planning for the commissioning process.

**Commissioning Report:** The document that records the results of the commissioning process, including the as-built performance of the MEP system and the CxA documents all sign-offs.

**Commissioning Specifications:** The contract document, that details the Contractor's role and responsibilities for execution of the commissioning (Cx) process.

**Contract Documents:** The documents binding on parties involved in the construction of this project (drawings, specifications, change orders, amendments, contracts, etc.)

**Debugging:** Prior to CxA Witness phase of Functional Testing, a procedure or process of operating component(s) and / or system(s) in accordance with the intent of the Project's Documents. Where "debugging" appears in the Contract Documents, it requires that failures, inconsistencies, and non-conforming items be corrected.

**Factory Testing:** Testing of equipment by the equipment manufacturer's personnel usually conducted at the manufacturer's factory or assembly plant. Factory testing may be witnessed by an Owner's representative and/or other members of the Cx Team prior to releasing the equipment for delivery to the job site.

**Integrated Systems Test (IST):** A series of procedures including Smoke Mode Procedures and Emergency System Procedures used to evaluate building-wide operation of tested systems under simulated fires and power failure conditions. During the IST's emphasis is placed on evaluating interactions between building systems and transition of building systems between different operating modes.

**Seasonal testing:** Functional checkouts that are deferred until the system(s) will experience conditions closer to their design conditions.

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**APPENDIX 1 – COMMISSIONING PLAN**



# COMMISSIONING PLAN

## Dockstader PRPS Reporting Station

September 23<sup>rd</sup>, 2024

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Rev.	Date	Issue
0	2024-08-30	Draft
1	2024-09-23	<i>Issued for Tender</i>

## Executive Summary

The process of Commissioning is A quality-focused process for enhancing the delivery of a project. The process focuses on upon verifying and documenting that the facility and all its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owner's Project Requirements

The purpose of this document is to identify the scope, strategies and responsibilities for all the team members within the commissioning process for each phase of the project. This document describes how the commissioning process will be undertaken construction, acceptance and warranty phases. However, the Quality Control and Quality Assurance for activates related to design or construction are the responsibility of the those contracted to perform these activities.

The Commissioning Plan outlines the process, procedures, and standards for all parties involved in the project.

The goals of the Commissioning Plan are to identify and define the following:

- ☐ Commissioning Team Members
- ☐ Commissioning Team Members responsibilities for each Phase activity of the commissioning process
- ☐ Commissioning process activities to be conducting during the construction, acceptance and warranty phase of the project
- ☐ Systems to be verified.
- ☐ Acceptance criteria for the completion of verification process.

The Commissioning Provider (CDML) is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, site safety, cost estimating, or construction management. The Commissioning Provider (CDML) may assist with problem-solving or resolving nonconformance or deficiencies, but ultimately that responsibility resides with the general contractor and the design professionals.

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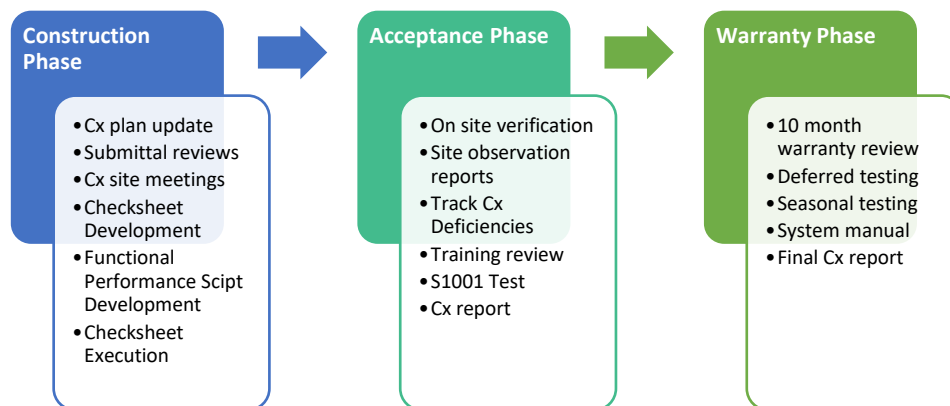
## 1 Introduction

CDML has been appointed as the independent Commissioning Authority for the Dockstader PRPS Reporting Station Project.

## 2 Overview

The commissioning plan's purpose is to define the scope of the project, outline CDML deliverables, and describe the assistance needed throughout the commissioning process. In addition, it provides major milestones and a definition of major tasks and load banks or other needs for the project.

The Commissioning Process Flowchart and Matrix graphically depicts the commissioning process and its flow from the Construction Phase through to the Warranty Phase.



### 2.1 Purpose of the Commissioning Plan

This plan does not provide a detailed explanation of testing procedures. The detailed testing requirements and procedures will be the pre-functional (construction) checklists, vendor startup forms and functional performance tests that will be developed with input from the design and construction teams. Final forms will be issued prior to equipment start-up and system testing.

Overview of the Commissioning Process to be executed on this project is as follows:

1. The Cx Plan has been written to define the process that is followed to ensure issues are found at the earliest timeframe in the project.
2. The process is intended to verify and document the facility systems function and interaction as intended. This will be accomplished through witnessing and documenting various tests to include:
  - a. Level 1 Factory Witness Test
  - b. Level 2 Installation and QA/QC inspections
  - c. Level 3 Startup tests
  - d. Level 4 Functional Performance Testing
  - e. Level 5 Integrated Systems Test

3. The Subcontractors and Vendors are responsible for the execution of the Commissioning process for level 2 and 3. Once these levels have been completed, CDML will start the Acceptance Phase of the project and complete Level 4 and Level 5.
4. Level 4 – Functional Performance Testing (FPT) starts after build issues have been closed. CDML performs the requires tests on the individual pieces of equipment / systems during this phase.
5. A major component of the commissioning process is the Integrated Systems Test (IST). This phase of commissioning is intended to verify that the emergency and redundant systems, will perform appropriately when called upon. The IST will be conducted after all factory and field component/system quality control, start-up, and test procedures have been completed. The goal of this testing is to verify the operation, proper interdependencies, redundancies, and fail-safe operation of all critical systems. IST is performed by CDML once commissioning issues are closed or determined that they will need to be pushed to Turnover Issues.

## 2.2 Overall Commissioning Scope

Commissioning is a systematic process of ensuring that all building systems perform interactively according to the design intent and the Owner's operational needs. Commissioning begins during the design and owner/design requirement phase reviews, and continues through construction, acceptance testing and then field-verification of the functional performance of the various electrical and mechanical components and systems.

Commissioning during the construction of this Project is intended to achieve the following specific objectives according to Contract Documents.

- Ensuring that equipment and systems are installed per project requirements and receive the required operational checkout by installing contractors and vendors.
- Verify and document proper functional performance and alarm reporting of the equipment and systems.

In general, CDML commissioning scope includes the following systems for the Dockstader PRPS Reporting Station (Note a greater breakdown of included Systems & Equipment will be built into the Commissioning Platform Cx Alloy (described further in this plan)):

- Elevator
- Fire Protection
- Plumbing & HVAC & BMS
  - Domestic Water
  - Domestic Hot Water
  - Sanitary Plumbing
  - Compressed Air
  - HVAC
  - Heating Systems
  - Cooling Systems
  - Natural Ventilation Systems
  - Environmental Monitoring Systems
- Electrical
  - Grounding
  - Electrical Distribution – General, Life Safety & Non-Life Safety
  - Digital Power Metering



- Lighting Control
  - EV Charging
  - Lightning Protection
  - Emergency Lighting
- Communications
  - Cabling, Racks, Rooms & Environment
  - Audio Visual
- Security & Safety
  - Access Control
  - Intercom
  - Video Surveillance
  - Fire Alarm
  - Panic / Duress Systems

## 2.3 Commissioning Roles

General descriptions of the commissioning roles are as follows:

<b>CxA (CDML):</b>	Coordinates the commissioning process including schedules and load bank plans, performs site observation visits, writes test procedures, oversees and documents performance tests, identifies and describes functional deficiencies, tracks and verifies resolution of deficiencies, and documents commissioning results throughout.
<b>Owner (ROP):</b>	Participates in the commissioning process and assist in design and operational discussions and discrepancy resolution as needed.
<b>GC (tbd):</b>	Facilitates the commissioning process, ensures that Subs perform their responsibilities, and integrates commissioning into the construction process and schedule.
<b>Sub-Contractors (tbd):</b>	Demonstrate proper system performance, provide labor, material, and equipment support throughout the commissioning process (may be performed by GC). Respond to issues and correct deficiencies as found.
<b>Eng/Arch (DSAI &amp; Project Partners):</b>	Provides Basis of Design documentation, sequences of operation, performs construction observations, reviews testing procedures and load bank plans for their ability to demonstrate design intent and achievement of performance criteria, approves O&M manual materials, and assist in resolving design questions and other operational and technical issues.
<b>Mfr. / Vendors:</b>	Provides documentation to facilitate the commissioning work including specified O&M data, sequences of operation and factory test results. Performs contracted startup, ongoing commissioning support and follow-up/warranty support throughout commissioning. Responds to issues and provides factory and field support, as need to correct deficiencies as found.

## 2.4 Responsibility Matrix

The following matrix tabulates the major commissioning process activities when they occur during the project and the commissioning team member roles and responsibilities for each activity. Additional details on each activity is detailed further in this document.

<b>R:</b>	Responsible	<b>A:</b>	Assist	<b>REV:</b>	Review/Comment	<b>AA:</b>	Accept/Approve
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ACTIVITIES	PROJECT PHASES					COMMISSIONING TEAM MEMBERS								
	Pre-Design	Design	Construction	Acceptance	Warranty	Owner	Architect	Mechanical Consultant	Electrical Consultant	General Contractor	Mechanical Contractor	Electrical Contractor	Controls Contractor	CDML
Commissioning Plan		✓	✓	✓		REV	REV	REV	REV	REV	REV	REV	REV	R
Commissioning Reviews		✓					A	A	A					REV
Commissioning Meetings			✓	✓		A	A	A	A	A	A	A	A	R
Shop Drawing			✓			REV	AA	AA	AA	R	R	R	R	REV
Completion of Construction Checklists		✓	✓	✓						R	R	R	R	REV
Equipment Start-Ups			✓					REV	REV		R	R	R	REV
Site Observations reports			✓							A	A	A	A	R
Functional Performance Test Development			✓			A	A	A	A	A	A	A	A	R
Contractor Functional Performance Testing		✓	✓	✓						R	R	R	R	
O&M Review			✓					AA	AA	A	A	A	A	REV
Commissioning Issues Log		✓	✓	✓	✓	A	A	A	A	A	A	A	A	R
TAB Report				✓				AA			R			REV
Functional Performance Testing				✓		A				A	A	A	A	R
Training Sessions and Plan				✓		A		A	A	A	R	R	R	A
System Manual					✓	REV	A	A	A	A	A	A	A	R
Final Commissioning Report					✓									R
Seasonal & Deferred Testing					✓	A		A	A	A	A	A	A	R
11 Month Warranty Review					✓	A		A	A	A	A	A	A	R

### 3 Design Phase Activities

#### 3.1 Design Reviews

CDML will review the Pre-Tender set of design specifications and drawings with the OPR and review from a perspective of:

- Errors and Omissions
- Good Engineering Practice
- The ability to test systems and equipment
- Accessibility and maintainability

CDML is not responsible for the design concept, design criteria or compliance with codes.

Design reviews will be issued in detailing the drawing/specification reviewed, the issue noted and the relevant commissioning team member that a response is required from. Issues resolution will be tracked until a satisfactory response is received.

### 4 Construction Phase Activities

#### 4.1 Construction Schedule

The General Contractor (GC) will provide the construction date milestones to the commissioning team so a commissioning schedule can be developed based on the construction schedule. The GC will work with CDML to incorporate the commissioning schedule into the construction schedule so both the construction and Acceptance Phase of commissioning meets the requirements of overall delivery schedule.

#### 4.2 Commissioning Scripts

Commissioning Scripts are tests and inspections that shall be used during the Construction and Acceptance Phases of commissioning. Commissioning Scripts shall be written in accordance with this commissioning plan. CDML will provide the Commissioning Scripts that are used during Levels 1 to 3 commissioning (Construction **Checklists** – See Below). CDML is responsible for the development of the Commissioning Scripts that are used during Levels 4 & 5 commissioning (Functional Performance **Tests**). All scripts shall be approved prior to use. As required, CDML will update the scripts with the comments and resubmit for final approval.

Commissioning tasks are not considered closed or complete until all of the required paperwork, reports, pictures, issues and test results have been provided to CDML.

##### 4.2.1 Construction Checklists

Construction checklists are important to verify that the equipment and systems are installed, energized and operational and that the contractor's functional performance testing may proceed. Each piece of equipment receives full QA/QC checkout by the contractor. No sampling strategies are used. In general, the contractor will complete construction checklists for all equipment and systems prior to formal functional performance testing of equipment or subsystems of the given system. The checklists will be monitored by the Commissioning Team and CDML during the construction phase.

CDML will provide the Construction checklists in electronic format for the project via CxAlloy. They detail installation and start-up check that should be reviewed on each piece of equipment. These sheets also detail the pre-requisites for functional performance testing.

### **4.3 Commissioning Meetings**

Commissioning (Cx) team meetings are essential to maintain the progress of the project and the momentum of the commissioning process. A kick-off meeting is conducted by CDML where the commissioning process is reviewed with the commissioning team members. Additional meetings will be required throughout construction, scheduled by CDML with necessary parties attending, to plan, scope, coordinate, schedule and review future activities and resolve problems. Frequency will vary throughout the construction as the Commissioning process requirements vary depending on what is happening on the construction site. Team members at meetings must be authorized to make commitments and decisions for their respective parties.

### **4.4 M&E Shop Drawing Reviews**

Review comments will focus on compliance with the OPR, integration coordination, accessibility and maintainability, O&M training and documentation requirements, and the ability to test and validate system operation. CDML requires access to all approved submittals after processing by the Design Team.

CDML will provide comments to the relevant design team per agreed communications protocol. The design team will consider the commissioning related comment(s).

### **4.5 Independent Electrical Testing Review**

A Third Party Electrical Testing Agent will be hired to perform all of the necessary electrical testing to include LV Cable meggering and torque verification, transformer testing, Protection relay testing, circuit breaker testing, earth resistivity, electrical equipment inspection, meter testing, and ground testing. An Electrical Testing Plan will be developed based on NETA ATS standard and submitted to CDML for review and approval. CDML will review the Independent Electrical Testing submittal and test forms to ensure all the proper tests will be completed and once the testing is complete CDML will review the final results to ensure all tests were completed correctly.

### **4.6 Equipment Start-up**

The General Contractor shall coordinate equipment and systems start-ups with their mechanical and electrical sub-contractors and their sub-trades such as controls, sheet-metal, fire alarm and the air/ water balancers. Sufficient notice for contractor, sub-contractors, equipment manufactures, and contractors testing agencies to plan, and coordinate work must be provided. CDML may attend equipment start up at our own discretion or as per CDML's contract scope.

The contractor shall submit start up procedures, data sheets and recording forms for review, a minimum of four weeks prior to execution of the start-up verification process. The start-up checklists shall be in the form supplied by the manufacturer or, if not available, they must record all necessary setting and checks conducted at start up to satisfy the manufactures warranty.

Issues noted during start up can be tracked on the commissioning issues log and addressed by the relative contractor for the start up to be deemed complete.

The Sub-Contractors and their manufacturers, suppliers or testing agencies shall provide all instrumentation and equipment necessary to conduct the tests. The Contractor shall advise the Engineer's Representatives or CDML of instrumentation to be used and the dates the instruments were calibrated and provide calibration certificates.

When the General Contractor has tested confirmed that the systems are operating and controlling per the design intent, and all prerequisites have been completed then functional performance verification/testing can be scheduled and coordinated with the parties referenced above, CDML, the Owner and Consultants.

## **5 Acceptance / Commissioning Phase**

### **5.1 Commissioning Schedule (Level 4 & 5)**

CDML will develop a commissioning schedule with tasks and deliverables to complete the commissioning process. The Schedule will be a living document and will be monitored throughout the project. At times commissioning includes some simultaneous electrical and mechanical testing, however daily coordination will occur to work together to fully execute the test scripts.

### **5.2 Testing and Balance Review**

The TAB Contractor will prepare a balancing report documenting that all air and hydronic systems have been adjusted and are within acceptable design values. CDML may carry accuracy check of the flowrates, after the Mechanical Engineer of Record reviewed and accepted the report. This check of accuracy will be conducted in conjunction with the TAB contractors using their instruments. CDML will verify that all required data has been collected, that the measured results follow the design documents, and that any non-compliance items have been resolved and rebalanced prior to the start of functional performance testing.

### **5.3 Pre-Requisites for Functional Performance Testing (Level 4)**

The following pre-requisite items are required prior to the start of functional performance testing (Level 4). In all cases documentation should be available for review in advance of the start of Level 4 commissioning.

1. The installing contractor has completed verification of installation of equipment per drawings, specifications and submittals.
2. The de-energized electrical testing and documentation has been completed.
3. The pre-energization steps and checklists were completed prior to energization.
4. The responsible startup personnel have completed startup of equipment per their requirements and/or project specifications.
5. Test and Balance has been completed on hydronic and air systems and preliminary reports are available for review.
6. The electrical and mechanical device/control contractors have tested their automation systems to verify proper control and alarm interface with related external systems and confirm operation per published sequences and/or specifications.
7. Equipment interfaces with BMS and/or EPMS systems have been verified and documentation is available for review.

### **5.4 Level 4 – Equipment, Subsystem and System Commissioning**

The purpose of the Functional Performance Testing (FPT) is to assure that all work has been complete as specified and that the systems are functional in the manner intended. CDML is responsible for the execution during Level 4 and the GC, Sub Trades and Vendors shall provide CDML with the required support to allow a successful completion of Level 4 Functional Performance Testing. During the level 4 testing, the GC will provide load banks and the sub trades will install.

Level 4 Functional Performance Testing Scripts will include;

1. The verification that all control system's sequences of operation (SOO) including failure scenarios meet the project and operational requirements. The system components will be checked to verify that they are responding in accordance with the SOO.
2. Verify interface with the site building automation and electrical power monitoring systems.
3. Performance parameters of the system will be verified at various operation conditions and load levels

FPT will be conducted as many times as necessary to successfully demonstrate to the satisfaction of CDML that the specified design criteria have been achieved. After a failure to a piece of equipment, the repair may require some or all of the test script to be repeated.

Testing will include testing for all modes of operation, maintenance, failure modes, capacity tests, recovery tests, and reporting and annunciation of alarms and abnormal conditions. All alarm and monitoring points shall be verified.

Acceptance testing procedures include the following;

1. Software Verification
2. Test and Commissioning of all graphic (EPMS, BAS) systems.
3. Building Automation System (BAS) and Electrical Power Monitoring System (EPMS) servers must be available for Level 4 FPTs. Under no circumstances can Level 4 testing commence without the permanent servers, networks & network switches & workstations in place & operational.
4. Level 4 Functional Performance Test must be done with the EPMS/BAS networks in their final configurations, on permanent servers, switches & networks. The associated workstations must be in place for the FPT.
5. CDML will properly record all tests and submit organized data and test documents after the tests have been performed.

CDML will provide level 4 commissioning scripts in advance of testing for review.

## **5.5 Commissioning Issues Log**

During construction phase CDML will document commissioning related issues on CxAlloy under Construction Issues. These issues will be distributed by CDML to the Commissioning Team. The Commissioning Team is expected to implement the necessary secondary circulation as necessary for resolution. The Construction Managers Cx Coordinator and CDML will track all issues raised to verify that they are dealt with in a timely manner and will circulate regular status reports to all members of the Commissioning Team.

During the Acceptance Phase, deficiencies identified during the verification and testing will be documented and reported to the Owner and commissioning team.

The issues log report will include all details of the components or systems found to be non-compliant with the parameters of the test plans. The report details the responsible party(s) required to comment/address the item raised.

## 5.6 Project Tracking

The project tracking will be done via CxAlloy a cloud-based program. This will consist of listing of all mechanical and electrical equipment to be tested as part of the project and the status of each piece of equipment. Once steps are completed the system/equipment is then considered verified.

## 5.7 Level 5 – Integrated Systems Testing - Overview

The purpose of an Integrated System Testing (IST) is to verify that the installation of the equipment and systems has been completed and complies with the Basis of Design and Owner's Requirements. The IST shall test the facility and how the interaction of other systems effects the overall operation of the facility. During this testing various operational and failure mode testing shall be completed. Some tests may be repeated from previous levels since this is the first time the complete facility is operating at its designed load as a complete system and the interaction of these systems may need to be observed.

The facility is to be in a turn over state with all installation, testing, issues and final cleaning completed prior to the IST. All issues are to be corrected and tested prior to the IST. The IST will be done in a turn over state. Once the IST is completed all settings, switches, valves and breaker set to their normal operational mode, then the site will be in the position where it can be turned over to Operations.

### **Integration Systems Test Scripts Include:**

1. CDML will develop Integrated Systems Test (IST) scripts that simultaneously validate the interdependency of each commissioned system during various facility events.
2. IST will prove the facility is capable of properly operating, recovering and maintaining environmental space conditions.
3. IST shall be conducted as many times as necessary to successfully demonstrate to the satisfaction of the EoR and CDML that the specified design criteria have been achieved. In some cases, a failure of a test and the repair of that failure may require the complete or partial steps of the IST to be repeated.

### **Level 5 – IST Process includes:**

1. Confirmation the facility is prepared for the IST testing by verifying and documenting the following;
  - a. All Level 4 test are completed successfully and closed.
  - b. All related Issues on the Cx Issues Log are completed and closed.
  - c. Site is completed and clean per the IST requirements.
  - d. The IST shall include performance and dynamic testing of individual and interdependent systems and address the following categories.
    - i. Battery and utility failure mode
    - ii. Operating modes to be tested and will include
      1. Loss of utility
      2. Return of utility source
      3. Manual modes
      4. Automatic modes
  - e. Verify upon transfer to standby generator all operating parameters to be within accepted ratings.
  - f. Radio communication will be established and protocol amongst testing personnel.

- g. This level of commissioning demonstrates how the site infrastructure, such as generators, HVAC units/systems and life-safety and other systems will likely perform as a system over the next 60 months.

## 5.8 Integrated Systems Testing of Fire Protection and Life Safety Systems (S1001)

The purpose of this Fire Protection and Life Safety Systems Integrated System Testing (IST) is to validate and document that the integrated operation/actions between the architectural, electrical, mechanical, systems and equipment react to life safety systems per the design intent.

The intent of this script is to verify proper operation of the current build. The tasks and tests contained in this script are to be performed after substantial completion of Vendor / Contractor executed Level 3 Commissioning (Equipment Start-up / Testing) and the CxA executed Level 4 Commissioning (Functional Performance Testing). Substantial completion of these phases in the commissioning process have verified that individual components, apparatus, subsystems and systems are deemed functional and ready for operation. During the performance of this script, evaluations of each system's performance will be made during and after each test procedure with respect to a systems' interface with other systems during the test procedure.

## 6 Turnover Activities

### 6.1 Operation and Maintenance Manual Reviews

As part of the commissioning process, CDML will review the O&M manual content to verify compliance with the OPR and Specifications. As required review comments will be issued to the relevant design team member per the agreed communications protocol. The Design team will incorporate the commissioning comments, at their discretion.

### 6.2 Training Plan

To achieve successful Operations & Maintenance (O&M) training delivery, CDML will be requesting that the General Contractor and the Sub trades develop a training plan that defines the roles and responsibilities of the project's Construction team, Subcontractors, Suppliers, Design Consultant, and end user as they relate to the training. The plan will include a schedule of training dates, agenda, times, locations, training provider and durations.

#### Common Training Topics – Building Operators

- General purpose of this system or equipment. What it serves.
- Important safety features and procedures
- Review of control drawings and schematics (have copies for attendees)
- Review of O&M Manuals, illustrating where verbal training information is found in writing (have copies for attendees)
- Startup, loading, normal operation, unloading, shutdown, unoccupied operation, seasonal changeover, etc., as applicable
- Integral controls (packaged): programming, troubleshooting, alarms, manual operation



### Common Training Topics – Building Operators

- Building automation controls (BAS): programming, troubleshooting, alarms, manual operation, interface with integral controls
- Interactions with other systems, operation during power outage and fire
- Relevant health and safety issues and concerns and special safety features
- Energy conserving operation and strategies
- Any special issues to maintain warranty
- Common troubleshooting issues and methods, control system warnings and error messages, including using the control system for diagnostics
- Special requirements of tenants for this equipment’s function
- Service, maintenance, and preventative maintenance (sources, spare parts inventory, special tools, etc.)
- Continuous system monitoring, including data logging, performance analysis, and periodic retro-commissioning.
- System behavior under different environmental conditions
- Emergency response to handle sudden changes in environmental conditions

### Common Training Topics – Occupants

- Impact of occupants’ actions on HVAC system performance and energy efficiency. Guidelines on optimal use of the system.
- Indoor Environmental Quality Awareness: the importance of maintaining good indoor air quality and how the HVAC system’s automatic functions
- Using feedback mechanisms to report comfort levels and system performance issues.

## 7 Warranty Phase Activities

### 7.1 Deferred / Seasonal Testing

Functional Performance Tests (FPTs) may need to be deferred until after Substantial Completion for a variety of reasons. The most common reasons include HVAC systems may need to have different weather conditions than those at the end of construction or verified systems may need to have a load put on them before testing can be considered meaningful. FPTs that occur after Substantial Completion will be conducted, documented, and tracked during the warranty phase.

#### 7.1.1 Unforeseen Deferred Tests

If any test cannot be completed due to the building structure, required occupancy condition, or other deficiency, the functional testing may be delayed upon approval of the owner. These tests are conducted in the same manner as the seasonal tests, as soon as possible.

### 7.1.2 Seasonal Testing

Seasonal variation in operations or control strategies may require additional testing during the opposite season to verify performance of the HVAC system and controls in heating or cooling mode. Trends set up during the acceptance phase testing will be reviewed. Tests are executed and documented, with deficiencies corrected by the appropriate contractors. Any final adjustments to the O&M manuals and as-built drawings due to the testing are also completed.

## 8 Final Commissioning Report

After completion of all commissioning activities, CDML will write a final report documenting the overall results of the commissioning process and recommending acceptance of the commissioning process and related documentation to the owner.

The final commissioning report will include an overview or summary of the commissioning process, signed off functional tests, the final commissioning issues log and resolutions, commissioning progress and field reports, a deferred testing log, an unresolved issues log, a lessons-learned evaluation, and concluding with a recommendation to accept the process as complete.

## 9 CDML Commissioning Team

Role	Name	Phone	Email
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Mechanical Cx	Kyle Johnston	647-328-1476	<a href="mailto:kjohnston@cdml.ca">kjohnston@cdml.ca</a>



# COMMISSIONING PLAN

## Dockstader PRPS Reporting Station

September 23<sup>rd</sup>, 2024

**CDML Primary Contact:** Jaime Carmichael  
Senior Commissioning Consultant  
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Rev.	Date	Issue
0	2024-08-30	Draft
1	2024-09-23	<i>Issued for Tender</i>

## Executive Summary

The process of Commissioning is A quality-focused process for enhancing the delivery of a project. The process focuses on upon verifying and documenting that the facility and all its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owner's Project Requirements

The purpose of this document is to identify the scope, strategies and responsibilities for all the team members within the commissioning process for each phase of the project. This document describes how the commissioning process will be undertaken construction, acceptance and warranty phases. However, the Quality Control and Quality Assurance for activates related to design or construction are the responsibility of the those contracted to perform these activities.

The Commissioning Plan outlines the process, procedures, and standards for all parties involved in the project.

The goals of the Commissioning Plan are to identify and define the following:

- ☐ Commissioning Team Members
- ☐ Commissioning Team Members responsibilities for each Phase activity of the commissioning process
- ☐ Commissioning process activities to be conducting during the construction, acceptance and warranty phase of the project
- ☐ Systems to be verified.
- ☐ Acceptance criteria for the completion of verification process.

The Commissioning Provider (CDML) is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, site safety, cost estimating, or construction management. The Commissioning Provider (CDML) may assist with problem-solving or resolving nonconformance or deficiencies, but ultimately that responsibility resides with the general contractor and the design professionals.

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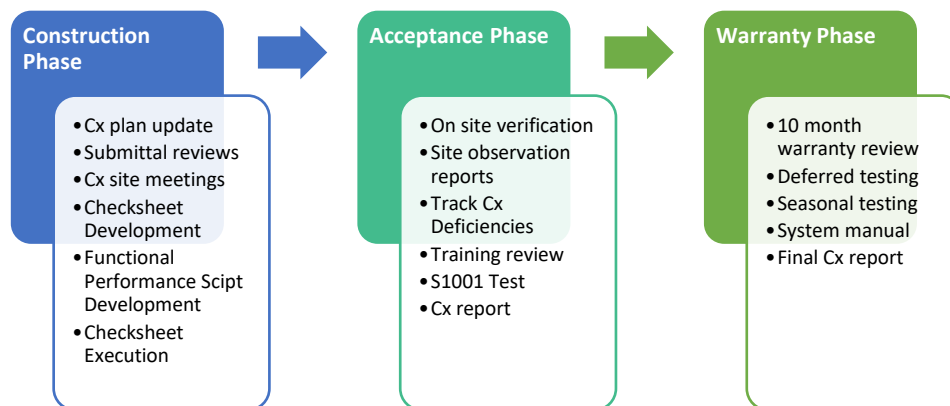
## 1 Introduction

CDML has been appointed as the independent Commissioning Authority for the Dockstader PRPS Reporting Station Project.

## 2 Overview

The commissioning plan's purpose is to define the scope of the project, outline CDML deliverables, and describe the assistance needed throughout the commissioning process. In addition, it provides major milestones and a definition of major tasks and load banks or other needs for the project.

The Commissioning Process Flowchart and Matrix graphically depicts the commissioning process and its flow from the Construction Phase through to the Warranty Phase.



### 2.1 Purpose of the Commissioning Plan

This plan does not provide a detailed explanation of testing procedures. The detailed testing requirements and procedures will be the pre-functional (construction) checklists, vendor startup forms and functional performance tests that will be developed with input from the design and construction teams. Final forms will be issued prior to equipment start-up and system testing.

Overview of the Commissioning Process to be executed on this project is as follows:

1. The Cx Plan has been written to define the process that is followed to ensure issues are found at the earliest timeframe in the project.
2. The process is intended to verify and document the facility systems function and interaction as intended. This will be accomplished through witnessing and documenting various tests to include:
  - a. Level 1 Factory Witness Test
  - b. Level 2 Installation and QA/QC inspections
  - c. Level 3 Startup tests
  - d. Level 4 Functional Performance Testing
  - e. Level 5 Integrated Systems Test

3. The Subcontractors and Vendors are responsible for the execution of the Commissioning process for level 2 and 3. Once these levels have been completed, CDML will start the Acceptance Phase of the project and complete Level 4 and Level 5.
4. Level 4 – Functional Performance Testing (FPT) starts after build issues have been closed. CDML performs the requires tests on the individual pieces of equipment / systems during this phase.
5. A major component of the commissioning process is the Integrated Systems Test (IST). This phase of commissioning is intended to verify that the emergency and redundant systems, will perform appropriately when called upon. The IST will be conducted after all factory and field component/system quality control, start-up, and test procedures have been completed. The goal of this testing is to verify the operation, proper interdependencies, redundancies, and fail-safe operation of all critical systems. IST is performed by CDML once commissioning issues are closed or determined that they will need to be pushed to Turnover Issues.

## 2.2 Overall Commissioning Scope

Commissioning is a systematic process of ensuring that all building systems perform interactively according to the design intent and the Owner's operational needs. Commissioning begins during the design and owner/design requirement phase reviews, and continues through construction, acceptance testing and then field-verification of the functional performance of the various electrical and mechanical components and systems.

Commissioning during the construction of this Project is intended to achieve the following specific objectives according to Contract Documents.

- Ensuring that equipment and systems are installed per project requirements and receive the required operational checkout by installing contractors and vendors.
- Verify and document proper functional performance and alarm reporting of the equipment and systems.

In general, CDML commissioning scope includes the following systems for the Dockstader PRPS Reporting Station (Note a greater breakdown of included Systems & Equipment will be built into the Commissioning Platform Cx Alloy (described further in this plan)):

- Elevator
- Fire Protection
- Plumbing & HVAC & BMS
  - Domestic Water
  - Domestic Hot Water
  - Sanitary Plumbing
  - Compressed Air
  - HVAC
  - Heating Systems
  - Cooling Systems
  - Natural Ventilation Systems
  - Environmental Monitoring Systems
- Electrical
  - Grounding
  - Electrical Distribution – General, Life Safety & Non-Life Safety
  - Digital Power Metering



- Lighting Control
  - EV Charging
  - Lightning Protection
  - Emergency Lighting
- Communications
  - Cabling, Racks, Rooms & Environment
  - Audio Visual
- Security & Safety
  - Access Control
  - Intercom
  - Video Surveillance
  - Fire Alarm
  - Panic / Duress Systems

## 2.3 Commissioning Roles

General descriptions of the commissioning roles are as follows:

<b>CxA (CDML):</b>	Coordinates the commissioning process including schedules and load bank plans, performs site observation visits, writes test procedures, oversees and documents performance tests, identifies and describes functional deficiencies, tracks and verifies resolution of deficiencies, and documents commissioning results throughout.
<b>Owner (ROP):</b>	Participates in the commissioning process and assist in design and operational discussions and discrepancy resolution as needed.
<b>GC (tbd):</b>	Facilitates the commissioning process, ensures that Subs perform their responsibilities, and integrates commissioning into the construction process and schedule.
<b>Sub-Contractors (tbd):</b>	Demonstrate proper system performance, provide labor, material, and equipment support throughout the commissioning process (may be performed by GC). Respond to issues and correct deficiencies as found.
<b>Eng/Arch (DSAI &amp; Project Partners):</b>	Provides Basis of Design documentation, sequences of operation, performs construction observations, reviews testing procedures and load bank plans for their ability to demonstrate design intent and achievement of performance criteria, approves O&M manual materials, and assist in resolving design questions and other operational and technical issues.
<b>Mfr. / Vendors:</b>	Provides documentation to facilitate the commissioning work including specified O&M data, sequences of operation and factory test results. Performs contracted startup, ongoing commissioning support and follow-up/warranty support throughout commissioning. Responds to issues and provides factory and field support, as need to correct deficiencies as found.

## 2.4 Responsibility Matrix

The following matrix tabulates the major commissioning process activities when they occur during the project and the commissioning team member roles and responsibilities for each activity. Additional details on each activity is detailed further in this document.

<b>R:</b>	Responsible	<b>A:</b>	Assist	<b>REV:</b>	Review/Comment	<b>AA:</b>	Accept/Approve
-----------	-------------	-----------	--------	-------------	----------------	------------	----------------

ACTIVITIES	PROJECT PHASES					COMMISSIONING TEAM MEMBERS								
	Pre-Design	Design	Construction	Acceptance	Warranty	Owner	Architect	Mechanical Consultant	Electrical Consultant	General Contractor	Mechanical Contractor	Electrical Contractor	Controls Contractor	CDML
Commissioning Plan		✓	✓	✓		REV	REV	REV	REV	REV	REV	REV	REV	R
Commissioning Reviews		✓					A	A	A					REV
Commissioning Meetings			✓	✓		A	A	A	A	A	A	A	A	R
Shop Drawing			✓			REV	AA	AA	AA	R	R	R	R	REV
Completion of Construction Checklists		✓	✓	✓						R	R	R	R	REV
Equipment Start-Ups			✓					REV	REV		R	R	R	REV
Site Observations reports			✓							A	A	A	A	R
Functional Performance Test Development			✓			A	A	A	A	A	A	A	A	R
Contractor Functional Performance Testing		✓	✓	✓						R	R	R	R	
O&M Review			✓					AA	AA	A	A	A	A	REV
Commissioning Issues Log		✓	✓	✓	✓	A	A	A	A	A	A	A	A	R
TAB Report				✓				AA			R			REV
Functional Performance Testing				✓		A				A	A	A	A	R
Training Sessions and Plan				✓		A		A	A	A	R	R	R	A
System Manual					✓	REV	A	A	A	A	A	A	A	R
Final Commissioning Report					✓									R
Seasonal & Deferred Testing					✓	A		A	A	A	A	A	A	R
11 Month Warranty Review					✓	A		A	A	A	A	A	A	R

### 3 Design Phase Activities

#### 3.1 Design Reviews

CDML will review the Pre-Tender set of design specifications and drawings with the OPR and review from a perspective of:

- Errors and Omissions
- Good Engineering Practice
- The ability to test systems and equipment
- Accessibility and maintainability

CDML is not responsible for the design concept, design criteria or compliance with codes.

Design reviews will be issued in detailing the drawing/specification reviewed, the issue noted and the relevant commissioning team member that a response is required from. Issues resolution will be tracked until a satisfactory response is received.

### 4 Construction Phase Activities

#### 4.1 Construction Schedule

The General Contractor (GC) will provide the construction date milestones to the commissioning team so a commissioning schedule can be developed based on the construction schedule. The GC will work with CDML to incorporate the commissioning schedule into the construction schedule so both the construction and Acceptance Phase of commissioning meets the requirements of overall delivery schedule.

#### 4.2 Commissioning Scripts

Commissioning Scripts are tests and inspections that shall be used during the Construction and Acceptance Phases of commissioning. Commissioning Scripts shall be written in accordance with this commissioning plan. CDML will provide the Commissioning Scripts that are used during Levels 1 to 3 commissioning (Construction **Checklists** – See Below). CDML is responsible for the development of the Commissioning Scripts that are used during Levels 4 & 5 commissioning (Functional Performance **Tests**). All scripts shall be approved prior to use. As required, CDML will update the scripts with the comments and resubmit for final approval.

Commissioning tasks are not considered closed or complete until all of the required paperwork, reports, pictures, issues and test results have been provided to CDML.

##### 4.2.1 Construction Checklists

Construction checklists are important to verify that the equipment and systems are installed, energized and operational and that the contractor's functional performance testing may proceed. Each piece of equipment receives full QA/QC checkout by the contractor. No sampling strategies are used. In general, the contractor will complete construction checklists for all equipment and systems prior to formal functional performance testing of equipment or subsystems of the given system. The checklists will be monitored by the Commissioning Team and CDML during the construction phase.

CDML will provide the Construction checklists in electronic format for the project via CxAlloy. They detail installation and start-up check that should be reviewed on each piece of equipment. These sheets also detail the pre-requisites for functional performance testing.

### **4.3 Commissioning Meetings**

Commissioning (Cx) team meetings are essential to maintain the progress of the project and the momentum of the commissioning process. A kick-off meeting is conducted by CDML where the commissioning process is reviewed with the commissioning team members. Additional meetings will be required throughout construction, scheduled by CDML with necessary parties attending, to plan, scope, coordinate, schedule and review future activities and resolve problems. Frequency will vary throughout the construction as the Commissioning process requirements vary depending on what is happening on the construction site. Team members at meetings must be authorized to make commitments and decisions for their respective parties.

### **4.4 M&E Shop Drawing Reviews**

Review comments will focus on compliance with the OPR, integration coordination, accessibility and maintainability, O&M training and documentation requirements, and the ability to test and validate system operation. CDML requires access to all approved submittals after processing by the Design Team.

CDML will provide comments to the relevant design team per agreed communications protocol. The design team will consider the commissioning related comment(s).

### **4.5 Independent Electrical Testing Review**

A Third Party Electrical Testing Agent will be hired to perform all of the necessary electrical testing to include LV Cable meggering and torque verification, transformer testing, Protection relay testing, circuit breaker testing, earth resistivity, electrical equipment inspection, meter testing, and ground testing. An Electrical Testing Plan will be developed based on NETA ATS standard and submitted to CDML for review and approval. CDML will review the Independent Electrical Testing submittal and test forms to ensure all the proper tests will be completed and once the testing is complete CDML will review the final results to ensure all tests were completed correctly.

### **4.6 Equipment Start-up**

The General Contractor shall coordinate equipment and systems start-ups with their mechanical and electrical sub-contractors and their sub-trades such as controls, sheet-metal, fire alarm and the air/ water balancers. Sufficient notice for contractor, sub-contractors, equipment manufactures, and contractors testing agencies to plan, and coordinate work must be provided. CDML may attend equipment start up at our own discretion or as per CDML's contract scope.

The contractor shall submit start up procedures, data sheets and recording forms for review, a minimum of four weeks prior to execution of the start-up verification process. The start-up checklists shall be in the form supplied by the manufacturer or, if not available, they must record all necessary setting and checks conducted at start up to satisfy the manufactures warranty.

Issues noted during start up can be tracked on the commissioning issues log and addressed by the relative contractor for the start up to be deemed complete.

The Sub-Contractors and their manufacturers, suppliers or testing agencies shall provide all instrumentation and equipment necessary to conduct the tests. The Contractor shall advise the Engineer's Representatives or CDML of instrumentation to be used and the dates the instruments were calibrated and provide calibration certificates.

When the General Contractor has tested confirmed that the systems are operating and controlling per the design intent, and all prerequisites have been completed then functional performance verification/testing can be scheduled and coordinated with the parties referenced above, CDML, the Owner and Consultants.

## **5 Acceptance / Commissioning Phase**

### **5.1 Commissioning Schedule (Level 4 & 5)**

CDML will develop a commissioning schedule with tasks and deliverables to complete the commissioning process. The Schedule will be a living document and will be monitored throughout the project. At times commissioning includes some simultaneous electrical and mechanical testing, however daily coordination will occur to work together to fully execute the test scripts.

### **5.2 Testing and Balance Review**

The TAB Contractor will prepare a balancing report documenting that all air and hydronic systems have been adjusted and are within acceptable design values. CDML may carry accuracy check of the flowrates, after the Mechanical Engineer of Record reviewed and accepted the report. This check of accuracy will be conducted in conjunction with the TAB contractors using their instruments. CDML will verify that all required data has been collected, that the measured results follow the design documents, and that any non-compliance items have been resolved and rebalanced prior to the start of functional performance testing.

### **5.3 Pre-Requisites for Functional Performance Testing (Level 4)**

The following pre-requisite items are required prior to the start of functional performance testing (Level 4). In all cases documentation should be available for review in advance of the start of Level 4 commissioning.

1. The installing contractor has completed verification of installation of equipment per drawings, specifications and submittals.
2. The de-energized electrical testing and documentation has been completed.
3. The pre-energization steps and checklists were completed prior to energization.
4. The responsible startup personnel have completed startup of equipment per their requirements and/or project specifications.
5. Test and Balance has been completed on hydronic and air systems and preliminary reports are available for review.
6. The electrical and mechanical device/control contractors have tested their automation systems to verify proper control and alarm interface with related external systems and confirm operation per published sequences and/or specifications.
7. Equipment interfaces with BMS and/or EPMS systems have been verified and documentation is available for review.

### **5.4 Level 4 – Equipment, Subsystem and System Commissioning**

The purpose of the Functional Performance Testing (FPT) is to assure that all work has been complete as specified and that the systems are functional in the manner intended. CDML is responsible for the execution during Level 4 and the GC, Sub Trades and Vendors shall provide CDML with the required support to allow a successful completion of Level 4 Functional Performance Testing. During the level 4 testing, the GC will provide load banks and the sub trades will install.

Level 4 Functional Performance Testing Scripts will include;

1. The verification that all control system's sequences of operation (SOO) including failure scenarios meet the project and operational requirements. The system components will be checked to verify that they are responding in accordance with the SOO.
2. Verify interface with the site building automation and electrical power monitoring systems.
3. Performance parameters of the system will be verified at various operation conditions and load levels

FPT will be conducted as many times as necessary to successfully demonstrate to the satisfaction of CDML that the specified design criteria have been achieved. After a failure to a piece of equipment, the repair may require some or all of the test script to be repeated.

Testing will include testing for all modes of operation, maintenance, failure modes, capacity tests, recovery tests, and reporting and annunciation of alarms and abnormal conditions. All alarm and monitoring points shall be verified.

Acceptance testing procedures include the following;

1. Software Verification
2. Test and Commissioning of all graphic (EPMS, BAS) systems.
3. Building Automation System (BAS) and Electrical Power Monitoring System (EPMS) servers must be available for Level 4 FPTs. Under no circumstances can Level 4 testing commence without the permanent servers, networks & network switches & workstations in place & operational.
4. Level 4 Functional Performance Test must be done with the EPMS/BAS networks in their final configurations, on permanent servers, switches & networks. The associated workstations must be in place for the FPT.
5. CDML will properly record all tests and submit organized data and test documents after the tests have been performed.

CDML will provide level 4 commissioning scripts in advance of testing for review.

## **5.5 Commissioning Issues Log**

During construction phase CDML will document commissioning related issues on CxAlloy under Construction Issues. These issues will be distributed by CDML to the Commissioning Team. The Commissioning Team is expected to implement the necessary secondary circulation as necessary for resolution. The Construction Managers Cx Coordinator and CDML will track all issues raised to verify that they are dealt with in a timely manner and will circulate regular status reports to all members of the Commissioning Team.

During the Acceptance Phase, deficiencies identified during the verification and testing will be documented and reported to the Owner and commissioning team.

The issues log report will include all details of the components or systems found to be non-compliant with the parameters of the test plans. The report details the responsible party(s) required to comment/address the item raised.

## 5.6 Project Tracking

The project tracking will be done via CxAlloy a cloud-based program. This will consist of listing of all mechanical and electrical equipment to be tested as part of the project and the status of each piece of equipment. Once steps are completed the system/equipment is then considered verified.

## 5.7 Level 5 – Integrated Systems Testing - Overview

The purpose of an Integrated System Testing (IST) is to verify that the installation of the equipment and systems has been completed and complies with the Basis of Design and Owner's Requirements. The IST shall test the facility and how the interaction of other systems effects the overall operation of the facility. During this testing various operational and failure mode testing shall be completed. Some tests may be repeated from previous levels since this is the first time the complete facility is operating at its designed load as a complete system and the interaction of these systems may need to be observed.

The facility is to be in a turn over state with all installation, testing, issues and final cleaning completed prior to the IST. All issues are to be corrected and tested prior to the IST. The IST will be done in a turn over state. Once the IST is completed all settings, switches, valves and breaker set to their normal operational mode, then the site will be in the position where it can be turned over to Operations.

### Integration Systems Test Scripts Include:

1. CDML will develop Integrated Systems Test (IST) scripts that simultaneously validate the interdependency of each commissioned system during various facility events.
2. IST will prove the facility is capable of properly operating, recovering and maintaining environmental space conditions.
3. IST shall be conducted as many times as necessary to successfully demonstrate to the satisfaction of the EoR and CDML that the specified design criteria have been achieved. In some cases, a failure of a test and the repair of that failure may require the complete or partial steps of the IST to be repeated.

### Level 5 – IST Process includes:

1. Confirmation the facility is prepared for the IST testing by verifying and documenting the following;
  - a. All Level 4 test are completed successfully and closed.
  - b. All related Issues on the Cx Issues Log are completed and closed.
  - c. Site is completed and clean per the IST requirements.
  - d. The IST shall include performance and dynamic testing of individual and interdependent systems and address the following categories.
    - i. Battery and utility failure mode
    - ii. Operating modes to be tested and will include
      1. Loss of utility
      2. Return of utility source
      3. Manual modes
      4. Automatic modes
  - e. Verify upon transfer to standby generator all operating parameters to be within accepted ratings.
  - f. Radio communication will be established and protocol amongst testing personnel.

- g. This level of commissioning demonstrates how the site infrastructure, such as generators, HVAC units/systems and life-safety and other systems will likely perform as a system over the next 60 months.

## 5.8 Integrated Systems Testing of Fire Protection and Life Safety Systems (S1001)

The purpose of this Fire Protection and Life Safety Systems Integrated System Testing (IST) is to validate and document that the integrated operation/actions between the architectural, electrical, mechanical, systems and equipment react to life safety systems per the design intent.

The intent of this script is to verify proper operation of the current build. The tasks and tests contained in this script are to be performed after substantial completion of Vendor / Contractor executed Level 3 Commissioning (Equipment Start-up / Testing) and the CxA executed Level 4 Commissioning (Functional Performance Testing). Substantial completion of these phases in the commissioning process have verified that individual components, apparatus, subsystems and systems are deemed functional and ready for operation. During the performance of this script, evaluations of each system's performance will be made during and after each test procedure with respect to a systems' interface with other systems during the test procedure.

## 6 Turnover Activities

### 6.1 Operation and Maintenance Manual Reviews

As part of the commissioning process, CDML will review the O&M manual content to verify compliance with the OPR and Specifications. As required review comments will be issued to the relevant design team member per the agreed communications protocol. The Design team will incorporate the commissioning comments, at their discretion.

### 6.2 Training Plan

To achieve successful Operations & Maintenance (O&M) training delivery, CDML will be requesting that the General Contractor and the Sub trades develop a training plan that defines the roles and responsibilities of the project's Construction team, Subcontractors, Suppliers, Design Consultant, and end user as they relate to the training. The plan will include a schedule of training dates, agenda, times, locations, training provider and durations.

#### Common Training Topics – Building Operators

- General purpose of this system or equipment. What it serves.
- Important safety features and procedures
- Review of control drawings and schematics (have copies for attendees)
- Review of O&M Manuals, illustrating where verbal training information is found in writing (have copies for attendees)
- Startup, loading, normal operation, unloading, shutdown, unoccupied operation, seasonal changeover, etc., as applicable
- Integral controls (packaged): programming, troubleshooting, alarms, manual operation



### Common Training Topics – Building Operators

- Building automation controls (BAS): programming, troubleshooting, alarms, manual operation, interface with integral controls
- Interactions with other systems, operation during power outage and fire
- Relevant health and safety issues and concerns and special safety features
- Energy conserving operation and strategies
- Any special issues to maintain warranty
- Common troubleshooting issues and methods, control system warnings and error messages, including using the control system for diagnostics
- Special requirements of tenants for this equipment's function
- Service, maintenance, and preventative maintenance (sources, spare parts inventory, special tools, etc.)
- Continuous system monitoring, including data logging, performance analysis, and periodic retro-commissioning.
- System behavior under different environmental conditions
- Emergency response to handle sudden changes in environmental conditions

### Common Training Topics – Occupants

- Impact of occupants' actions on HVAC system performance and energy efficiency. Guidelines on optimal use of the system.
- Indoor Environmental Quality Awareness: the importance of maintaining good indoor air quality and how the HVAC system's automatic functions
- Using feedback mechanisms to report comfort levels and system performance issues.

## 7 Warranty Phase Activities

### 7.1 Deferred / Seasonal Testing

Functional Performance Tests (FPTs) may need to be deferred until after Substantial Completion for a variety of reasons. The most common reasons include HVAC systems may need to have different weather conditions than those at the end of construction or verified systems may need to have a load put on them before testing can be considered meaningful. FPTs that occur after Substantial Completion will be conducted, documented, and tracked during the warranty phase.

#### 7.1.1 Unforeseen Deferred Tests

If any test cannot be completed due to the building structure, required occupancy condition, or other deficiency, the functional testing may be delayed upon approval of the owner. These tests are conducted in the same manner as the seasonal tests, as soon as possible.

### 7.1.2 Seasonal Testing

Seasonal variation in operations or control strategies may require additional testing during the opposite season to verify performance of the HVAC system and controls in heating or cooling mode. Trends set up during the acceptance phase testing will be reviewed. Tests are executed and documented, with deficiencies corrected by the appropriate contractors. Any final adjustments to the O&M manuals and as-built drawings due to the testing are also completed.

## 8 Final Commissioning Report

After completion of all commissioning activities, CDML will write a final report documenting the overall results of the commissioning process and recommending acceptance of the commissioning process and related documentation to the owner.

The final commissioning report will include an overview or summary of the commissioning process, signed off functional tests, the final commissioning issues log and resolutions, commissioning progress and field reports, a deferred testing log, an unresolved issues log, a lessons-learned evaluation, and concluding with a recommendation to accept the process as complete.

## 9 CDML Commissioning Team

Role	Name	Phone	Email
<b>Project Manager</b>	Jaime Carmichael	416-432-3955	<a href="mailto:jcarmichael@cdml.ca">jcarmichael@cdml.ca</a>
<b>Electrical Cx Lead</b>	Jaime Carmichael	416-432-3955	<a href="mailto:jcarmichael@cdml.ca">jcarmichael@cdml.ca</a>
Electrical Cx	Zoran Postic	416-526-6095	<a href="mailto:zpostic@cdml.ca">zpostic@cdml.ca</a>
<b>Mechanical Cx Lead</b>	Haril Thakore	416-859-1217	<a href="mailto:hthakore@cdml.ca">hthakore@cdml.ca</a>
Mechanical Cx	Kyle Johnston	647-328-1476	<a href="mailto:kjohnston@cdml.ca">kjohnston@cdml.ca</a>

**1.0 GENERAL****1.1 Documents**

- 1.1.1 This Section, along with Drawings, forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

**1.2 Description of Work Included**

- 1.2.1 Provide labour, materials, equipment, access, cooperation, coordination, and services to allow the testing of concrete and concrete reinforcement to be carried out by Testing Agency.
- 1.2.2 Scope of required quality assurance testing is described in this Section to inform Contractor of type and scope of testing on project and to allow Contractor to make appropriate allowances.
- 1.2.3 Contractor is responsible to schedule testing described, to coordinate construction schedules with Testing Agency, and to cooperate with Testing Agency in execution of this work.
- 1.2.4 Testing required for Contractor's own quality control or as noted in clause 1.6.3 will be paid for by Contractor.

**1.3 Related Work Specified Elsewhere**

- 1.3.1 Section 03 20 00 – Concrete Reinforcing
- 1.3.2 Section 03 30 00 – Structural Cast-in-Place Concrete

**1.4 Reference Standards**

- 1.4.1 Testing of concrete and reinforcement shall conform to requirements of the following Building Code and Standards unless otherwise required by this Specification:
- .1 Ontario Building Code - 2012 0 REG 88/19
  - .2 CSA A23.1/CSA A23.2 – Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete
  - .3 CSA-W59 – Welded Steel Construction (Metal Arc Welding)
  - .4 CSA-W178.1 – Certification of Welding Inspection Organizations
  - .5 ASTM A1044/A1044M – Standard Specification for Steel Stud Assemblies for Shear Reinforcement of Concrete
- 1.4.2 Revision date of referenced codes, standards, and guidelines shall be as indicated in the above referenced Building Code. Where no reference is made within the Building Code, the latest published edition shall be used.
- 1.4.3 Where the Standard is referenced in this Specification, it means documents specified in this clause and their referenced Standards.

- 1.4.4 Keep a copy of A23.1/A23.2 on site and available for reference for duration of the Work.
- 1.4.5 Where there are differences between the Specifications and Drawings and the codes, standards, or acts, the most stringent shall govern.

#### **1.5 Definitions - For This Section**

- 1.5.1 "Owner", "Contractor", and "Consultant" per the General Conditions and Definitions.
- 1.5.2 "Specialty Engineer" is a Professional Engineer registered in Ontario responsible for components designed by Contractor and who seals and signs shop drawings.
- 1.5.3 "Testing Agency" means a third party testing and inspection agency.
- 1.5.4 "Standard" and "Standards" mean reference standards listed under "Reference Standards" in this Section.

#### **1.6 Appointment of Testing Agency**

- 1.6.1 A CSA-approved Testing Agency shall be appointed to test concrete, reinforcement, and grout as per this Specification and shall include:
  - .1 Review of initial mix designs.
  - .2 Testing as outlined in Article 3.0.
- 1.6.2 Unless stated otherwise in Division 00 / Division 01, Testing Agency shall be engaged by Owner.
- 1.6.3 Contractor shall pay for testing not covered in clause 1.6.1, including but not be limited to:
  - .1 Review of Contractor-requested mix design changes.
  - .2 Waiting time incurred by Testing Agency in excess of 30 minutes.
  - .3 Testing required by Contractor for stripping of formwork, such as field-cured cylinders, etc.
  - .4 Additional costs due to overtime, shift work, holiday or weekend work, except that Owner will pay for holiday or weekend pickup when concrete was placed on a regular workday.
  - .5 Retesting or additional testing of concrete or reinforcement where tests have failed to meet specified requirements.

#### **1.7 Submittals**

- 1.7.1 Submit the following documents:
  - .1 Testing and Inspection Reports
    - .1 Reports shall be simultaneously distributed to the following parties:
      - .1 Consultant
      - .2 Contractor

- .3 Owner
- .2 Reports indicating defective works should be distributed immediately.
- .3 Reports shall be submitted within 5 business days.

## **2.0 DUTIES**

### **2.1 Responsibility of Contractor**

- 2.1.1 Cooperate fully with Testing Agency.
- 2.1.2 Give Testing Agency at least 24 hours prior notice of concrete placement.
- 2.1.3 Contractor is responsible to provide finished product that meets Specification. If initial tests indicate that concrete failed to meet Specification, Consultant will decide if additional testing is necessary. Testing shall be done by a CSA-approved Testing Agency but need not be Owner's agency. Proposed additional testing shall have prior approval of Consultant.
- 2.1.4 Strengths of cored samples must equal specified strength if tested dry or 85% of specified if tested wet, with wet or dry tests as per the Standard.

### **2.2 Responsibility and Duties of Testing Agency**

- 2.2.1 Testing Agency has authority to, and is expected to reject concrete not meeting Specifications.
- 2.2.2 Testing results and reviews performed by Testing Agency shall be submitted as noted in Article 1.7.
- 2.2.3 Testing Agency shall immediately notify Consultant if concrete is being placed without their notification, or if insufficient notice is provided.
- 2.2.4 Bring low 7-day, 28-day, and 56-day strength tests to immediate attention of Consultant and Contractor.
- 2.2.5 At completion of project, Testing Agency to provide a signed letter to Owner, with copy to Consultant, confirming that testing has been carried out per the Specifications and that Contractor and Consultant have been notified of any deficiencies in material properties.

## **3.0 TESTING – CONCRETE AND REINFORCEMENT**

### **3.1 General**

- 3.1.1 Number strength tests consecutively and mark cylinders as follows:
- 3.1.2 For 28 Day Mixes:
  - .1 7-Day Test: One cylinder marked "A28".
  - .2 28-Day Test: Two cylinders marked "B28" and "C28".

- 
- 3.1.3 For 56 Day Mixes (where required by Drawings, Specifications or when utilized to reduce embodied carbon in mixes):
- .1 28-Day Test: One cylinder marked "A56".
  - .2 56-Day Test: Two cylinders marked "B56" and "C56".
- 3.1.4 90-Day Test: (where required by Drawings, Specifications or when utilized to reduce embodied carbon in mixes):
- .1 28-Day Test: One cylinder marked "A90".
  - .2 56-Day Test: One cylinder marked "B90".
  - .3 90-Day Test: Two cylinders marked "C90" and "D90".
- 3.1.5 Test reports shall record:
- .1 Name of Project
  - .2 Date and time of sampling
  - .3 Name of supplier
  - .4 Delivery truck number
  - .5 Batch time and discharge time
  - .6 Identification of sampling and testing technicians
  - .7 Exact location in structure of concrete sampled
  - .8 Design strength of concrete sampled
  - .9 Admixtures, cement type, maximum aggregate size
  - .10 Air and concrete temperature
  - .11 Slump, and air content
- 3.1.6 Field-cured cylinders shall be marked "F".
- 3.1.7 Slump tests shall be performed prior to addition of superplasticizers.
- 3.1.8 Tests for slump and air content shall be taken with each strength test and as required by Specifications and Drawings.
- 3.1.9 Chloride ion tests shall be performed on first set of compressive test cylinders taken from first parking slab pour to show that chloride ion content of these mixes satisfies limits set out in CSA A23.1.

### **3.2 Regular Testing - Concrete**

- 3.2.1 To conform to the Standard, except each test shall consist of a minimum of three cylinders – as outlined in clause 3.1.
- 3.2.2 Testing for concrete with SCMs to reduce cement content (greater than 30% cement reduction as defined in Section 03 30 00) to conform to the Standard, except each test shall consist of four cylinders – one for 7-day strength, one for 28-day strength, and two for 56-day strength.
- 3.2.3 Concrete supplied from different plants or suppliers of same mix-type shall be considered different mixes for purposes of testing requirements.
- 3.2.4 Regular testing applied to all elements not listed in clause 3.3.

**3.3 Full-Time Testing - Concrete**

3.3.1 Full time testing shall apply to:

- .1 Concrete specified as exposure class C-1, C-XL, or C-2 in parking slab-on-grade locations.

3.3.2 Full time testing shall conform to the Standard and regular testing except:

- .1 Testing Agency shall have a representative on job site at all times that concrete requiring full time testing is being placed.
- .2 Test slump and air content from every truck and reject any concrete not within Specification.

3.3.3 For concrete mixes meeting 3.3.1.1, test compressive strength with a frequency not less than 1 test for every 25 cu. m. First and last batch of concrete to be placed each day shall always be tested.

3.3.4 Full time testing applies for duration of project as follows:

- .1 Provide full-time testing for elements listed in 3.3.1 and for each mix type by Supplier until satisfactory control of concrete mix is established by Testing Agency.
  - .1 For slump and air content, satisfactory performance shall be established from test results on not less than 5 consecutive batches of concrete placed.
- .2 Where Regular Testing has been initiated for a mix, Testing Agency shall resume Full Time Testing per 3.3.2 if any test fails to satisfy the Standard, agreed strength criteria, or as directed by Structural Consultant or Owner.
- .3 Where a mix type has not been utilized on project for more than 30 consecutive days, Full Time Testing shall apply until satisfactory compliance with this Standard is re-established.

**3.4 Field-Cured Cylinders**

3.4.1 Protect field-cured cylinders against wind and store on floor immediately below slab they represent unless floor below is heated. In that case, store cylinders on top of slab and cover with a plywood box. Cylinders are to be undisturbed at this location until picked up by Testing Agency. Do not store field-cured cylinders in temperature-controlled containers.

**3.5 Testing of Reinforcing Bars and Accessories**

3.5.1 Testing Agency shall, over duration of project, perform at least one tensile and bend test for each bar size and mill stamp used on project. Such testing shall comply with applicable CSA documents. Further testing may be requested at Consultant's discretion.

3.5.2 Testing Agency will select bars to be tested from reinforcing supplied to construction site, not from suppliers' yard. Cut bars to required length and replace shortened bars at no cost to Owner.

- 3.5.3 Supply mill certificates of chemical analysis in accordance with CSA G30.18R and G30.18W for all bar supplied to site.
- 3.5.4 Cut samples of mechanical splices and welded reinforcement as directed by Consultant. Replace mechanical splices and welded reinforcement cut out for testing.
- 3.5.5 When requested, provide samples of support accessories (chairs, bolsters, spacers) that are intended to be used.

**End of Section**



**1.0 GENERAL****1.1 Documents**

- 1.1.1 This Section, along with the Drawings, forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

**1.2 Description of Work Included**

- 1.2.1 Provide all labour, materials, equipment, and services necessary to supply, erect, and strip formwork and falsework for poured-in-place concrete shown or indicated on Contract Drawings and Specifications.
- 1.2.2 Install anchor bolts, embedded metal, inserts, hangers, reglets, dovetail anchors, etc. supplied by applicable trades for casting into concrete, and assume responsibility for correct positioning within agreed tolerance and in accordance with drawings supplied by trades.
- 1.2.3 Install openings, sleeves, block-outs, etc. required by other trades and assume responsibility for correct positioning within agreed tolerance and in accordance with drawings supplied by trades.

**1.3 Related Work Specified Elsewhere**

- 1.3.1 Section 03 20 00 – Concrete Reinforcing
- 1.3.2 Section 03 30 00 – Structural Cast-in-Place Concrete

**1.4 Reference Standards**

- 1.4.1 Concrete formwork shall conform to requirements of the following Building Code and Standards unless otherwise required by this Specification:
- .1 Ontario Building Code - 2012 0 REG 88/19
  - .2 CSA A23.1/CSA A23.2 – Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete
  - .3 CSA A23.3 – Design of Concrete Structures
  - .4 CSA S269.1 – Falsework and Formwork
- 1.4.2 Revision date of referenced codes, standards, and guidelines shall be as indicated in the above referenced Building Code. Where no reference is made within the Building Code, the latest published edition shall be used.
- 1.4.3 Where the Standard is referenced in this Specification, it means documents specified in this clause and their referenced Standards.
- 1.4.4 Keep a copy of A23.1/A23.2 on site and available for reference for duration of the Work.
- 1.4.5 Where there are differences between the Specifications and Drawings and the codes, standards, or acts, the most stringent shall govern.

**1.5 Definitions - For This Section**

- 1.5.1 "Owner", "Contractor", and "Consultant" per the General Conditions and Definitions.
- 1.5.2 "Specialty Engineer" is a Professional Engineer registered in Ontario responsible for components designed by Contractor and who seals and signs shop drawings.
- 1.5.3 "Standard" and "Standards" mean reference standards listed under "Reference Standards" in this Section.

**1.6 Submittals**

- 1.6.1 Shop Drawings for Formwork, Falsework, and Re-Shoring
  - .1 Structural Drawings shall not be reproduced, in whole or in part, for use as shop drawings.
  - .2 Well in advance of construction, submit to Consultant drawings showing complete design of slab formwork, falsework, and re-shoring systems stamped by a qualified Professional Engineer licensed in the Province of Ontario.
  - .3 As a minimum, show the following:
    - .1 Stripping schedule;
    - .2 Sequence for installing re-shores;
    - .3 Number of slabs re-shored at any given time;
    - .4 Formwork details related to stripping and re-shoring;
    - .5 Locations of proposed construction joints; and
    - .6 Camber.
  - .4 When requested, submit written proposal for Consultant review as to how specified cambers are to be achieved in field.
  - .5 Opening information
    - .1 Submit drawings of structure showing formed holes, recesses, and sleeving required under all Sections.
  - .6 As-Built Drawings
    - .1 Mark on a complete set of final reproducible drawings any changes, additions, or deletions that occur during construction as a result of Contractor's work, change orders, or for any other reason.
  - .7 Sloping Roofs or Floors
    - .1 When requested, well in advance of construction, submit complete details of forming together with placing and compaction procedures for sloping roofs or floors, including details of construction and placing of top forms and top form panels.

**2.0 PRODUCTS****2.1 General**

2.1.1 Products shall satisfy requirements of the Standard unless otherwise specified herein or on Drawings.

**2.2 Materials****2.2.1 Form Material**

- .1 Exposed surfaces - High-density overlay form ply (Ainsworth 107 or preapproved equal), metal, plywood, or plywood lined. Plywood to conform to the Standard.
- .2 Unexposed surfaces - metal, plywood, or wood lumber to conform to the Standard.
- .3 Plywood and wood formwork materials shall conform to the Standard and be free from warp and sawn straight so lines and shapes will be accurately retained.
- .4 Un-lined forms for unexposed surfaces shall be made with a good grade of lumber or plywood and fitted so there will be no leakage of mortar.
- .5 Use metal forms, plywood lined forms, or plywood forms of sufficient structural strength for exposed surfaces. Plywood for lining shall be GIS exterior grade fir plywood with waterproof glue.
- .6 Proprietary and/or modular forming systems shall be designed so they do not interfere with specified placement of reinforcement or other embedded hardware and must be pre-approved by Consultant.

**2.2.2 Ties and Spreaders**

- .1 Use metal form ties that are adjustable in length to permit tightening of forms. Use only snap-off type of form ties, which will permit no metal within 25 mm (1") of concrete surface after removal. Twisted wire form ties are not acceptable.
- .2 Wood spreaders inside wall forms will not be permitted.

**2.2.3 Form Release Agent**

- .1 Use non-staining form release agent that is compatible with finishes and membranes specified elsewhere in Contract Documents.
- .2 Form release agents shall be delivered in manufacturer's sealed and trademarked containers and shall be guaranteed to provide, clean stain-free concrete release and not to interfere with future-applied coatings and finishes.
  - .1 Vegetable-Based: 100% biodegradable, zero-VOC, rapeseed - or soy-based

- .2 Water-Based: Biodegradable, maximum VOC content allowed: 55 g/L

### **3.0 EXEXECUTION**

#### **3.1 General**

- 3.1.1 Concrete formwork construction shall be in accordance with the Standard unless otherwise specified herein or on Drawings. Only workers who are skilled and experienced in their trade shall do the work.

#### **3.2 Lines and Levels**

- 3.2.1 Verify lines, levels, and column centers before proceeding with work and ensure that dimensions agree with Drawings.
- 3.2.2 Co-ordinate and co-operate with other trades in forming and setting of recesses, chases, sleeves, inserts, bolts, and hangers.

#### **3.3 Design of Formwork, Falsework, and Re-Shoring**

- 3.3.1 Conform to the Standard.
- 3.3.2 Design formwork and re-shoring to safely support vertical and lateral loads until they can be supported by structure. Design formwork for loads and lateral pressures recommended in CSA S269.1. Contractor assumes full responsibility for structural adequacy of forms to withstand concrete, environmental, and construction loads.
- 3.3.3 Design and provide shoring and bracing to excavations and underpinning to safely withstand lateral pressures to which they may be subjected.
- 3.3.4 See drawings for locations where reinforced concrete members are not structurally stable until walls and slabs intersecting with them have been constructed to specified level and concrete has reached at least 70% of specified strength.
- 3.3.5 Design shores for these slabs and walls to safely support total vertical and lateral loads until walls and slabs are complete and have reached 70% of specified strength. Design shores so they can be unloaded gradually.
- 3.3.6 As a minimum, work shall conform to the Standard. Refer to "Formwork for special Architectural finishes" in CSA A23.1 for architectural concrete.
- 3.3.7 Where concrete is exposed to view, forms are to be laid out so joints are kept to a minimum and located in an orderly and symmetrical arrangement wherever possible. Form ties shall be evenly spaced and located in straight horizontal and vertical lines. Spacing and location of form tie holes shall be detailed by Contractor and approved by Consultant. See architectural Drawings and Specifications for special requirements for architectural, or exposed, concrete.

- 3.3.8 Strength and rigidity of forms shall be such that they will not leak mortar or result in visible irregularities in finished concrete. In addition, deflection of facing materials between studs, as well as deflection of studs and walers, shall not exceed 0.0025 times the span.
- 3.3.9 Construct forms so finished concrete will conform to shape, dimensions, and tolerances specified in the Standard or on structural Drawing, whichever is most rigorous. They shall also incorporate cambers specified on structural Drawings. Movement resulting from form support deflection, closure of form joints, and elastic shortening of forms and shoring must be calculated and added to cambers indicated on Drawings. Coordination to achieve more rigorous tolerances on concrete dimensions required to accommodate geometric tolerance of various trades and finishes (cladding, structural steel, etc.) shall be completed by Contractor.
- 3.3.10 Construct forms so they may be dismantled and removed without damaging concrete.
- 3.3.11 Submit details of sequence and extent of formwork removal and re-shoring for Consultant review. Such details shall include magnitude of loads and location of re-shores at each level. Forms shall not be removed or adjusted until review is complete. Such review does not relieve Contractor of responsibility for formwork and safety during construction.
- 3.3.12 Set shores on wedges or use adjustable shores so they may be removed without causing undue strains in concrete.
- 3.3.13 Do not exceed safe capacity of structure with construction or shoring loads. Safe capacity of structure may be taken as design live load, as indicated on structural Drawings, multiplied by ratio of concrete strength at time of loading to specified concrete strength, but not greater than 1.0.

#### **3.4     Erection**

- 3.4.1 Sleeves and openings shown on structural Drawings must be confirmed with mechanical, electrical, and architectural Drawings. Report discrepancies to Consultant.
- 3.4.2 Sleeves and openings not shown on structural Drawings must be approved by Consultant.
- 3.4.3 Keep untreated forms moist to prevent shrinkage prior to placing of concrete and wet surface at time of placing.
- 3.4.4 Treated formwork surfaces shall have approved form coating applied in accordance with manufacturer's recommendations, prior to placing reinforcing steel. Remove excess form coating. Do not apply form release agent after reinforcing steel has been placed. Ensure reinforcing steel does not come in contact with form release oil.
- 3.4.5 Erect, support, brace, and maintain formwork to safely support vertical and lateral loads until they can be supported by structure.
- 3.4.6 Falsework erection shall be supervised by Professional Engineer responsible for its design.

3.4.7 Inspect forms prior to concrete pour to ensure they have been erected in conformance with formwork shop drawings.

3.4.8 Construction

- .1 Form footing sides unless footings are shown to be placed against undisturbed soil or unless excavation is left with vertical sides against which concrete can be directly cast.
- .2 Mark building, grid, or other lines on forms to permit accurate positioning of reinforcing steel.
- .3 Construct templates and supports to rigidly fix reinforcing dowels in forms prior to concreting.
- .4 Provide suitable markers to indicate location and configuration of continuing concrete members so dowels can be positioned accurately in relation to their position in continuing members.
- .5 Set anchor bolts, templates, steel connection units, hardware, or other inserts into forms and secure them rigidly so they do not become displaced during concreting. Set and secure these items to tolerances specified and required in appropriate Sections.
- .6 Build top forms on sloping concrete where required to prevent flow of concrete out of forms. Provide vents to top forms to permit air or bleed water to escape from forms.
- .7 Where concrete is poured against structural steel beams causing unbalanced horizontal pressures, provide sufficient horizontal support to resist such pressures and prevent deflection of steel beams.

**3.5 Tolerances**

- 3.5.1 Tolerances for concrete work shall conform to requirements of the Standard and Drawings.
- 3.5.2 Variations in building lines that result in extension of building over lot lines or restriction lines will not be permitted.
- 3.5.3 These tolerances are acceptable with regard to structural requirements. Interfacing tolerances may not be compatible with the above. Review and coordinate interfacing tolerances so various elements come together properly.

**3.6 Product Handling**

- 3.6.1 Protect formwork materials before, during, and after installation and protect installed work and materials of other trades.
- 3.6.2 In event of damage, immediately make required repairs or replacements necessary to approval of Consultant and at no cost to Owner.

**3.7      Removal of Formwork**

- 3.7.1 Forms shall not be removed until concrete has attained sufficient strength that no damage to strength or continuity of concrete will occur when forms are removed. Time for formwork removal of suspended concrete shall be approved by Consultant. See also requirements of Article 3.2.
- 3.7.2 Prying against face of concrete to remove forms is not allowed; only wooden wedges shall be used.
- 3.7.3 Where forms are being reused, thoroughly clean and retreat them.
- 3.7.4 Where possible, forms should be reused. Minimize damage to formwork so it can be reused.
- 3.7.5 Remove form ties carefully to avoid marking concrete and to allow for patching. Grout bottom of form tie hole to prevent rust staining.
- 3.7.6 As a minimum, conform to requirements of CSA S269.1 and the following:
- .1 Design of re-shore shall accommodate load distribution resulting from differences in stiffness between storeys such as slabs, transfer floors, and grade.
  - .2 Maintain re-shoring or formwork in place for minimum 28 days or longer as may be required for concrete to reach its specified 28-day strength.
  - .3 Do not strip within one and a half bays of construction joint until new concrete beyond construction joint has reached 75% of its specified 28-day strength.
  - .4 Provide and install adequate shoring to safely support horizontal or inclined members after 28-day specified strength is achieved where superimposed loads exceed design loads.
  - .5 Side forms for vertical members may be stripped as soon as concrete is sufficiently strong to stand unsupported and safely resist imposed loads.

**3.8      Construction Joints**

- 3.8.1 Obtain approval from RJC for location and details of construction joints not shown.

**3.9      Control Joints**

- 3.9.1 Construct control joints at locations indicated and in accordance with details shown.
- 3.9.2 Construct clean expansion joints free of foreign material, likely to impair proper operation of joint.
- 3.9.3 Provide non-extruding joint filler in expansion joints for full area between adjacent concrete members. Anchor filler material to adjacent member or between concrete members and adjacent members of other materials.
- 3.9.4 Where shown, provide waterstops in expansion joints.

**End of Section**



**1.0 GENERAL****1.1 Documents**

- 1.1.1 This Section, along with the Drawings, forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

**1.2 Description of Work Included**

- 1.2.1 Provide all labour, materials, equipment, and services necessary to supply and install reinforcing steel work shown or indicated in Contract Drawings and Specifications including accessories such as hanger bars, spirals, wire ties, support bars, chairs, spacers, supports, or other devices required to position reinforcing properly.

**1.3 Related Work Specified Elsewhere**

- 1.3.1 Section 03 00 50 – Testing of Concrete  
1.3.2 Section 03 11 00 – Concrete Forming and Accessories  
1.3.3 Section 03 30 00 – Structural Cast-in-Place Concrete  
1.3.4 Section 05 12 00 – Structural Steel Framing

**1.4 Reference Standards**

- 1.4.1 Concrete reinforcing shall conform to requirements of the following Building Code and Standards unless otherwise required by this Specification:
- .1 Ontario Building Code - 2012 0 REG 88/19
  - .2 CSA A23.1/CSA A23.2 – Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete
  - .3 CSA A23.3 – Design of Concrete Structures
  - .4 ASTM A1064M – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
  - .5 CSA G30.18 – Carbon Steel Bars for Concrete Reinforcement
  - .6 CSA W47.1 – Certification of Companies for Fusion Welding of Steel
  - .7 CSA S413 – Parking Structures
  - .8 Reinforcing Steel Institute of Canada (RSIC) – Manual of Standard Practice
  - .9 ASTM A820M – Standard Specification for Steel Fibers for Fiber-Reinforced Concrete
  - .10 ASTM C1116M – Standard Specification for Fiber-Reinforced Concrete

- 1.4.2 Revision date of referenced codes, standards, and guidelines shall be as indicated in the above referenced Building Code. Where no reference is made within the Building Code, the latest published edition shall be used.
- 1.4.3 Where the Standard is referenced in this Specification, it means documents specified in this clause and their referenced Standards.
- 1.4.4 Keep a copy of A23.1/A23.2 on site and available for reference for duration of the Work.
- 1.4.5 Where there are differences between the Specifications and Drawings and the codes, standards, or acts, the most stringent shall govern.

## **1.5 Definitions - For This Section**

- 1.5.1 "Owner", "Contractor", and "Consultant" per the General Conditions and Definitions.
- 1.5.2 "Specialty Engineer" is a Professional Engineer registered in Ontario responsible for components designed by Contractor and who seals and signs shop drawings.
- 1.5.3 "Standard" and "Standards" mean reference standards listed under "Reference Standards" in this Section.

## **1.6 Testing**

- 1.6.1 As per Section 03 00 50 - Testing of Concrete and Reinforcement.

## **1.7 Submittals**

- 1.7.1 Suppliers shall provide an embodied carbon breakdown for all reinforcing steel utilized in the project for review and approval:
  - .1 The breakdown shall be provided prior to ordering material indicating the total embodied carbon (kg CO<sub>2</sub>e).
  - .2 The breakdown shall also be provided at the end of the project with the values updated to reflect the final as-built quantities and resulting embodied carbon (kg CO<sub>2</sub>e).
  - .3 The breakdown shall be a tabular submittal showing quantities and embodied carbon based on accompanying EPDs as outlined below.
  - .4 Refer to Division 1 for the maximum allowable upfront (A1-A3) kgs of embodied carbon.
  - .5 The maximum embodied carbon for reinforcing steel shall not exceed 0.78 kg CO<sub>2</sub>e / kg.
- 1.7.2 Submit Environmental Product Declarations (EPDs) compliant with CSA-ISO 14025-07.
  - .1 Product EPDs must be third party certified, including external verification.

- .2 Alternatively with written approval producers may submit an industry average EPD in which the manufacturer is explicitly recognized as a participant by the program operator.
- 1.7.3 Submit third party certified documentation identifying the following information:
  - .1 global warming Potential (GWP in kg / tonne), CO<sub>2</sub>e;
  - .2 depletion of the stratospheric ozone layer, in kg CFC -11;
  - .3 acidification of land and water sources, in moles H<sup>+</sup> or kg SO<sub>2</sub>;
  - .4 eutrophication, in kg nitrogen or kg phosphate;
  - .5 formation of tropospheric ozone, in kg NO<sub>x</sub>, kg O<sub>3</sub>, or kg ethane;
  - .6 depletion of non-renewable energy resources, in MJ.
- 1.7.4 Submit documentation of recycled content of reinforcing bars. A breakdown of post-consumer and post-industrial recycled content should be specified. A mill certificate shall be provided.
- 1.7.5 Submit documentation of where the reinforcing bars were extracted, processed, and manufactured. Materials should be selected from within a 160 km (100 mile) radius.
- 1.7.6 Submit documentation during the closeout period indicating the amount of recycled scrap reinforcement noted in section 3.1.3.

## **2.0 PRODUCTS**

### **2.1 General**

- 2.1.1 Products shall satisfy requirements of the Standard unless otherwise specified herein or on Drawings.

### **2.2 Materials**

- 2.2.1 Reinforcing bars shall conform to the Standard unless otherwise specified herein or on Drawings.
- 2.2.2 Reinforcing bars to be welded shall conform to the Standard, G30.18W.
- 2.2.3 Reinforcing steel that is part of seismic load-resisting system to conform to the Standard, G30.18W.
- 2.2.4 Reinforcing bars to be provided by Gerdau Long Steel Rebar Steel Mill in Whitby, ON.
- 2.2.5 Welded wire fabric shall conform to the Standard; size and gauges as shown on Drawings.
- 2.2.6 Welded wire fabric for slabs shall be delivered in flat sheets.
- 2.2.7 In suspended parking slabs, bar support chairs shall be plastic or plastic coated.

- 2.2.8 Chairs, Bolsters, Bar Supports, Spacers: To CSA A23.1. In case of concrete exposed to view or weather, accessories shall be such that no metal is permitted to come closer than 40 mm (1-5/8") from a formed face and 50 mm (2") from a troweled surface. Use precast concrete supports for exposed concrete beams and soffits and concrete cast against soil/rock. Precast concrete supports shall be made of concrete of quality and strength at least equal to that specified for member in which they are used.
- 2.2.9 Steel fibers shall meet requirements of ASTM A820 Type 1, deformed fibers. Minimum ultimate tensile strength shall be 1036 MPa. Minimum aspect ratio shall be 80. Minimum fiber length shall be 60 mm. Maximum fiber diameter shall be 0.03 inches. Steel fibers shall be Dramix RC 80/60 BN manufactured by Bekaert Corporation.
- 2.2.10 Steel fiber concrete shall be proportioned as required in ASTM C1116, alternative 3, in consultation with fiber manufacturer based on required concrete properties indicated on Drawings and Specifications.

### **3.0 EXECUTION**

#### **3.1 General**

- 3.1.1 Concrete reinforcement work shall be in accordance with the Standards unless otherwise specified herein or on Drawings. Ensure work is executed only by workers skilled and experienced in their trade.
- 3.1.2 Notify Consultant at least 24 hours before concrete is placed so Consultant may review the work.
- 3.1.3 Place surplus reinforcing steel in area designated for recycling.
- 3.1.4 Identify with a tag each bundle of bars with a code mark corresponding to that appearing on bar list.
- 3.1.5 Bend reinforcement once only and at room temperature of 18°C. Do not straighten or re-bend reinforcement. Do not use bars with kinks or bends not shown on Drawings.
- 3.1.6 Replace bars that develop cracks or splits.
- 3.1.7 Non-galvanized reinforcement to be electrically isolated from galvanized steel including but not limited to reinforcement, hardware (sleeves, conduit), embedded plates, structural steel, or window washing anchors.
- 3.1.8 Williams All-Thread - Bar must not be welded or subjected to heat of torch or used as a ground.

#### **3.2 Field Bending**

- 3.2.1 Do not field bend reinforcement except where indicated or authorized in writing by Consultant.
- 3.2.2 When field bending is authorized, bend without heat, applying slow and steady pressure.

3.2.3 Replace bars that develop cracks or splits.

### **3.3 Construction Joints in Cast-in-Place Concrete**

3.3.1 Obtain acceptance from Consultant for details of construction joints not shown.

3.3.2 Continue reinforcement through joint in its normal position. Add additional reinforcement across joint as shown or directed. Where mechanical splice is required at construction joint, use of LENTON Formsaver type coupler manufactured by nVent or approved equivalent is appropriate.

### **3.4 Mechanical Splicing of Reinforcement**

#### **3.4.1 Tension Splices**

- .1 Provide mechanical tension splices at locations indicated. Where mechanical splice/coupler is indicated, correct type of coupler should be used. Typically standard coupler is appropriate. Transitional couplers to be provided whenever bar diameter changes. Provide positional couplers when both sides of bar cannot be rotated (hooks, bends, coupled both ends, etc.)
- .2 Unless noted otherwise, mechanical tension splices shall develop 120% of specified yield strength, but not less than 110% of actual yield strength, of reinforcement being spliced or of smaller bar if spliced bars are of different sizes.
- .3 Unless noted otherwise, mechanical tension splices shall develop specified tensile strength of reinforcement being spliced or of smaller bar if spliced bars are of different sizes.
- .4 In each concrete member, unless otherwise indicated, mechanical tension splices in adjacent bars shall be staggered not less than the greater of 800 mm or 40 bar diameters.
- .5 Install mechanical splices in accordance with manufacturer's requirements.

#### **3.4.2 Compression Splices**

- .1 Provide compression splices at locations indicated.
- .2 Non End-Bearing Mechanical Splices
  - .1 Unless noted otherwise, mechanical compression splices shall develop 120% of specified tensile yield strength, but not less than 110% of actual tensile yield strength of reinforcement being spliced or of smaller bar, if spliced bars are of different sizes.
  - .2 In each concrete member, stagger splices of adjacent bars by at least 800 mm.
- .3 End-Bearing Splices
  - .1 End bearing splices shall develop ultimate compressive strength of reinforcing bars spliced.

- .2 Accurately sawcut end bearing surfaces of bars to be spliced 90 degrees to axis of bar with a tolerance of 1-1/2 degrees.
- .3 In setting bars, rotate until angle between bearing surfaces is at minimum, but not more than 3 degrees of full bearing.
- .4 In each concrete member, stagger splices in adjacent bars by 800 mm but not less than 20 bar diameters.
- .4 Rebar End Welded to Plates
  - .1 Provide weld details for weldable couples where bars are specified to be end welded to plates, steel sections, etc. for amount specified in above sections.

### 3.5 Shop Drawings

- 3.5.1 Refer to Section 01 33 00 for submittals.
- 3.5.2 Allow at least two weeks for shop drawing review by Structural Engineer of concrete reinforcement, bar support, and accessories. Allow sufficient time for review, correction, fabrication, shipping to site, and placement.
- 3.5.3 Clearly indicate bar sizes, grades, spacing, location and quantities of reinforcing mesh, bar supports, and accessories, mechanical splices, and identifying code marks to permit correct placement without reference to structural drawings. Include total weight of materials being installed.
- 3.5.4 Placing drawings and bar lists will be reviewed for number and size of bars only. This review in no way relieves Contractor's responsibility for carrying out the Work in accordance with Drawings.
- 3.5.5 Substitution of imperial reinforcing sizes and grades will only be accepted if placing drawings showing imperial sizes are submitted for Consultant review. Approval must be obtained before work commences.
- 3.5.6 Clearly indicate placing order of reinforcement.
- 3.5.7 Prepare sections of congested joints to avoid site issues.
- 3.5.8 Prepare reinforcement shop drawings and bar lists taking into account openings and recesses shown on architectural, structural, mechanical, and electrical Drawings, and on sleeving shop drawings. Reinforcement shop drawings may only be reviewed if sleeving and conduit shop drawing are submitted in parallel.
- 3.5.9 Completely dimension openings, recesses, and sleeves, and relate to suitable grid lines and elevation datum.
- 3.5.10 Structural drawings are not prepared to be used as erection or shop drawings. However, electronic files or sepia's may be used by Contractor under following conditions:
  - .1 Copyright remains with Read Jones Christoffersen Ltd.
  - .2 Drawings will only be used for shop drawings for this project and not be put to any other use.

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- .3 Read Jones Christoffersen Ltd. assumes no liability for errors or omissions in drawings. Contractor assumes all risk and expenses associated with use of structural drawings in production of Contractor's work.
  - .4 References to Read Jones Christoffersen Ltd. must be deleted from title block.
  - .5 Contractor signs a release available from Read Jones Christoffersen Ltd. that addresses the above items in more detail.
- 3.5.11 Detail reinforcement in accordance with Contract Documents, CSA A23.1, CSA S304.1, and detailing standards in CRSI Manual of Standard Practice.
- 3.5.12 Where 10M top bars and welded wire fabric are shown, provide adequate chairs, bolsters, or supports so bars are not bent or displaced prior to or during concreting operation.
- 3.5.13 Detail sections to fully illustrate placement of concrete reinforcement at areas such as openings, change of levels, spandrel, stairs, and wherever else required.
- 3.5.14 Provide large-scale detail concrete sections at areas of steel concentrations, such as at intersections of beams and columns, column splices, or wherever else required.
- 3.5.15 Indicate placing sequence for reinforcement, such as intersections of beams and beams, slabs and beams, and within slabs.
- 3.5.16 Indicate minimum clearances between reinforcement and minimum concrete cover to reinforcement.
- 3.5.17 Indicate location and embedment of dowels.
- 3.5.18 Location, number, and type of support accessories, including support bars suitably sized and spaced to rigidly support weight of reinforcement and construction load.
- 3.5.19 Submit code marks or symbols used on reinforcement of each manufacturer so that RJC may identify grades and sizes of reinforcement.
- 3.5.20 Shop Drawings for Welding Reinforcement
- .1 When requested, submit drawings showing, as minimum, the following: locations, elevations, and size of welds; welding procedures and techniques; reports of chemical compositions; and verification of weldability, stamped as approved by Canadian Welding Bureau.
- 3.5.21 Shop Drawings for Mechanical Splices
- .1 Submit drawings showing, as minimum, the following: location, elevations, and size of splices; materials; and procedures.
- 3.5.22 Certificates
- .1 When requested, provide Consultant with certified copy of reports of reinforcing steel showing physical and chemical analysis minimum 4 weeks prior to commencing fabrication.

.2 When requested, provide test data from Canadian Testing Laboratory proving that each size and grade of reinforcement proposed meets Specification requirements. Reinforcement reviewed for use by Consultant shall be identified in a manner suitable to Consultant. Only steel that has been reviewed and accepted may be used in project. This analysis should be provided for each heat of steel.

.3 Provide Steel Fibers: Certification and test reports for each shipment of fibers.

#### 3.5.23 Substitutions

.1 Substitution of different size bars permitted only upon written acceptance of Consultant.

#### 3.5.24 As-Built Drawings

.1 Mark on a complete set of final reproducible drawings any changes, additions, or deletions that occur during construction as a result of Contractor's work, change orders, or for any other reasons.

### 3.6 **Fabrication**

3.6.1 Fabricate reinforcing to the Standard and Contract Documents.

3.6.2 Reinforcing bars shall be cold bent. Bars shall not be straightened or re-bent.

3.6.3 Colour code each bar to correspond with code mark appearing on bar list.

3.6.4 Steel stud assemblies for shear reinforcement shall be fabricated in accordance with ASTM A1044/A1044M.

### 3.7 **Product Delivery, Storage, and Handling**

3.7.1 Store reinforcement in a manner to prevent excessive rusting and fouling with dirt, grease, form-oil, and other bond-breaking coatings.

3.7.2 Reinforcement at time concrete is placed shall be free from excessive rusting, mud, oil, or other coatings that adversely affect its bonding capacity.

### 3.8 **Placing**

3.8.1 Reinforcing of size and shapes shown on structural Drawings shall be accurately placed in accordance with Drawings and requirements of the Standard.

3.8.2 Reinforcement shall be adequately supported by chairs, spacers, support bars, hangers, or other accessories, and secured against displacement within tolerances permitted in the Standard. Support devices contacting surfaces exposed to exterior shall be non-corroding.

3.8.3 Bars that are not part of structural design or Drawings, and whose only function is supporting other reinforcing in lieu of other support accessories, shall be considered accessories.



- 3.8.4 In suspended parking slabs, uncoated metal ties shall not extend more than 5.0 mm (3/16") into concrete cover.
- 3.8.5 Reinforcement shall be adequately tied and chaired to maintain it in specified location during pouring. Lifting of reinforcing or welded wire mesh into specified position during concrete pour will not be allowed.
- 3.8.6 Tolerances for bar placement shall be per the Standard. Tolerances shall not be used to justify use of chair, bolsters, or chair/support combinations that result in improper cover.
- 3.8.7 Williams All-Thread Bar must not be welded, subjected to high heat of torch, nor used as a ground.
- 3.8.8 Field cutting is to be done by abrasive wheel or band saw.
- 3.8.9 Prior to concreting, accurately place reinforcement, support, and secure against displacement, as indicated on reviewed placing drawings and in accordance with CSA A23.1. Tack welding of reinforcement to secure in place will not be permitted.
- 3.8.10 Set column anchor bolts and wall dowels prior to concreting with wooden templates or other approved means.
- 3.8.11 Do not 'wet set' reinforcement into fresh concrete.
- 3.8.12 Secure reinforcement in columns and walls using sufficient spacers on each face to maintain requisite distance between reinforcement and column or wall face and so vertical bars are plumb.
- 3.8.13 Where continuous drop panels or slab thickenings are noted on Drawings, place bottom slab reinforcement in bottom of continuous drop panel or slab thickening, unless noted otherwise on Drawings.
- 3.8.14 Where toppings are placed on waterproof membranes, vapour barriers, and the like, prevent reinforcement or tie wire from contacting these items.
- 3.8.15 Ensure that longitudinal bars in beams have adequate vertical spacing between layers in accordance with the Standard.
- 3.8.16 Pre-assemble column and beam cages as necessary. Do not "spring" or bend ties and stirrups to place longitudinal reinforcement.
- 3.8.17 Splice locations are subject to review by Consultant.

### **3.9 Welding**

- 3.9.1 Welding of reinforcing steel shall be in accordance with the applicable Standard.
- 3.9.2 Welding of concrete reinforcement shall be performed by workers who are approved by Canadian Welding Bureau in accordance with the Standard. Submit copies of Canadian Welding Bureau approved welding procedure and certificate of current operator qualification to Consultant prior to commencement of welding.
- 3.9.3 Welding to reinforcement is only permitted as indicated in Contract Documents or with prior written approval of Consultant.

**3.10     Construction Review**

- 3.10.1 No concrete shall be placed until Consultant has completed a review of reinforcement in place. Provide minimum 24 hours notice of time when reinforcement will be substantially in place and ready for Consultant's review. Provide minimum of 6 hours for review and any required remedial work prior to concrete placement.
- 3.10.2 Consultant's general review during construction and inspection and testing by Independent Inspection and Testing Companies reporting to Consultant are both undertaken to inform Owner of Contractor's performance and shall in no way augment Contractor's quality control or relieve Contractor of contractual responsibility.

**3.11     Tolerances**

- 3.11.1 Perform fabrication and setting so completed work will be within tolerances set out in CSA A23.1.
- 3.11.2 These tolerances are acceptable with regard to structural requirements. Interfacing tolerances may not be compatible with the above. Review and coordinate interfacing tolerances so various elements come together properly.

**End of Section**

**1.0 GENERAL****1.1 Documents**

- 1.1.1 This Section, along with the Drawings, forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

**1.2 Description of Work Included**

- 1.2.1 Provide all labour, materials, equipment, and services necessary to supply and install cast-in-place concrete work shown or indicated in Contract Drawings and Specifications including concrete toppings, bases, sumps, curbs, posts, manholes, pits, paving, sidewalks, equipment bases or curbs, grouting of baseplates, etc.
- 1.2.2 Coordinate concrete placement fully with other trades. Confirm other related work, such as inserts, dowels, sleeves, reinforcement, etc., is complete before placing concrete.

**1.3 Related Work Specified Elsewhere**

- 1.3.1 Section 03 00 50 – Testing of Concrete and Reinforcement
- 1.3.2 Section 03 11 00 – Concrete Forming and Accessories
- 1.3.3 Section 03 20 00 – Concrete Reinforcing
- 1.3.4 Section 03 35 00 – Concrete Finishing
- 1.3.5 Section 05 12 00 – Structural Steel Framing
- 1.3.6 Section 05 31 00 – Steel Decking

**1.4 Reference Standards**

- 1.4.1 Concrete work shall conform to requirements of the following Building Code and Standards unless otherwise required by this Specification:
- .1 Ontario Building Code - 2012 0 REG 88/19
  - .2 CSA A23.1/CSA A23.2 – Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete
  - .3 CSA A23.3 – Design of Concrete Structures
  - .4 CSA S413 – Parking Structures
  - .5 CSA A3000 – Cementitious Materials Compendium
  - .6 ACI 347 – Guide to Formwork for Concrete
  - .7 CSA S269.1 – Falsework and Formwork
- 1.4.2 Revision date of referenced codes, standards, and guidelines shall be as indicated in the above referenced Building Code. Where no reference is made within the Building Code, the latest published edition shall be used.

- 1.4.3 Where the Standard is referenced in this Specification, it means documents specified in this clause and their referenced Standards.
- 1.4.4 Keep a copy of A23.1/A23.2 and ACI 506.2 on site and available for reference for duration of the Work.
- 1.4.5 Where there are differences between the Specifications and Drawings and the codes, standards, or acts, the most stringent shall govern.

## **1.5 Definitions - For This Section**

- 1.5.1 "Owner", "Contractor", and "Consultant" per the General Conditions and Definitions.
- 1.5.2 "Specialty Engineer" is a Professional Engineer registered in Ontario responsible for components designed by Contractor and who seals and signs shop drawings.
- 1.5.3 "Standard" and "Standards" mean reference standards listed under "Reference Standards" in this Section.

## **1.6 Submittals**

- 1.6.1 Keep a record at the job site showing time and place of each pour of concrete, together with a transit-mix delivery slip certifying contents of pour. Make the record available to the Owner for inspection upon request. Upon completion of this portion of work, submit placing records and delivery slips to the Owner.
- 1.6.2 Submit details of proposed methods of concrete curing and provisions for weather protection to the Consultant for review.
- 1.6.3 Submit plan locations and details of construction joints for the Consultant's review.
- 1.6.4 Certificates
  - .1 The concrete supplier shall have a current "Certificate of Ready Mixed (or Mobile Mix) Concrete Production Facilities," as issued by the National Ready Mixed Concrete Association (NRMCA). The certificate shall be submitted to the Consultant upon request.
  - .2 When requested, prior to beginning work and when any change in materials or source of supply is proposed, provide the following certificates prepared by an independent inspection company. The cost of this work shall be borne by the Contractor.
    - .1 Certification that all raw materials used in the production of concrete proposed for the work comply with requirements of the specifications and CSA A23.1. Specifically, the Contractor must confirm that aggregates used will not react with alkalis in the concrete to cause deleterious expansion.
    - .2 Certification that compressive strength, water-cement ratio, slump, entrained air content, and other specified properties will be met using the proposed mixes.

- .3 Certification that classes of exposure C-1, A-1, and C-XL will meet the 56-day limits specified in CSA A23.1 for the rapid chloride permeability test using the proposed mixes.
- .4 The concrete supplier shall submit representative chloride permeability test data distributed over a period of 56 days for concrete exposure classes C-1, A-1, and C-XL with and without calcium nitrite corrosion inhibitor or any other admixture containing ionic salts.
- .3 When requested, the concrete supplier shall submit their most current "Concrete Mix Design Statistical Analysis" records for the proposed concrete plant. These records shall indicate the concrete supplier's average strength, standard deviation, coefficient of variation and target strength, as per the requirements of CSA A23.1 and the NRMCA. Data included in this statistical analysis shall be from the last 12 months.
- .4 Concrete Quality Plan
  - .1 When requested, submit a complete "Concrete Quality Plan", in the format provided by the NRMCA.
- .5 Preconstruction Trial Batches
  - .1 A detailed trial-batching program shall be carried out as indicated below for the following concrete mixes:
    - .1 All HVSCM mixes
  - .2 The purpose of the program is to allow the concrete supplier to demonstrate that their proposed concrete mix design meets the requirements of the contract documents.
  - .3 The program is to gain data on strength, shrinkage, and modulus of elasticity.
  - .4 At least four weeks prior to the trial-batching program taking place, the concrete supplier shall submit a detailed plan outlining the methodology, extent of concrete quality testing, schedule, and the like for the trial-batching program.
  - .5 The trial-batching program, including all necessary tests, shall be carried out by the concrete supplier at no additional expense to the Owner.
  - .6 The trial-batching program and all related tests are to be witnessed by an independent inspection and testing company appointed by the Owner.
  - .7 The concrete supplier shall allow free access to representatives of this company to make checks and any additional tests they feel are necessary, on behalf of the Owner.
  - .8 The trial-batching program shall involve the production of at least three truckloads or 20 cu. m of the required concrete.

- .9 The time from batching to discharge shall be equivalent to the typical haul time that is anticipated between the batching plant and the job site.
- .10 Trial Batches
- .1 Laboratory trial mixes, followed by full-size batch tests, shall be made to demonstrate that the materials, mix formula, and production techniques chosen will produce concrete meeting the requirements for the job. The following properties, as applicable to the work, shall be evaluated in the trial: workability, air content, finishability, setting time, temperature development, hardened air-void parameters, strength, and durability. If recent and adequate test data exists, the Owner may waive this requirement. If materials or placing conditions change significantly, further trials may be necessary.
- .2 Contractor shall submit a list of proposed locations for trial pours to be completed.
- .3 Contractor shall conduct on-site trial pours with trial mixes of concrete noted in section 6.1.
- .11 As-Built Drawings
- .1 Mark on a complete set of final reproducible drawings any changes, additions, or deletions that occur during construction as a result of the Contractor's work, change orders, or for any other reason.
- 1.6.5 Submit Environmental Product Declarations (EPDs) compliant with CSA-ISO 14025:07 (R2022) for each concrete mix design product proposed on the project.
- .1 Product EPDs must be third party certified, including external verification, or alternatively producers may submit an industry-wide EPD in which the manufacturer is explicitly recognized as a participant by the program operator.
- .2 The maximum embodied carbon for each type of member utilized shall not exceed the values below unless approved by the Consultant.

Member Type	Maximum kg CO <sub>2e</sub> / m <sup>3</sup>	Product
Piers	270	Lafarge ECOPact GWP Range (Upper)
Topping on Steel Deck	215	Lafarge ECOPact GWP Range (Upper)
Topping	215	Lafarge ECOPact GWP Range (Upper)

Foundation Slab	270	Lafarge ECOPact GWP Range (Upper)
Footing	236	Lafarge ECOPact GWP Range (Upper)
Foundation Walls	326	Ontario Industry Average
Stairs	215	Lafarge ECOPact GWP Range (Upper)
Core Walls	270	Lafarge ECOPact GWP Range (Upper)

- 1.6.6 Submit third party certified documentation identifying the following information:
- .1 Global Warming Potential (GWP in kg / tonne), CO<sub>2</sub>e;
  - .2 Depletion of the stratospheric ozone layer, in kg CFC -11;
  - .3 Acidification of land and water sources, in moles H<sup>+</sup> or kg SO<sub>2</sub>;
  - .4 Eutrophication, in kg nitrogen or kg phosphate;
  - .5 Formation of tropospheric ozone, in kg NO<sub>x</sub>, kg O<sub>3</sub>, or kg ethane; and
  - .6 Depletion of non-renewable energy resources, in MJ.
- 1.6.7 Submit a letter stating the total weight and volume of all products that are extracted, manufactured, and purchased within 160 km (100 mile) radius.
- 1.6.8 Submit a letter stating the total weight and volume of waste (returned or unused concrete) diverted from landfills. Provide details of how the waste was recovered, reused, or recycled.

## 2.0 **PRODUCTS**

### 2.1 **General**

- 2.1.1 Products shall satisfy requirements of the Standard unless otherwise specified herein or on Drawings.
- 2.1.2 Provide samples of materials upon request.
- 2.1.3 All cast-in-place concrete to be Lafarge ECOPact GWP Range (Upper) except for foundation walls.

### 2.2 **Materials**

- 2.2.1 Aggregates shall be natural stone and conform to the Standard. If recycled aggregate is available:
- .1 Utilization shall be in elements as approved by the Structural Consultant.
  - .2 Use shall be limited to maximum 25% of mass proportion of total aggregates.

- .3 Recycled aggregates may be used if proven track record of acceptable use in concrete can be demonstrated. Aggregate shall meet requirements of ASTM C33.
- 2.2.2 Mixing water shall conform to the Standard.
- 2.2.3 Air entraining admixtures to the Standard.
- 2.2.4 Pozzolanic admixtures may be used and shall conform to the Standard.
- 2.2.5 Calcium chloride, as either a raw material or a constituent in other admixtures, shall not be used unless approved in writing by Consultant.
- 2.2.6 Curing compounds shall conform to Specification and also be compatible with specified floor hardeners, covering adhesives, and waterproofing compounds.
- 2.2.7 Grout shall be pre-approved, pre-mixed, and non-shrink conforming to the Standard. Exposed grout shall be non-staining, cement grey in colour.
- 2.2.8 Modulus of Elasticity (E): For each concrete mix design,
  - .1 average (mean) of Modulus of Elasticity (as measured by appropriate testing) at all times during construction is to be not less than value shown on structural Drawings, or not less than  $4,500\sqrt{f'c}$  MPa if no value is shown on structural Drawings.
- 2.2.9 Concrete: Normal density concrete with air-dry density of  $23 \pm 1$  kN/cu. m. Conform to CSA A23.1.
- 2.2.10 Cement Type: General Use Portland Cement (Type GU) or Low Heat of Hydration Portland Cement (Type LH) meeting requirements of CSA A3000.
- 2.2.11 Admixture:
  - .1 Corrosion Inhibiting Admixture: Calcium nitrite based corrosion inhibitor, "DCI" or "DCI(S)" by W.R. Grace & Co. or Masterlife CI 30 by BASF Construction Chemicals (or approved alternative), shall be added at rate of 10 L/cu. m of concrete where required on structural Drawings. Corrosion inhibitor shall contain  $30 \pm 3\%$  of calcium nitrite by weight. Selection of "DCI", "DCI(S)" or "CI 30" (or approved alternative) shall be as directed by admixture supplier, based on anticipated placing and curing conditions and specific concrete mix design selected.
- 2.2.12 Shrinkage Control Fibres: "Dramix" steel fibres by Bekaert or approved alternative, 60/1.05.
- 2.2.13 Bonding Agent: Use Sika Sikdur 32 epoxy bonding agent for bonded topping installations.
- 2.2.14 Curing Compound: Conform to CSA A23.1.
- 2.2.15 Grout Beneath Base Plates: Non-shrink, non-metallic, flowable grout, In Pakt or approved alternative having a compressive strength at 28 days of at least 35 MPa (5 ksi). Where grout is exposed to view or weather, use non-ferrous grout.



**2.2.16 Supplementary Cementing Materials (SCMs)**

- .1 It is anticipated that one or more supplementary cementing materials will have to be used in concrete to produce a mix with acceptable fresh and hardened concrete properties and acceptable thermal characteristics during hardening. Materials will be one or more of the following:
  - .1 Granulated blast furnace slag
  - .2 Fly-ash
  - .3 Silica fume
- .2 SCMs – fly ash, granulated blast furnace slag, or silica fume – shall comply with requirements of CSA A23.1 and A3000.
- .3 Supplier shall submit evidence satisfactory to Owner to demonstrate that storage and dispensing facilities for SCMs do not have deleterious effects on materials themselves. These facilities will not expose these materials to such effects as agglomeration or balling of particles, separation or change in effective particle size of solids in slurries, freezing and thawing, or excessive heat.

**2.2.17 Aggregates**

- .1 Concrete supplier shall demonstrate by appropriate tests and test results that aggregates chosen have potential to meet design strength requirements specified herein.
- .2 Coarse Aggregate: Crushed rock conforming to CSA A23.1. Maximum size of coarse aggregates shall be 20 mm but smaller maximum sizes may be used.
- .3 Fine Aggregate: Natural and conforming to CSA A23.1.

**2.2.18 Unshrinkable Fill**

- |    |   |                         |
|----|---|-------------------------|
| .1 | Cement Type   | General Use GU Portland |
| .2 | <u>Minimum</u> 24-Hour Strength   | 0.07 MPa (10 psi)       |
| .3 | <u>Maximum</u> 28-Day Strength  | 0.4 MPa (60 psi)        |
| .4 | Class of Exposure   | N/A                     |
| .5 | Size of Coarse Aggregate  | 20 mm to 40 mm          |
| .6 | Slump at Point of Discharge   | 150 mm to 200 mm        |
| .7 | Calcium chloride or pozzolanic mineral admixtures shall not be used. Air entraining admixtures may be added if desired. |                         |

---

### 3.0 EXECUTION

#### 3.1 General

- 3.1.1 Concrete work shall be in accordance with the Standard unless otherwise specified herein or on Drawings. Work shall be executed only by experienced and skilled workers.
- 3.1.2 Notify Consultant at least 24 hours before concrete is placed to allow Consultant to review the work.
- 3.1.3 Prior to initial supply of concrete to project, schedule a “Pre-Pour Meeting” as outlined in Concrete Supplier’s Concrete Quality plan.
- 3.1.4 Waste Management
  - .1 Designate location or uses for excess concrete prior to placing of concrete.
  - .2 Designate location for cleaning out concrete trucks prior to unloading of concrete. Options could include but are not limited to:
    - .1 Company-owned site for that purpose (meeting environmental standards).
    - .2 On-site area to be paved later in project.

#### 3.2 Mix Designs

- 3.2.1 Concrete mixes shall be proportioned by the supplier to meet the compressive strength, exposure class, and other performance specifications noted in the contract documents. In addition, concrete mix design shall satisfy the transport, placing, and finishing requirements of the Contractor. All concrete shall be normal weight unless noted otherwise. Concrete types are specified in accordance with CSA A23.1 Table “Alternate methods for specifying concrete”, Alternate 1.
- 3.2.2 Concrete mix design is the responsibility of the supplier, including the use of admixtures, alone or in combination. The supplier is also responsible for ensuring the plastic and hardened properties of the concrete meet the construction and specified requirements. This includes the long-term performance of the hardened mix.
- 3.2.3 Suppliers shall provide an embodied carbon breakdown for all concrete utilized in the project for review and approval:
  - .1 The breakdown shall be provided prior to the start of construction indicating the total embodied carbon (kg CO<sub>2</sub>e).
  - .2 The breakdown shall also be provided at the end of the project with the values updated to reflect the final as-built quantities and resulting embodied carbon (kg CO<sub>2</sub>e).
  - .3 The breakdown shall be a tabular submittal showing all mixes, quantities and embodied carbon based on accompanying EPDs as outlined below.

- .4 Refer to Division 1 for the maximum allowable upfront (A1-A3) kgs of embodied carbon.
- .5 The maximum embodied carbon for reinforcing steel shall not exceed 415 kg of CO<sub>2</sub>e / tonne.
- 3.2.4 Aggregates shall be natural stone and conform to the Standard. If recycled aggregate is available, use shall be limited to a maximum of 25% of the mass proportion of total aggregates. Recycled aggregates may be used if a proven track record of acceptable use in concrete can be demonstrated. All aggregate shall meet the requirements of ASTM C33.
- 3.2.5 The mix designs shall take full advantage of Supplementary Cementing materials (SCMs), such as fly ash, silica fume, and blast furnace slag, to reduce the cement content of concrete. SCMs shall conform to the Standard.
  - .1 The following information should be submitted in a letter signed by the Specialty Engineer representing the concrete supplier / manufacturer:
  - .2 The reduction in Portland cement from Base Mix to Actual SCM Mix (as a percentage of the base mix), where Base Mix is defined below. This can be submitted as a total reduction of Portland cement for all the concrete mixes used on the project.
  - .3 Note: The Portland Cement Content (kg/cu. m) for each Base Mix is to be calculated as follows:  
  

$$\text{Portland Cement Content of Base Mix (kg/cu m)} = \text{Design strength values in MPa at 28 days} \times K$$

Where  $K=10$  for non-air-entrained concrete, or  $K=12.5$  for air-entrained concrete
  - .4 The cement reduction percentages by element are to be used as minimum on this project. These percentage reductions in cement should be achieved without affecting cost or schedule for the project.
  - .5 Manufacturer of concrete admixtures to confirm compatibility of product with cement reduction/addition of SCM's percentages.
  - .6 Concrete mixes shall not have a SCM's in quantities, which lead to increased rates of carbonation.
- 3.2.6 Pump mix slumps shall also conform to the above.
- 3.2.7 Water/Cement ratios and air contents for exposure class shall be as per the Standard.
- 3.2.8 The proposed mixes shall be submitted to the Consultant and Testing Agency for review.
- 3.2.9 The mix designs shall note the constituents by the properties required by the structural drawings, and the structural elements for which the mix is to be used.

**3.3     Testing**

3.3.1 Per Section 03 00 50.

**3.4     Samples**

3.4.1 Contractor shall submit a list of proposed locations for trial pours to be completed (e.g. in footing elements, in the basement level, or in a section of the parking slab-on-grade).

3.4.2 Contractor shall conduct on-site trial pours with for all mixes noted in section 1.6.4.5.1. The trial pours shall include finishing and curing methods to establish appropriate techniques and durations for the project. The following properties shall be evaluated in the trial: workability, air content, finishability, setting time, temperature development, hardened air-void parameters, strength, and salt-scaling durability (as per modified standard). The Contractor shall repeat samples for any rejected work.

3.4.3 Finishers not sufficiently experienced with finishing high volume supplementary cementitious mixes (HVSCM's) such as, but not limited to high volume fly ash (HVFA) concrete shall practice slab finishing techniques on footing elements to gain the required experience.

**3.5     Placing of Concrete**

3.5.1 Conveying and placing of concrete is to conform to the Standard.

3.5.2 Consolidate concrete by means of vibrators of appropriate size operated by experienced workers.

3.5.3 Use of vibrators to transport concrete is not permitted.

3.5.4 Discard cement slurry used to prime concrete pumps and do not place in project.

3.5.5 Immediately before placing concrete, clean forms and reinforcement of foreign matter.

3.5.6 Maximum time limit of 120 min from time of initial mixing to complete discharge shall be observed. Exemptions to maximum time limit, if required, shall be agreed upon by Engineer, Owner, and concrete supplier prior to placement of concrete. In some circumstances, set retarders or hydration stabilizers may be used to extend discharge time.

3.5.7 During hot weather conditions, as defined by CSA A23.1, do not use concrete mixed more than 1 hour after introduction of mixing water.

3.5.8 Allow 24 hours minimum to elapse after placing concrete in columns, piers, or walls before placing concrete in beams or slabs supported thereon.

3.5.9 Prior to pouring concrete elements directly supported above, remove forms to such an extent to allow Architect/Owner/Engineer to review quality of exposed column surfaces. Provide necessary protection to exposed surfaces upon completion of review.

- 3.5.10 Place concrete on steel joist and steel deck floors in a manner that avoids piling up of concrete. Do not drop concrete directly from buckets, but employ suitable means of distribution. Wet down deck during hot weather prior to concreting.
- 3.5.11 Remove concrete spilled onto forms around hoisting equipment before depositing concrete in these areas.
- 3.5.12 Pumping Concrete
- .1 Pumping or pneumatic placing of concrete shall only be used if velocity of discharge is reduced to a point where no separation or scattering of concrete occurs, and consistency of mix has been designed to allow such a system with no adverse effects on quality of concrete.
  - .2 Excess grout or mortar used to lubricate pipelines, or washout water, must not be discharged into forms.

### **3.6 Openings and Inserts**

- 3.6.1 Notify trades sufficiently in advance to make provisions for openings, inserts, and fasteners. Cooperate with trades in forming and setting of slots, sleeves, bolts, dowels, hangers, inserts, conduits, clips, etc. Embedded hardware may be subject to review by Consultant.
- 3.6.2 Openings and sleeves shown on structural Drawings must be confirmed with mechanical, electrical, and architectural Drawings.
- 3.6.3 Openings and sleeves not shown on structural Drawings must be approved by Consultant.
- 3.6.4 Do not pass sleeves, ducts, pipes, or other openings through joists, beams, columns, or wall zones without written approval of Consultant.
- 3.6.5 Do not eliminate, cut, or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of modifications by Consultant before placing concrete.

### **3.7 Construction and Control Joints**

- 3.7.1 Construction joints shall conform to the Standard except that for horizontal joints in walls, other than retaining walls, it will be sufficient to place fresh concrete on a clean rough surface unless directed otherwise by Consultant or otherwise noted on structural Drawings.
- 3.7.2 Joints in slabs-on-grade shall be located as indicated on structural and/or architectural Drawings. Unless noted otherwise on Drawings, a joint in slab-on-grade may be a pour joint, trowelled joint, saw cut, or other pre-approved method. Depth of joints shall be minimum 1/4 of thickness of slab. Saw cut joints are to be completed within 12 hours of placing. Submit alternative joint details in writing to Consultant.
- 3.7.3 Construction joints in walls and columns shall occur at top of slab and underside of slab/beam systems unless noted otherwise on structural Drawings.

- 3.7.4 Construction joints not shown in Drawings or Specifications shall be subject to approval of Consultant. Consultant may require keys or extra reinforcing to be provided at Consultant's discretion with associated costs borne by Contractor.
- 3.7.5 Existing concrete surface at construction joints shall be brought to a saturated surface dry condition immediately prior to placement of concrete.
- 3.7.6 Construction joints exposed to view may be subject to non-structural review by Consultant.
- 3.7.7 Unless noted otherwise on Drawings, control joints in walls are to be located at maximum spacing of 9 m (30') on center and detailed as indicated on structural Drawings.
- 3.7.8 Supply and install pre-molded waterstops in construction joints where indicated on Drawings. Weld joints to make watertight. Install waterstops in accordance with manufacturer's specifications and recommendations. Waterstop procedures require approval of Consultant.
- 3.7.9 Obtain approval from RJC for location and details of construction joints not shown.
- 3.7.10 Maximum length of concrete slab pour shall be 40 m (120'-0).
- 3.7.11 Maximum length of concrete foundation wall pour shall be 15 m (50').
- 3.7.12 Maximum height of concrete pour shall be 5 m (15'-0).
- 3.7.13 If construction joint (including joints around temporary openings) will be exposed in its permanent condition, such as in a parking garage, joint must be caulked as outlined under Materials section.

### **3.8 Curing and Protection**

- 3.8.1 Curing procedures shall be in accordance with the Standard. Alternate methods may be used, with Consultant's approval, providing they produce concrete that meets Contract Documents.
- 3.8.2 Cold and hot weather protection shall comply with the Standard or requirements on structural Drawings, whichever are more rigorous.
- 3.8.3 Concrete placed during extreme drying conditions shall satisfy A23.1.
- 3.8.4 (Reference Standard CSA A23.1/A23.2) Submit plan for curing to Owner, for review and approval, together with other tender documents. Prepare curing plan in accordance with the Standard, including:
  - .1 Method for protecting concrete from evaporation of surface moisture from fresh concrete.
  - .2 Type of curing material to be used.
  - .3 How surface will be kept moist and quality control requirements for keeping surface moist.
  - .4 Time of initiation and duration of curing.

.5 Provisions to address potential problems such as high winds and hot and cold weather.

.6 Limitations of access, if any, to surfaces being cured.

3.8.5 Concrete mixes that meet definition of HVSCM-1 and where classes of exposure C-1, A-1, F-1, S-1, and S-2 apply shall have Extended Curing. For other exposure classifications, concrete mixes that meet definition of HVSCM-1 or 2 shall have Additional Curing.

- $\text{HVSCM-1} = \text{FA}/40 + \text{S}/45 > 1.00$

- $\text{HVSCM-2} = \text{FA}/30 + \text{S}/35 > 1.00$

where FA = fly ash (Type F, CI1, or CH content of concrete (% mass of total cementing materials) and S = slag content of concrete (% mass of total cementing materials)

- Additional Curing = 7 days at  $> 10^{\circ}\text{C}$  for a time necessary to attain 70% of specified strength. When using silica fume concrete, additional curing procedures shall be used. See Standard.

- Extended Curing = wet-curing period of 7 days. Curing types allowed are ponding, continuous sprinkling, absorptive mat, or fabric kept continuously wet.

3.8.6 Obtain approval of Owner for proposed means of monitoring concrete curing conditions. Contractor is responsible for confirming completion of curing.

3.8.7 Protect concrete in accordance with CSA A23.1, concrete supplier's requirements, and as specified herein to prevent freshly deposited concrete from freezing, being exposed to abnormally high temperatures or temperature differentials, premature drying, and moisture loss for period of time necessary to develop specified properties of concrete.

3.8.8 Protection of Completed Work

.1 At all times during the work, protect exposed concrete, exposed masonry, and other exposed members from staining or becoming coated with concrete leakage due to continuing concreting operations. Members that become coated may be classified as defective by Consultant.

.2 Protect exposed members from staining due to rusting of reinforcement projecting beyond construction joints.

.3 Take suitable measures to prevent spalling and cracking damage occurring to structure due to water freezing in expansion joints, small holes, slots, or depressions, and take suitable measures to prevent damage occurring to foundations and the like due to frost action in soil or backfill.

- .4 Application of de-icing salts on completed work is not permitted.

#### 3.8.9 Wet Curing

- .1 Following provisions apply to slabs in following locations:
  - .1 Parking Garage
- .2 Basic Curing Period: Protect concrete from premature drying and extremes of temperatures, and wet cure at minimum temperature of 10°C for three consecutive days. Wet curing shall commence immediately after placement and finishing of concrete.
- .3 Additional Curing for Durability: Immediately following the Basic Curing Period, continue to wet cure concrete (at minimum temperature of 10°C for an additional four consecutive days or until concrete reaches 70% of its 28-day compressive strength, whichever is greater.
- .4 Wet curing is to be achieved using one or more technique as outlined in CSA A23.1.
- .5 If absorptive mat or fabric material is used, it is imperative that it be kept continuously wet by means of sprinklers, soaker hoses, or another acceptable means.
- .6 Use of curing compounds will not be permitted in these areas.
- .7 When requested, submit detailed description of procedures that will be employed to wet cure.
- .8 As a minimum, procedures shall indicate:
  - .1 method for protecting concrete from evaporation of surface moisture from fresh concrete;
  - .2 type of curing material to be used;
  - .3 how surface will be kept moist and quality control requirements for keeping surface moist;
  - .4 time of initiation and duration of curing;
  - .5 provisions to address potential problems such as high winds and hot and cold weather; and
  - .6 limitations of access, if any, to surfaces being cured.
- .9 Submit 300 mm x 300 mm (12" x 12") sample of each type of material (absorptive mat, fabric, plastic film, waterproof paper etc.) that will be used to wet cure concrete.

### 3.9 **Slabs-on-Grade**

- 3.9.1 Do not place concrete slabs-on-grade until specified sub-floor material has been placed, inspected, and approved.
- 3.9.2 Do not place concrete on a frozen sub-grade, or on one that contains frozen materials.



- 3.9.3 Do not place concrete on sub-grade that has been frozen and thawed until sub-grade has been reviewed by geotechnical engineer and approved. If, in geotechnical engineer's opinion, bearing capacity of sub-grade has been compromised, remove affected materials and replace with compacted granular fill at no additional cost to Owner.
- 3.9.4 Upon approval of placement of sub-floor material and setting of reinforcement, place and consolidate concrete, and finish and cure as specified herein.
- 3.9.5 Where slab-on-grade is exposed to de-icing chemicals, provide approved sealant at joint between slab-on-grade and abutting surfaces.
- 3.9.6 Saw-cut slab-on-grade as shown with maximum length between saw-cuts of 4.5 m (15' 0"). Arrange panels as shown or to Consultant's approval.
- 3.9.7 Carry out cutting in accordance with recommendations contained in CSA A23.1, but in any event between 6 and 18 hours after placement of concrete.
- 3.9.8 After period of at least 28 days, fill saw-cuts with mortar containing cement, sand, and latex bonding agent. Ensure that joints to be filled are clean, dry, and free of foreign matter.
- 3.9.9 Mask edges of saw-cuts as required to prevent concrete floors from becoming stained.
- 3.9.10 Construction joints may be provided in slabs-on-grade so that pours on any one day may be kept to reasonable sizes. Locate construction joints to the Consultant's approval.

### **3.10 Toppings**

- 3.10.1 Conform to CSA A23.1 and requirements noted below unless noted otherwise in Contract Documents.
- 3.10.2 Set screeds and bulkheads rigidly and accurately to prevent displacement during concreting.
- 3.10.3 Special provisions for bonded and unbonded toppings:
  - .1 Maximum pour size for bonded and unbonded toppings is to be limited to 100 sq. m.
  - .2 Maintain one-to-one length-to-width aspect ratio for all pours, where extent and geometry of topping permits.
  - .3 Toppings are to be poured in a "checkerboard" pattern to minimize effects of shrinkage. Adjacent sections of topping shall be poured no sooner than three days after adjoining section was poured.
  - .4 Ensure temperature of base course is 10°C minimum prior to pouring toppings.
  - .5 Provide hot and cold weather protection for toppings in accordance with CSA A23.1.
  - .6 Placing and Finishing Toppings

- .1 Place and finish toppings in accordance with CSA A23.1.
- .7 Curing
  - .1 Continuously wet cure bonded toppings for minimum seven days.
- .8 Jointing
  - .1 Bonded toppings do not require special provisions with respect to jointing provided provisions noted above are adhered to.
  - .2 Location of joints in topping shall match those in base course.

#### 3.10.4 Unbonded (Loose Laid) Toppings

- .1 Unbonded or loose laid toppings are constructed by applying topping mixture over a bond breaker and hardened concrete base, to which no bonding agent has been applied. By definition, unbonded toppings are specifically designed to not bond to concrete base.
- .2 Base Course Finishing and Preparation
  - .1 Base courses that are to receive unbonded or loose laid toppings are to be finished smooth by means of a steel trowel.
- .3 Placing and Finishing Toppings
  - .1 Place toppings on bond breaker and finish toppings in accordance with CSA A23.1.
- .4 Curing
  - .1 Cure unbonded toppings in accordance with CSA A23.1.
- .5 Jointing
  - .1 Unbonded toppings are to be sawcut, per typical detail for slabs-on-grade, at maximum spacing of 3.0 m (10 ft.) in both directions, unless noted otherwise. For toppings that are to receive hard architectural floor finishes, jointing shall be laid out in accordance with Architect's requirements and is subject to final approval by Architect.

3.10.5 Repair cracks in concrete toppings. Extent of repair and method of crack repair must meet requirements of flooring installation contractor and Owner.

### 3.11 Making Good

3.11.1 Where directed by Consultant, rectify temporary openings left in concrete construction around pipes, ducts, and the like using mortar of same proportions as surrounding work. Reinforce mortar with welded wire fabric where openings exceed 75 mm (3"). Roughen existing surfaces to receive mortar or apply suitable bonding agent such that mortar will be securely bonded to existing concrete.

**3.12     Unshrinkable Fill**

- 3.12.1 Unshrinkable fill is intended for use locally in place of granular backfill below slabs-on-grade or within excavations where compaction of granular material is difficult to achieve. It is not intended for use below footings or around foundation walls, tunnels, laterally loaded caissons, etc., where vertical and/or lateral structural bearing capacities are required. Obtain written approval from Consultant prior to using unshrinkable fill.
- 3.12.2 Place unshrinkable fill material at a slump between 150 and 200 mm (6" and 8"). Material shall flow into excavation to fill the entire space. Take care so no air is entrapped beneath horizontal projections or in other locations within excavation.
- 3.12.3 Where bracing, shoring, and/or sheeting is used to support sides of excavation or to prevent movements that could damage other services or adjacent pavements, this support system shall be removed as backfilling proceeds.
- 3.12.4 If excavation is within travelled portion of roadway, cover it for at least 24 hours with steel plate of sufficient strength to support traffic during this period. Where road traffic is not to be accommodated, cover backfilled excavation with wooden planking or other protection for users of road allowance until unshrinkable fill will support weight of an adult person.

**3.13     Grouting Beneath Base Plates**

- 3.13.1 Grout beneath plates bearing on concrete with approved non-shrink flowable grout. Conform with manufacturer's directions for mixing and placing grout. Completely fill voids below plates. Fill voids left by shims after shims are removed.
- 3.13.2 During cold weather, preheat base plates and footings and maintain temperature at minimum 12°C for 6 days after grouting.

**3.14     Concrete Work at Existing Structure**

- 3.14.1 Before proceeding with work in or adjacent to existing structure, verify that conditions are as indicated on Drawings. If they are not, advise RJC of discrepancies and do not proceed until RJC has given instructions.
- 3.14.2 Prior to proceeding with the work, determine exact founding elevations of existing footings adjacent to new work. Report findings to RJC before proceeding further.
- 3.14.3 Install footings adjacent to existing footings in sequences indicated, and against undisturbed soil as shown, and so stability of existing footings and existing slabs-on-grade are maintained at all times. Temporarily support existing foundations as required.
- 3.14.4 Where openings are shown to be cut into existing structure, drill at corners and saw-cut remainder so saw-cuts do not extend into structure to be retained. Overcutting may require major structural strengthening.

**3.15 Patching**

- 3.15.1 Repair and patch honeycombing, exposed reinforcement, and other defects at own cost to satisfaction of Consultant using procedure preapproved by Consultant. Exposed patching must also be accepted by Consultant.
- 3.15.2 Immediately after removal of forms, remove bolts, ties, nails, or other metal not specifically required for construction purposes or cut back to a depth of 25 mm (1") from surface of concrete.

**3.16 Tolerances**

- 3.16.1 Tolerances shall conform to the Standard or requirements on structural or architectural Contract Documents, whichever are more rigorous.
- 3.16.2 Variations in building lines that result in extension of building over lot lines or restriction lines will not be permitted.
- 3.16.3 These tolerances are acceptable with regard to structural requirements. Interfacing tolerances may not be compatible with the above. Review and coordinate interfacing tolerances so various elements come together properly.

**3.17 Finishing - Floors**

- 3.17.1 Finishing shall conform to CSA A23.1 - Section 7.7 as minimum. Take care during finishing to maintain cambers specified on structural Drawings. See also architectural Drawings and Specifications for additional finish requirements.
- 3.17.2 Unless noted otherwise, floor finishes shall be Class A "Conventional slab on grade and elevated floors" with and overall F-number FF = 20 and FL=15.

**3.18 Finishes - Formed Surfaces**

- 3.18.1 All formed surfaces shall be treated in accordance with CSA A23.1, Section 7.10 as a minimum. See also architectural Drawings and Specifications for additional finish requirements.

**3.19 Openings Through Structural Work**

- 3.19.1 If, after any part of structural work has been completed additional openings are required to be made through structure, inform Consultant. No opening, including cored sleeves, shall be made through completed work without authorization in writing from Consultant.
- 3.19.2 Where location of openings is approved, locate reinforcement by scanning or other positive means as required by Consultant and adjust location of opening so no reinforcement is cut unless specifically approved otherwise in writing by Consultant.
- 3.19.3 In case of precast concrete slabs, holes shall be cut or drilled only by precast concrete fabricator.

**3.20     Rejection of Defective Work**

3.20.1 In event that concrete tests do not conform to requirements of this Specification, or when conditions are such to cause doubt about safety of structure, testing of structure will be undertaken at direction of Consultant. This may entail further concrete tests, coring, or load testing per the Standard, or any other test Consultant deems suitable. Such test shall be made at expense of Contractor and to satisfaction of Consultant.

3.20.2 Where, in opinion of Consultant, material or workmanship fails to meet requirements of Specification, such work may be rejected. Replace or repair rejected work to approval of Consultant and at no additional cost to Owner.

**End of Section**

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**1 . GENERAL**

**1.1 Intent**

1.1.1 Provide all articles, labour, materials, equipment, transportation, hoisting and incidentals noted, specified or required to complete the work of this Section.

**1.2 Work Included**

1.2.1 Finishing of exterior horizontal concrete surfaces.

**1.3 Related Sections**

1.3.1 Section 32 13 13 – Concrete Paving.

**1.4 References**

1.4.1 ASTM C309-06: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

1.4.2 CSA A23.1-04: Concrete Materials and Methods of Concrete Construction. CSA A23.2-04: Methods of Test and Standard Practices for Concrete.

1.4.3 CSA A23.2-04: Methods of Test and Standard Practices for Concrete.

**1.5 Quality Assurance**

1.5.1 Applicator: person or firm specializing in commercial concrete floor finishing, and with five years documented experience.

**1.6 Project Conditions**

1.6.1 Perform Work only when environmental conditions are as specified in Section 32 13 13 – Concrete Paving.

1.6.2 Ensure that adequate temporary heating is provided as required for cold weather work.

**2 . PRODUCTS**

**2.1 Materials**

2.1.1 Hardener: non-metallic type, Diamag 7 by Sika Canada Inc., Sealtight Type R-Premixed by W. R. Meadows, or Maximent by Degussa.

2.1.2 Water: as specified in Section 03 30 00.

2.1.3 Non Silca- White Lightning.

**3 . EXECUTION**

**3.1 Examination**

3.1.1 Verify existing conditions are ready to receive work.

- 3.1.2 Verify concrete does not contain admixtures which would be incompatible with floor hardener materials or other applied finishes.
- 3.1.3 Beginning of application implies acceptance of existing site conditions.

## 3.2 **Finishing**

### 3.2.1 Exterior finishes

- .1 Broom Finish:
  - .1 After float and or Trowel finishing, flat surfaces to be broom-finished shall be slightly roughed by light brooming with a stiff brush or broom to a uniform non-skid surface to the satisfaction of the Consultant. Textured Broom Finish, when indicated, will have a random swirl, stiff brush finish. Finished surfaces, unless otherwise indicated, shall be true in all planes within 8 mm in 3 m as determined by a 3 m straightedge placed anywhere in the concrete.
- .2 All sidewalks, plazas and patio flat surfaces are to be broom finished.
- .2 Trowel Finish:
  - .1 After float finishing, surfaces to be trowel-finished shall be power-trowelled and finally hand-trowelled once the surface has hardened sufficiently. Finished surfaces shall be true in all planes within 5 mm in 3 m as determined by a 3 m straightedge placed anywhere on the slab. The surface shall have a smooth, even, dense texture free from blemishes.
- .3 Sandblast Finish (applied to Smooth-Formed Concrete):
  - .1 Report to the Consultant, in writing, all defects of surfaces or work prepared by other trades and on unsatisfactory site conditions. Thoroughly examine all surfaces scheduled to be sandblasted to see that they are satisfactory and not liable to impair performance or appearance.
  - .2 Commencement of work shall imply total acceptance of surface and site conditions.
  - .3 Protect work of other trades from damage resulting from the work of this Section. Mask off edges at junction with other materials and with non-sandblasted concrete as required. Make good any resulting damage, to the satisfaction of the Consultant, at no additional cost to the Owner. All concrete surfaces where called for shall be sandblasted so that the resulting surfaces shall have a uniform appearance to match the sample area approved by the Consultant for the class of finish.
  - .4 Execute the work using the required gun technique, proceeding progressively over the entire area being finished to produce a uniform even texture throughout with the same degree of aggregate exposure as that of the approved sample area.
  - .5 Class of Aggregate Exposure shall be as follows:
    - .1 Class 1 (Brush): matrix removed - approx. 0.8 mm: a one-pass brush blast which will remove the cement matrix and expose the fine aggregate.

- .2 Class 2 (Light): matrix removed - approx. 1.6 mm: exposes additional fine aggregate and possibly the edges of some coarse aggregate.
- .3 Class 3 (Medium): matrix removed - approx. 6 mm: exposes the coarse aggregate around the edges.
- .4 Class 4 (Heavy): matrix removed - approx. 9.5 mm: exposes additional coarse aggregate; surface is rugged and uneven.
- .4 Promptly, as the work proceeds and upon completion, clean-up and remove rubbish and surplus material from the Place of the Work. Leave the work area broom clean at the end of each Working Day.

### **3.3 Curing**

- 3.3.1 Cure concrete to CSA A23.1/A23.2.
- 3.3.2 Curing of exposed surfaces shall commence as soon as the concrete has hardened sufficiently to prevent surface damage. Curing of concrete surfaces shall be achieved using one or more of the following methods:
  - .1 ponding or continuous sprinkling;
  - .2 absorptive mat or fabric kept continuously wet;
  - .3 4 mil thick polyethylene plastic film;
  - .4 other moisture-retaining methods as approved by the Consultant.
- 3.3.3 Basic Curing: moist cure concrete for a period of either three days at a minimum temperature of 10 degrees C or for the time necessary to attain 35% of the specified 28 day compressive strength of the concrete.
- 3.3.4 Cure air-entrained concrete an additional four consecutive days (for a total of seven days) at a minimum temperature of 10 degrees C or for the time necessary to attain 70% of the specified 28 day compressive strength of the concrete.
- 3.3.5 The basic curing time shall be extended on all structural concrete until the concrete has achieved sufficient strength for structural safety. (70% of the specified 28 day compressive strength of the concrete unless otherwise directed by the Consultant.)
- 3.3.6 When the air temperature is above 27 degrees C, perform curing to CSA A23.1.
- 3.3.7 During freezing weather, terminate water curing of concrete 12 hours before the end of the protection period.
- 3.3.8 Moisture cure fibre-reinforced slabs for a minimum of 7 days.

**END OF SECTION**



## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the concrete floor sealing work specified herein. This includes, but is not necessarily limited, to:
  - .1 General requirements for concrete floor sealing.
  - .2 Concrete sealers and other topical treatments for concrete.
  - .3 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only:
  - .1 Section 03 30 00 - Cast-in-place Concrete
  - .2 Section 03 35 00 – Concrete Finishing.
  - .3 Section 07 92 00 - Joint Sealants.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

### **1.4 Preinstallation Meetings**

- 1.4.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.
- 1.4.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.

- .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.
- .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.
- .3 Agenda:
  - .1 Review progress of related construction activities and preparations for particular activity under consideration.
  - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
- .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
- .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

#### **1.5 Administrative Requirements**

- 1.5.1 Coordination: Coordinate with concrete floor placement and concrete floor curing, and other work having a direct bearing on work of this section.
  - .1 Review Specification for work included under this Section and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials, materials to be used, installation of materials, sequence and quality control, Project staffing, restrictions on areas of placement and other matters affecting construction, to permit compliance with intent of this Section.

#### **1.6 Submittals**

- 1.6.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.6.2 Product Data: Submit product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for concrete floor sealing work specified in this Section.
- 1.6.3 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
  - .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.

- .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
- .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.6.4 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:
  - .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.
  - .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.6.5 Low-Emitting Materials: For applicable Products specified or used for activities of this Section (i.e., site-applied coatings, adhesives, and sealants), submit certifications from third-party organizations indicating compliance with VOC Emissions and VOC Content requirements specified in this Section.
- 1.6.6 Samples: Submit selection and verification samples for Products requiring colour, texture, or design selection. Submit manufacturer's list of finishes or colour swatches for Consultant's selection.
- 1.7 **Closeout Submittals**
  - 1.7.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.
  - 1.7.2 Operating and Maintenance Data: Submit care and maintenance instructions for concrete floor sealing to be included in building operation and maintenance manual.
  - 1.7.3 Warranty Documentation: Submit copy of extended warranties specified in this Section.
- 1.8 **Quality Assurance**
  - 1.8.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.
  - 1.8.2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.
  - 1.8.3 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and

secondary materials from sources recommended by manufacturers of primary materials.

1.8.4 Mock-Ups / First Installation Review: Construct mock-ups to verify selections made under submittals, demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

- .1 Location: In-situ (i.e. first installation), as directed on site by Consultant.
- .2 Purpose: To set benchmarks for installation and to judge subsequent work. Maintain Mock-ups during construction in undisturbed condition.
- .3 Provide mock-up area, approximately 10 sq. m (100 sq. ft.) under conditions similar to those which will exist during actual placing, with coatings applied.
- .4 Reviewed mock-ups: May become part of the completed work if undisturbed at the time of Substantial Performance of The work, provided they are undisturbed, and comply with requirements outlined in Contract Documents.

**1.9 Delivery, Storage And Handling**

- 1.9.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.
- 1.9.2 Deliver, store and handle concrete floor sealing materials in accordance with manufacturer's written instructions.
- 1.9.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.9.4 Replace defective or damaged materials with new.

**1.10 Site Conditions**

- 1.10.1 Ambient Conditions:
  - .1 Do not finish floors until interior heating system is operational or a minimum ambient temperature of 10 Deg C (50 Deg F) can be maintained.
  - .2 Ensure concrete substrate is within moisture limits prescribed by flooring manufacturer.
- 1.10.2 Ventilation: Sufficient to prevent injurious gases from temporary heat or other sources affecting concrete.

**1.11 Warranty**

- 1.11.1 Provide warranty covering the Work of this Section in accordance with Supplementary Condition SC49 / GC 12.3 WARRANTY.

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## **2 . PRODUCTS**

### **2.1 Manufacturers**

2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:

- .1 CPD Construction Products.
- .2 Euclid Chemical Canada Ltd.
- .3 Master® Builders Solutions
- .4 Sika Canada Inc.
- .5 W.R. Meadows Inc., Canada

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

### **2.2 Performance / Design Criteria**

2.2.1 Perform Work in accordance with CSA-A23.1/A23.2.

2.2.2 Coordinate with finish flooring Supplier and installer to ensure adequate slab flatness is provided for floor finish scheduled to be installed on slab.

2.2.3 Static Coefficient of Friction: Ensure floor surfaces are stable, firm and slip resistant after completing finishing procedures (where exposed). Provide Products with the following minimum values as determined by ASTM D2047 unless otherwise indicated on Drawings and Schedules:

- .1 Level Surfaces: Minimum 0.6.
- .2 Ramp Surfaces: Minimum 0.8.

2.2.4 Coordinate with finish flooring Supplier and installer to ensure adequate slab flatness is provided for floor finish scheduled to be installed on slab.

2.2.5 Ensure concrete is finished to achieve the following tolerances:

- .1 Under raised access flooring, for surfaces scheduled to have thick-set tile: F (F<sub>F</sub>) 20 and F (F<sub>L</sub>) 15.
- .2 Under Resilient Finishes, Epoxy Finish and Carpeted Areas: F (F<sub>F</sub>) 25 and F (F<sub>L</sub>) 20.
- .3 Under Thin-set flooring, and concrete surfaces exposed to view (sealed concrete): F (F<sub>F</sub>) 35 and F (F<sub>L</sub>) 25.
- .4 Polished concrete surfaces: F (F<sub>F</sub>) 45 and F (F<sub>L</sub>) 35.

2.2.6 VOC Content and Emissions:

- .1 VOC Emissions: For applicable items in this Section, comply with CDPH Standard Method v1.2–2017 (CA Spec 01350) and ensure products are certified per UL 2818, SCS Global Gold, or equivalent.

- .2 VOC Content Requirements: Wet-applied materials used in scope of this Section must conform to the following:
  - .1 Paints and Coatings: SCAQMD Rule 1113 or CARB SCM.
  - .2 Adhesives and Sealants: SCAQMD Rule 1168.
  - .3 Methylene chloride and perchloroethylene must not be intentionally added in paints, coatings, adhesives, or sealants.

## **2.3 Concrete Floor Hardeners**

- 2.3.1 Do not use floor hardeners with air-entrained concrete.
- 2.3.2 Non-Metallic Hardener: Factory pre-mixed dry shake/ dry powder abrasion resistant hardener.
  - .1 Emery Aggregate Hardeners
    - .1 MOH Hardness Scale: Minimum 8.
    - .2 Acceptable Products:
      - .1 "Surflex E" by Euclid Chemical Canada Ltd.
      - .2 "Emeri-Crete SH" by Sika Canada Inc.
      - .3 Approved equivalent.
    - .3 Use in following locations: Ambulance parking garage throughout.

## **2.4 Penetrating Concrete Floor Sealers And Densifiers**

- 2.4.1 Material Tag: This item is noted as "CS-1" on Drawings and Schedules.
- 2.4.2 Blend of silicate and siliconate polymers that penetrate concrete surfaces and chemically react to provide an increase in surface density, durability, and abrasion resistance.
  - .1 Acceptable Products:
    - .1 "Euco Diamond Hard" by Euclid Chemical,
    - .2 "Sikafloor 3S" by Sika Canada Inc.,
    - .3 "CPD Hard-Cure" by CPD Construction Products
    - .4 "Liqui Hard Ultra" by W.R. Meadows Inc., Canada
    - .5 MasterKure HD 200WB (formerly "Kure n Harden") by Master Builders Solutions Canada Inc. (Formerly BASF Canada Inc.)

## **2.5 Accessories**

- 2.5.1 Wet Cure Blanket: Clear polyethylene film to ASTM C171, minimum thickness 0.15 mm complying with maximum allowable moisture loss requirements of ASTM C156.

2.5.2 Concrete Slab Joint Filler: Two (2) component epoxy or polyurea, load-bearing, self-levelling concrete slab joint Filler, 100% solids compound, with a minimum Shore A Hardness of 80, colour to match slab colour

.1 Acceptable Products (Polyurea):

- .1 "Euco QWIKjoint UVR (Polyurea)" by Euclid Canada
- .2 "MasterSeal CR 100" by Master Builders Solutions Canada Inc. (Formerly BASF Canada Inc.)
- .3 Approved equivalent.

### **3 . EXECUTION**

#### **3.1 Examination**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.
- 3.1.2 Measure for floor flatness ( $F_F$ ) and floor levelness ( $F_L$ ) tolerances for floors to ASTM E1155/ASTM E1155M, within 48 hours after slab installation.
- 3.1.3 Correct the slab surface if the actual  $F$  ( $F_F$ ) or  $F$  ( $F_L$ ) number for the floor installation measures less than required.
- 3.1.4 Correct defects in the floor by grinding or removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

#### **3.2 Preparation Of Slabs**

- 3.2.1 After concrete has been placed, strike off concrete level and flush to screeds with true straight edge.
- 3.2.2 Immediately after striking off concrete, level and consolidate with wooden darby or bull float. Complete levelling and consolidation before free moisture (bleeding) rises to surfaces.
- 3.2.3 Wait until concrete stiffens sufficiently to sustain foot pressure with only about 6 mm (1/4") indentation.
- 3.2.4 Float concrete with hand float or with power float. If free bleeding water remains on surface at this time, remove it before floating.
- 3.2.5 For concrete exposed to view, rub exposed sharp edges of concrete with carborundum to produce 3 mm radiused edges unless otherwise indicated. Refer to Section 03 30 00 for additional requirements.

- 3.2.6 Use mechanical stripping to remove chlorinated rubber or existing surface coatings.
- 3.2.7 Use protective clothing, eye protection, respiratory equipment during stripping of chlorinated rubber or existing surface coatings.
- 3.2.8 Power screed interior exposed floor slabs with mechanical vibratory screeding equipment. Machine float and machine trowel floor surfaces to smooth, level and dense surfaces free from trowel marks, ridges and depressions, except where specified otherwise. Refer to Section 03 30 00 for additional requirements.
- 3.2.9 Power screed exterior frost slabs with mechanical vibratory screeding equipment. Float using magnesium floats and trowel to level and dense surfaces and finish to sidewalk "swirl" texture.
- 3.2.10 Use hand held vibrators and hand screed, float and trowel areas where power equipment is inaccessible, to same density and surface quality specified for floors finished with power operated equipment.

**3.3 Sawcutting And Filling Of Control Joints And Construction Joints**

- 3.3.1 Saw cut control joints (contraction joints) to CSA-A23.1/A23.2, 24 hours maximum after placing of concrete, and before concrete develops random contraction cracks. Do not postpone sawing operations beyond these time limitations.
- 3.3.2 Refer to Section 03 30 00 for joint requirements for structural work. For other requirements, provide control joints in unreinforced slabs, spaced at maximum 4.5 m on centre in square patterns.
  - .1 Construct control joints for a depth equal to no more than one-fourth of concrete thickness. Do not cut through reinforcement, heating systems and other embedded items.
  - .2 Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades, minimum 3 mm wide, ensuring cutting action will not tear, abrade, or otherwise damage surface.
  - .3 Continuously spray water on saw blade during sawing. Grind edges of sawcuts to eliminate burrs; do not grind to bevel or chamfer joint edges.
  - .4 After sawing and grinding, clean joints with jet of water and blow-out with compressed air. Immediately broom clean, residue caused by sawing operation as work progresses.
  - .5 When cleaned joints are dry and prior to traffic being allowed over area, install temporary filler using polyethylene rope in such joints to prevent contamination.
- 3.3.3 Install joint-filler strips at junctions with slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade



beams, and other locations, as indicated on Drawings and Schedules.

- .1 Do not fill isolation joints, construction joints and control joints sooner than 120 Days after concrete placement. Execute joint sealing during cool, dry ambient conditions when slab is in contracted state to minimize future joint separation at sealant filled joints.
  - .2 Ensure joints are clean and sound. Remove oil, dirt, debris, paint and other materials that may be a bond breaker. Remove temporary filler from sawcut joints. Clean joints and blow with compressed air.
- 3.3.4 Extend joint fillers full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated on Drawings and Schedules. Overfill joints during placement. Cut flush or grind flush with floor within 24.

### **3.4      Protection And Curing**

- 3.4.1 Protect concrete floor sealing from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades. Comply with CSA A23.1/A23.2 for cold-weather protection and hot-weather protection during curing.
- 3.4.2 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in writing by affected material's manufacturer. Do not use materials or process that can damage finishes, surfaces, or construction.
- 3.4.3 Promptly replace concrete floor sealing work damaged during construction that cannot be satisfactorily repaired.
- 3.4.4 Curing Methods: Cure formed and unformed concrete for at least seven days, or until minimum structural strength of concrete indicated in Section 03 30 00, and as required by CSA A23.1/CSA 23.2 (Table 2) for exposure class and floor finishes specified.

### **3.5      Floor Surface Treatment**

- 3.5.1 Apply dry shake hardener to manufacturer's written instructions on floor surfaces.
- 3.5.2 Apply sealer to manufacturer's written instructions on floor surfaces.
- 3.5.3 After floor treatment is dry, seal control joints and joints at junction with vertical surfaces with sealant.
- 3.5.4 Clean overspray. Clean sealant from adjacent surfaces.

### **3.6      Tolerances**

- 3.6.1 Slab flatness tolerances: in accordance with CSA A23.1 (Table 22) and scheduled floor covering manufacturer's recommendations.

**3.7 Repair/Restoration**

- 3.7.1 Remove and replace concrete that does not comply with requirements in this Section.
- 3.7.2 Protect finished installation in accordance with manufacturer's instructions.

**3.8 Field Quality Control**

- 3.8.1 Manufacturer Services:
- .1 Employ services of a trained concrete technician from staff of surface hardener manufacturer to give assistance to this Section in proper use of material during initial periods of installation.
- 3.8.2 Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Consultant at no cost to Owner.
- 3.8.3 Independent inspection and testing company may be appointed by Owner to carry out inspection and testing as directed by Consultant.
- 3.8.4 Remove defective materials and completed work which fail tests and replace as directed by Consultant.

**3.9 Floor Finishing Schedule**

<b><u>Scheduled Floor Finish</u></b>	<b><u>Concrete Finish Required</u></b>	<b><u>Hardener</u></b>	<b><u>Curing/Sealing Method*</u></b>
Carpet	Steel Trowel	None Required	Curing/sealing compound or Water or poly curing
Resilient Flooring	Steel trowel	None Required	Curing/sealing compound or Water or poly curing
Trowel Applied Composition Flooring (Epoxy, Urethane Acrylic, Neoprene, Polyester):	Steel trowel in accordance with CSA A23.1.	If recommended by composition flooring material manufacturer	Poly curing
Liquid Applied Rubber or Plastic Membrane (Mechanical Waterproofing):	Steel trowel in accordance with CSA A23.1	None required	Water or poly curing
Loading dock and other areas scheduled to receive shake hardened concrete finish	float finish followed by swirl steel trowel	non-metallic shake	Curing/sealing compound or Water or poly curing
Exposed concrete pedestrian ramps	one way broom finish for slip resistance	None Required	Curing/sealing compound or Water or poly curing
Thinset Ceramic and Quarry Tile, and Clay Tile	Steel trowel in accordance with CSA A23.1	None required	Water or poly curing
Ceramic and Quarry Tile, Clay Tile and Brick Tile over mortar bed	Steel trowel followed by blastrack in accordance with CSA A23.1	None required	Water or poly curing
Exposed Concrete	Steel trowel in accordance with CSA A23.1	Non-Metallic Hardener as required.	Curing/sealing compound

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<b><u>Scheduled Floor Finish</u></b>	<b><u>Concrete Finish Required</u></b>	<b><u>Hardener</u></b>	<b><u>Curing/Sealing Method*</u></b>
Interior Stairs and Ramps	Swirled	Non-Metallic Hardener as required.	Curing/sealing compound or Water or poly curing
Concrete to receive water repellent coating	fine textured float finish	None required	Curing/sealing compound or Water or poly curing

**END OF SECTION**

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Polished Concrete Finishing work specified herein. This includes, but is not necessarily limited, to:
- .1 Polished concrete finishing
  - .2 Auxiliary materials for a complete construction.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.
- .1 Refer to Section 03 30 00 and 03 35 10 for concrete requirements for polished concrete, including concrete materials, mixture design, placement procedures, initial finishing, and curing.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Definitions**

- 1.4.1 Design Reference Sample: Sample designated by Consultant in the Contract Documents that reflects acceptable surface quality and appearance of polished concrete.

### **1.5 Preinstallation Meetings**

- 1.5.1 Preinstallation Conference: Conduct conference at Project site.
- .1 Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with polished concrete to attend, including the following:
    - .1 Contractor's superintendent.

- .2 Independent testing agency responsible for concrete design mixtures.
- .3 Ready-mix concrete manufacturer.
- .4 Cast-in-place concrete subcontractor.
- .5 Polished concrete finishing Subcontractor.
- .2 Review cold- and hot-weather concreting procedures, curing procedures, construction joints, concrete repair procedures, concrete finishing, and protection of polished concrete.

**1.6 Action Submittals**

- 1.6.1 Product Data: Submit in accordance with Division 01 for the following:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for the Polished Concrete Finishing work and include product characteristics, performance criteria, physical size, finish and limitations.
- 1.6.2 Shop Drawings and Concrete Floor Polishing Schedule: Submit plan showing polished concrete surfaces and schedule of polishing operations for each area of polished concrete before start of polishing operations. Include locations of all joints, including construction joints, contraction joints (control joints) and scoring.
- 1.6.3 Samples: Submit in accordance with Division 01 for each type of product requiring colour selection.

**1.7 Informational Submittals**

- 1.7.1 Concrete Floor Protection Plan: Develop a concrete protection procedure which addresses the following procedures:
  - .1 Communication of protection plan to subcontractors and vendors.
  - .2 Procedures for cleaning up slab spills, including use of and availability of cleaning chemicals and absorptive materials at Site.

**1.8 Quality Assurance**

- 1.8.1 Installer Qualifications: A firm experienced in performing polished concrete finishing similar in material, design, and extent to that indicated for this Project with minimum five years experience, whose work has resulted in applications with a record of successful in-service performance, and that employs workers trained by manufacturer.
  - .1 Submit proof of current certification with manufacturer upon request.

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- 1.8.2 Field Sample Panels: After approval of verification sample and before casting concrete, produce field sample panels to demonstrate the approved range of selections made under Sample submittals. Produce a minimum of three sets of full-scale panels, approximately 1200 by 1200 mm minimum, to demonstrate the expected range of finish, colour, and appearance variations.
- .1 Locate panels as indicated or, if not indicated, as directed by Consultant.
  - .2 Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
  - .3 Demolish and remove field sample panels when directed.
- 1.8.3 Mock-ups: Before casting concrete, build mock-ups to verify selections made under Sample submittals and to demonstrate typical joints, surface finish, tolerances, and standard of workmanship. Build mock-ups to comply with the following requirements, using materials indicated for the completed Work:
- .1 Build mock-ups in the location and of the size indicated or, if not indicated, as directed by Consultant.
  - .2 Demonstrate curing, finishing, and protecting of polished concrete.
  - .3 Subject to compliance with requirements, reviewed mock-ups may become part of the completed Work if undisturbed at time of Substantial Performance of the Work.
- 1.8.4 Source Limitations for Polished Concrete Finishing Materials: Obtain concrete floor liquid treatment products of one manufacturer with resources to provide products of consistent quality in physical properties and resulting appearance.

**1.9 Delivery, Storage, And Handling**

- 1.9.1 Deliver and store products in manufacturer's unopened packaging with labels intact until ready for installation.
- 1.9.2 Store materials off the ground or on pallets, under cover and in a cool, dry location, out of direct sunlight, in accordance with manufacturer's recommendations.
- 1.9.3 Maintain copies of current safety data sheets of components on site. Provide personnel with appropriate safety data information and training as it relates to the specific chemical compounds to be utilized.
- 1.9.4 Close areas to traffic during floor application and after application for time period recommended in writing by manufacturer. Provide temporary protection as specified herein.

- 1.9.5 Protect completed slab to prevent damage by the other trades during floor completion for minimum period of 6 months.

**1.10 Project Conditions**

- 1.10.1 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- 1.10.2 Ensure that substrate materials are dry and free of contaminants. Do not commence with the application unless substrate conditions are suitable.
- 1.10.3 Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- .1 Hydraulic powered equipment must be diapered to avoid staining of the concrete.
  - .2 Ensure trades do not park vehicles on slab. If necessary, provide drop cloths under vehicles.
  - .3 Ensure no pipe cutting machine is used on floor slab.
  - .4 Do not place steel on interior slab to avoid rust staining.
  - .5 Ensure acids and acidic detergents do not encounter slab.
  - .6 Always protect slab.

**2 . PRODUCTS**

**2.1 Manufacturers**

- 2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.
- .1 Curecrete Distribution, Inc./Advanced Floor Products.
  - .2 CPD Construction Products
  - .3 Day1/Lythic
  - .4 Euclid Chemical Canada Ltd.
  - .5 Prosoco
  - .6 W.R. Meadows Inc., Canada
- 2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

**2.2 Design And Performance Requirements**

- 2.2.1 Perform Work in accordance with CSA-A23.1/A23.2 and ACI 310.1.
- 2.2.2 Concrete must finished to achieve the following tolerances: F (F<sub>F</sub>) 45 and F (F<sub>L</sub>) 35.

- 2.2.3 Slab surface must have a consistent look and exhibit a finish that has no evidence of streaking or burnish marks.
- 2.2.4 White residue or hazy appearance is not acceptable.
- 2.2.5 Aggregate Exposure: Concrete Polishing Council - Class A: "Cement Fines" finish (85 – 95 % Cement Fines; 5 – 15 % Fine Aggregate)
- 2.2.6 Polish Level: Concrete Polishing Council - Level 3: Polished.
- 2.2.7 Slip Resistance: finished installation must a minimum Dynamic Coefficient of Friction (DCOF) of 0.42 in accordance with ANSI A326.3 when tested using the BOT 3000 Digital Tribometer and with minimum 0.6 coefficient of friction in accordance with ASTM D2047.
- 2.2.8 Provide flooring products (sealers, densifiers, etc.) complying with CDPH Standard Method for VOC Emissions ( California Specification 01350) for indoor air quality requirements in accordance with UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or other third-party certification agency.

## **2.3 Polished Concrete Flooring System**

- 2.3.1 Material Tag: This item is noted as "POL" on Drawings and Schedules.
- 2.3.2 Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.
  - .1 Basis-of-Design:
    - .1 "Consolideck LS" by Prosoco Inc.
    - .2 "Retro-Plate 99" by Curecrete Distribution, Inc./Advanced Floor Products.
    - .3 "Euco Diamond Hard" by Euclid Chemical Canada Ltd.
    - .4 "Liqui-Hard® Concrete Densifier and Chemical Hardener" by W.R. Meadows of Canada
    - .5 "Cipadeck L" by CPD Construction Products
- 2.3.3 Film Forming Protective Treatments: General purpose film forming sealer to treat surfaces to increase resistance damage from water, staining, and abrasion and is suitable for natural polished concrete surfaces.
  - .1 Basis-of-Design (Medium Gloss):
    - .1 "Consolideck PolishGuard" by Prosoco Inc.
    - .2 "RetroGuard" by Curecrete Distribution, Inc./Advanced Floor Products.
    - .3 "Bellatrix" by W.R. Meadows of Canada



- .4 "UltraGuard" by Euclid Chemical Canada Ltd.
- .5 "Cipadeck Shield" by CPD Construction Products

**2.4 Polished Concrete Flooring with Epoxy Topcoat**

- 2.4.1 Material Tag: This item is noted as "EP-3" on Drawings and Schedules.
- 2.4.2 Epoxy Topcoat for Polished Concrete: 100% solids, 2-component epoxy topcoat with gloss finish.
  - .1 Performance Criteria:
    - .1 Tensile Strength: 20 MPa (2900 psi) (ASTM D638).
    - .2 Tensile Elongation: 10% at break (ASTM D638).
    - .3 Impact Resistance: Pass 160 in./lb. (ASTM D2794).
    - .4 Abrasion Resistance: 84 mg loss (ASTM D4060, Taber Abrasion, C-17 Wheel, 1000 cycles).
    - .5 Water Spotting Resistance: Excellent.
    - .6 Bacterial and Fungal Resistance: Does not support growth.
    - .7 Resistance to Battery Acid: Resistant if cleaned within 24 hours.
  - .2 Composition: Two-component, 100% solids epoxy coating.
    - .1 Mix Ratio: 2 parts A to 1 part B by volume.
    - .2 Viscosity (Mixed): 900 cps.
    - .3 Solids Content: 100%.
    - .4 Mixed Weight (Density): 1.2 kg/L (10 lb./US gal).
    - .5 Pot Life: 30 minutes at 23°C (74°F).
    - .6 Thin Film Set Time: 12-16 hours.
    - .7 Foot Traffic (Re-coat Time): 16 hours.
    - .8 Light Vehicular Traffic: 24 hours.
    - .9 Full Cure and Maximum Resistance: 7 days.
    - .10 Hardness (Shore D): 80 (ASTM D2240).
- 2.4.3 Primer: As recommend by manufacturer.
- 2.4.4 Non-Slip Aggregate: Provide properly graded, dry, contaminant-free grit for broadcast into topcoat as required for non-slip surfaces.
- 2.4.5 Basis-of-Design: "Zeradur 100" by Zeraus or approved equivalent.
- 2.4.6 Colour: refer to Finish Schedule on Drawings.

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**2.5     Auxiliary Materials**

- 2.5.1 Joint Sealants: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- 2.5.2 Water: Potable
- 2.5.3 Temporary Concrete Floor Protection: Provide at all locations upon completion of construction activities. Provide with required accessories for a complete installation.
  - .1 Roll Dimensions (W x L): 38 in x 100 ft (965 mm x 30.5 m). 317 sq ft (29.5 sq m).
  - .2 Acceptable Products: 'Ram Board Plus: Model # RB PLUS 38-100 Ram Board Plus' as manufactured by Ram Board.

**2.6     Equipment**

- 2.6.1 Auto Scrubber Machine: For cleaning operations.
- 2.6.2 Hand Grinder or stand-up edger for edge grinding/polishing.
- 2.6.3 Grinding/Polishing Equipment:
  - .1 Dry grinding/polishing machines complete with dust extraction system, including HEPA filtration vacuum.
- 2.6.4 Diamond Segments:
  - .1 Use heads from the same manufacturers throughout the entirety of the project.
- 2.6.5 Diamond Heads Types:
  - .1 Metal Diamonds: 80 or 150.
  - .2 Hybrid Style Diamonds: 50 or 100.
  - .3 Resin Bonded, Phenolic Diamonds: 100, 200, 400, 800, 1500, and 3000 (if necessary).
- 2.6.6 Burnishing Machine and Burnishing Pads: to produce specified results.
- 2.6.7 Burnishing Machine: High speed burnisher, generating pad speeds of 1,500 RPM or higher, as recommended by protective treatment manufacturer. Dust skirt must be installed at time of work.
- 2.6.8 Burnishing Pads: as recommended by protective treatment manufacturer.

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### **3 . EXECUTION**

#### **3.1 Examination**

- 3.1.1 Examine substrate, with installer present, for conditions affecting performance of finish. Correct conditions detrimental to timely and proper work. Do not proceed until unsatisfactory conditions are corrected.
- 3.1.2 Prior to application, verify that floor surfaces are free of construction laitance.
- 3.1.3 Commencement of Work implies acceptance of existing conditions.

#### **3.2 Preparation**

- 3.2.1 Remove remaining saw cut residue, form glue, texture overspray, paint drippings, and other built-up material on floor surface with non-powered, hand-held tools and mild cleaning chemicals that will not damage or mar concrete surface.
- 3.2.2 Repair, patch and fill cracks, voids, defects and damaged areas in surface as approved by Consultant. Allow repair materials to cure completely before application of product.
- 3.2.3 Power-sweep floor area with dust-free equipment.
- 3.2.4 Treat oil spots with oil emulsifier and oil absorbent materials to remove oils from below concrete surface. Scrub oil spot areas and remove liquids with vacuum.
- 3.2.5 Scrub floor with automatic scrubber capable of a minimum of 80 pounds head pressure.
- 3.2.6 Moisture Testing: Prior to commencement of polished concrete finishing, test floors to receive polished concrete finishing for moisture vapour emission.
  - .1 Perform tests so that each test area does not exceed 93 sq. m (1000 sq. ft.). Perform no fewer than three tests for the first 93 sq. m. (1000 sq. ft.) and an additional test for each additional 93 sq. m. (1000 sq. ft.). Ensure test areas are evenly spaced.
  - .2 Anhydrous Calcium Chloride Test: Conform ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapour emission rate of 2.25 kg of water/93 sq. m (5 lb of water/1000 sq. ft.) in 24 hours, unless otherwise recommended in writing by manufacturer.

#### **3.3 Polishing**

- 3.3.1 Perform polishing operations on concrete floor substrates which are at least 45 days old, unless specifically approved by manufacturer.

- 3.3.2 Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.
- .1 Machine grind floor surfaces to receive polished finishes level and smooth and to depth required to reveal aggregate to match approved mockup.
  - .2 Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
  - .3 Apply penetrating stain for polished concrete in polishing sequence and according to manufacturer's written instructions.
  - .4 Continue polishing with progressively finer-grit diamond polishing pads to gloss level, to match approved mockup.
  - .5 Control and dispose of waste products produced by grinding and polishing operations.
  - .6 Neutralize and clean polished floor surfaces.

**3.4 Epoxy Coating Application.**

- 3.4.1 Comply with manufacturer's instructions.
- 3.4.2 Mixing: Mix components in accordance with manufacturer's instruction.
- 3.4.3 Coating Application: Apply primer coat at 5 mils thickness or use coating product as self-priming coat. Allow primer to dry and firm up before applying the topcoat. Apply topcoat at 10-12 mils thickness with notched squeegee.
- 3.4.4 For non-slip surfaces, broadcast aggregate into wet topcoat and back-roll to encapsulate.
- 3.4.5 Curing: Allow the coating to cure for 16 hours before allowing foot traffic, 24 hours before light vehicular traffic, and 7 days before full service.
- 3.4.6 Keep water and detergent off floor until fully cured.

**3.5 Joint Filling**

- 3.5.1 Prepare, clean, and install joint filler according to manufacturer's written instructions.
- 3.5.2 Remove dirt, debris, saw cuttings, laitance, curing compounds, sealers and other foreign materials from joints. Leave contact faces of joints clean and dry.
- .1 Clean inner joint walls mechanically using dustless dry-cut saw, or similar tool, to the full depth of saw cuts and 2 inch minimum depth in construction joints so as to remove any form release agents, curing compounds, sealer residues, and other surface

contaminations that may interfere with bond of the specified joint filler material. Then clean dust and debris from mechanically prepared joints by vacuuming joint.

- 3.5.3 Install semirigid joint filler full depth in saw-cut joints and at least 50 mm (2 inches) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening. Concave joints are not acceptable.
- 3.5.4 Scoring: Score decorative jointing in concrete surfaces 1.6 mm (1/16 inch) deep with diamond blades to match pattern indicated. Rinse until water is clear.
  - .1 Joint Width: 10 mm (3/8 inch)

### **3.6 Repairs, Protection, And Cleaning**

- 3.6.1 Repair damaged finished surfaces of polished cast-in-place architectural concrete when approved by Consultant. Match repairs to colour, texture, and uniformity of surrounding surfaces and to repairs on approved mockups.
  - .1 Remove and replace polished cast-in-place architectural concrete that cannot be repaired to Consultant's approval.
  - .2 Ensure concrete scrubbing is performed with cleaners approved in writing by manufacturer.
- 3.6.2 Protect polished cast-in-place architectural concrete from staining, laitance, and contamination during remainder of construction period.
- 3.6.3 Protect surfaces of polished cast-in-place architectural concrete from contamination by oil, grease, hydraulic fluid, paint, adhesives, flux, and other contaminants.
  - .1 Diaper hydraulic powered equipment to avoid staining of concrete.
  - .2 Do not park vehicles on polished floor.
  - .3 Do not perform pipe cutting on polished floor.
  - .4 Do not store metals subject to oxidation on polished floor.
  - .5 Inform trades that concrete slab must be protected.
- 3.6.4 Covering: After completion of polishing, protect polished floors from subsequent construction activities with protective covering to permit hardener and densifier to activate.

END OF SECTION

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the architectural precast concrete work, including but not limited to:
  - .1 PCONC-1: Non-composite insulated concrete walls at building foundations (FW1) with connector and insulation system as specified; minimum 100 mm thick.
  - .2 PCONC-2: Non-insulated, monolithic architectural precast concrete cladding units: Unit composition: minimum 225 mm thick precast panels tied to cast-in-place concrete curb and structural steel structure (EW9).
- 1.2.2 Related Documents
  - .1 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.
- 1.3.2 Definitions:
  - .1 Design Reference Sample: Sample of approved architectural precast concrete colour, finish and texture, preapproved by Consultant.

### **1.4 Administrative Requirements**

- 1.4.1 Preinstallation Conference: Conduct conference at Project site to comply with requirements in 01 31 19 with the Contractor, applicable subcontractors, Product supplier and Consultant. As a minimum:
  - .1 Review methods and procedures related to installation, including manufacturer's written instructions;

- .2 Examine substrate conditions and all embedded plates and anchors for compliance with manufacturers installation requirements;
  - .3 Review temporary protection measures required during and after installation.
- 1.4.2 Sequencing: Supply loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

**1.5 Submittals**

- 1.5.1 Provide submittals in accordance with requirements of 01 33 00.
- 1.5.2 Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- 1.5.3 Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.
- 1.5.4 Shop Drawings: Detail fabrication and installation of architectural precast concrete units. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit. Indicate joints, reveals, and extent and location of each surface finish. Indicate details at building corners.
- .1 Shop drawings shall bear the seal and signature of a professional engineer licensed to design structures and registered in the Province of the Place of the Work.
  - .2 Indicate separate face and backup mixture locations and thicknesses.
  - .3 Indicate welded connections by standard symbols. Detail loose and cast-in hardware and connections.
  - .4 Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
  - .5 Indicate locations, extent, and treatment of dry joints if two-stage casting is proposed.
  - .6 Include plans and elevations showing unit location and sequence of erection for special conditions.
  - .7 Indicate location of each architectural precast concrete unit by same identification mark placed on panel.
  - .8 Indicate relationship of architectural precast concrete units to adjacent materials.
  - .9 Indicate locations and details of stone facings, anchors, and joint widths.

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- .10 Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.
  - .11 If requested, Provide comprehensive engineering analysis signed and sealed by the qualified professional engineer responsible for its preparation. Show governing panel types, connections, and types of reinforcement, including special reinforcement. Indicate location, type, magnitude, and direction of loads imposed on the building structural frame from architectural precast concrete.
- 1.5.5 Samples: Submit for each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of 3, illustrating full range of finish, colour, and texture variations expected; approximately 305 mm x 305 mm x 305 mm (12 by 12 by 2 inches).
- .1 When other faces of precast concrete unit are exposed, include Samples illustrating workmanship, colour, and texture of backup concrete as well as facing concrete.
  - .2 Connections and special prefabricated inserts may be required by the Consultant to be tested as part of the work of this Section. Provide complete design calculations, if requested.
  - .3 Submit 600 mm square panels for approval of each type, colour and finish of precast concrete. When the correct colour and finish has been achieved provide 2 additional matching samples for each type, colour and finish. The Consultant will retain one panel. Keep the second panel in the shop as a production guide and the third on the site of the Project.
  - .4 Work shall match the approved samples.
  - .5 The first unit produced of each unit type will be examined by the Consultant and if satisfactory will be approved. The quality of finish shall be equivalent to that of the corresponding Design Reference Sample panel representing the finish of the unit. If the quality of the precast concrete unit is not satisfactory to the Consultant, make the corrections necessary and produce a second unit for the Consultant's review. Set aside the accepted unit of each type and use as standard by which the remainder of the Work is judged. Remove rejected panels from the site.
- 1.5.6 Range Samples: After sample panel approval and before fabricating architectural precast concrete units, produce a minimum of 3 sets of samples, approximately 1.5 m<sup>2</sup> (16 sq. ft.) in area, representing anticipated range of each colour and texture on



Project's units. Following range sample, maintain one set of samples at Project site and remaining sample sets at manufacturer's plant as colour and texture approval reference.

- 1.5.7 Welding certificates: Submit certificates conforming to CSA W47 and CSA W49.
- 1.5.8 Material Certificates: Submit for the following items, signed by manufacturers:
  - .1 Cementitious materials.
  - .2 Reinforcing materials and prestressing tendons.
  - .3 Admixtures.
  - .4 Bearing pads.
  - .5 Structural-steel shapes and hollow structural sections.
- 1.5.9 Field quality-control test and special inspection reports: Submit after each visit by manufacturer's representative.

## **1.6 Quality Assurance**

- 1.6.1 Manufacturer/Supplier Qualifications: firm that assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer registered to practice in the Province of the Place of the Work.
  - .1 Companies with a proven record of satisfactory installation of projects similar in size and nature will be acceptable subject to the Consultant's approval.
  - .2 Use precast manufacturers who are certified under the Canadian Precast Prestressed Concrete Institute (CPCI) Certification Program.
  - .3 Use precast manufacturers who have experience in manufacturing precast architectural non-insulated panels specified for this Project for a minimum of five (5) years, and with a record of successful in service performance.
- 1.6.2 Installer Qualifications:
  - .1 Precast concrete work shall be performed by mechanics having a minimum of 5 years documented experience in the placing and finishing of precast concrete. Submit proof of experience to Consultant.
  - .2 Erect work using workmen skilled in this trade, set plumb, true and square, with joints parallel and uniform and align all horizontal joints with each other and all vertical joints with each other and in accordance with Drawings and reviewed shop drawings.

1.6.3 Mockups: After sample panel and range sample approval but before production of architectural precast concrete units, construct full-sized mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

- .1 Build mock-up of typical wall section, incorporating the precast architectural non-insulated panel, face finish, support framing and anchoring, substrate materials, and adjacent materials including flashing, doors, windows and trim.
- .2 Provide a minimum of one (1) full scale panel to demonstrate the expected range of finish, colour and texture.
- .3 Approved mockups may become part of the completed Work if undamaged at time of Substantial Performance of the Work, and will form the basis for acceptance for the remainder of the project.
- .4 Approval of mockups does not constitute approval of deviations from the Contract Documents unless such deviations are specifically approved by Consultant in writing.
- .5 Notify Consultant a minimum seven (7) days prior to mock-up construction.

## **1.7 Delivery, Storage, And Handling**

- 1.7.1 Deliver architectural precast concrete units in such quantities and at such times to limit unloading units temporarily on the ground.
- 1.7.2 Support units during shipment on nonstaining shock-absorbing material.
- 1.7.3 Store units with adequate dunnage and bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.
- 1.7.4 Place stored units so identification marks are clearly visible, and units can be inspected.
- 1.7.5 Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses which would cause cracking or damage.
- 1.7.6 Lift and support units only at designated points shown on Shop Drawings.

## **1.8 Site Conditions**

- 1.8.1 Prior to fabrication verify existing condition affecting the work and take field measurements necessary to ensure a perfect fit of all precast panels.

- 1.8.2 Prior to erection, examine areas which are to receive the work and report deficiencies and misalignments to the Contractor for correction.

**1.9 Warranty**

- 1.9.1 Warrant the work of this Section against defects in materials and workmanship for a period of 5 years including but not limited to spalling, cracking, splitting, deformation, loosening of exposed aggregates due to water freezing, improper materials, workmanship or arrangement.
- 1.9.2 Warrant work under this Section whether or not any portion has been assigned or subcontracted. In the case of work performed by Subcontractors and where warranties are specifically required, secure such additional written warranties and deliver to the Owner. Leave panels clean and free from all blemishes.

**2 . PRODUCTS**

**2.1 Manufacturers**

- 2.1.1 Manufacturers/Suppliers: Subject to compliance with requirements, provide products by one of the following:
- .1 Advanced Precast Inc; [www.advancedprecastinc.com](http://www.advancedprecastinc.com)
  - .2 Res Precast Inc., [www.resgroup.ca](http://www.resgroup.ca)
  - .3 Stubbe's Precast; [www.stubbes.org](http://www.stubbes.org)
  - .4 Tri Krete Precast; [www.tri-krete.com](http://www.tri-krete.com)
- 2.1.2 Basis-of-Design: This Specification is based on "mix 2-DD-W-SI-P-P-8 #1414" by Res Precast.
- 2.1.3 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

**2.2 Description**

- 2.2.1 Design and Performance Requirements:
- .1 Design precast architectural non-insulated panels, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
  - .2 Structural Performance: Provide architectural precast concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated.
    - .1 Design and fabricate panels, brackets and anchorage devices so that when installed they compensate for

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- dimensional differences in structure to which they are secured.
- .2 Compensate for structural deflection of L/360 due to live load and distortion of structure, under design criteria conditions, without imposing load on panel assembly.
  - .3 Sustain precast panel loads, and superimposed wind, snow and rain loads, and seismic loads, without exceeding deflection of L/360.
  - .4 Permit no water infiltration into the building under design loads.
- .3 Loads: As indicated on Drawings and Structural Documents.
- .4 Design framing system and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements.
- .1 Ensure anchors, lifting hooks, shear bars, fastening devices, spacers and other inserts or fittings, including devices required for support and attachment of *work* of this Section are recommended or designed by manufacturer for complete and rigid installation.
- .5 Seismic Performance: Provide products and systems specified in this Section to withstand the effects of earthquake motions in accordance with OBC 4.1.8.18 and CAN/CSA S832.
- .1 Professional engineer specified in Division 01 and referenced in this Section shall be responsible for designing systems and submitting signed and sealed analysis data and Shop Drawings illustrating seismic-resistant systems.
  - .2 Refer to Structural Drawings for seismic sensitivity values.
- .6 Thermal Movements: Provide for in-plane thermal movements resulting from annual ambient temperature changes of 49 deg C (120 deg F)
- .7 Thermal Design:
- .1 Design non-insulated wall panels using core which does not promote capillary action.
  - .2 Provide modified rain screen design based on two sealant beads and joints consisting of weather seal near exterior face and air/vapour barrier seal close to interior face of panel.

- .3 Design exterior weather barrier to shed majority of water from joint and interior air/vapour seal to demarcate line and Provide pressure equalization between interior and exterior of building skin. Provide vent and drain to outside air cavity between two joint sealants.

2.2.2 Design Standards: Comply with CSA-A23.3 and C.P.C.I. Metric Design Manual," applicable to types of architectural precast concrete units indicated.

2.2.3 Welding: Qualify procedures and personnel according to CSA W47 and CSA W59.

## **2.3 Fabricated Units**

2.3.1 Fabricate precast concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with CSA A23.4 product tolerances as well as position tolerances for cast-in items.

2.3.2 Panel faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp.

2.3.3 Finish: Match Consultant's design reference sample.

2.3.4 General Material Requirements: Generally provide concrete materials of identical performance as those specified in Section 03 30 00, Cast-in-Place Concrete except concrete shall have minimum compressive strength of 35 MPa at 28 days when tested in accordance with ASTM C39/C39M and maximum absorption of 6% when tested in accordance with CSA A23.1/A23.2. Precast concrete units shall contain entrained air controlled at 5% +/- 1%, when tested in accordance with ASTM C97 at time of batching. Stockpile sufficient quantity of materials to ensure uniformity of precast concrete work.

## **2.4 Materials**

2.4.1 Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide continuous and true precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.

2.4.2 Forms: Constructed of concrete, steel, fibreglass, reinforced plastic or plywood conforming to CSA-A23.1.

2.4.3 Form Liners: Units of face design, texture, arrangement, and configuration indicated.

- .1 Basis-of-Design: "1/21 B Malta" by Reckli

- .1 Maximum Depth : 100 mm thick with 50 x 50 mm vertically raked reveals.
- .2 Appearance: Mid-coarse chipped surface pattern.
- 2.4.4 Reinforcing Bars: CSA G30.18, Grade 400W, deformed.
- 2.4.5 Welded Wire Reinforcement: CSA-G30.18; size and gauge as indicated on reviewed Shop Drawings.
- 2.4.6 Prestressing Strand: uncoated, seven-wire, low-relaxation strand conforming to CSA A23.4.
- 2.4.7 Wythe Connectors: Low thermal conductivity types, manufactured to connect wythes of precast concrete panels and to carry stipulated loads.
- 2.4.8 Portland cement: Gray Portland Cement conforming to CAN/CSA-A3000 of one colour and from same mill.
- 2.4.9 Water: Potable and free from foreign materials in amounts harmful to concrete and embedded steel.
- 2.4.10 Silica Fume: ASTM C1240, amorphous silica.
- 2.4.11 Aggregates: CSA-A23.1/A23.2, ASTM C33, and ASTM C330.
  - .1 Face Mix Aggregates: Selected, hard, and durable; Provide aggregates for each type of exposed finish from a single source (pit or quarry).
- 2.4.12 Admixtures: in accordance with the manufacturer's directions. Do not use calcium chloride or admixtures containing calcium chloride.
  - .1 Fly Ash: Pozzolanic admixture meeting requirements of CSA A3001, Type recommended by panel manufacturer.
  - .2 Air entrainment admixture: in accordance with ASTM C260, refer to CSA A23.1, for location and exposure requirements.
  - .3 Water reducing admixtures in accordance with ASTM C494.
  - .4 Coloring Admixture: in accordance with ASTM C 979 and manufacturer's requirements.
- 2.4.13 Grout: sand-cement grout conforming to CSA-A23.1.
- 2.4.14 Bearing Pads: High density plastic or Neoprene, to ASTM D2240, smooth both sides.
- 2.4.15 Shims: Plastic or Steel.
- 2.4.16 Recessed Reglets: Stainless steel, shaped and flanged to remain in place once cast, foam plastic filled to eliminate wet concrete intrusion.

## **2.5 Support Devices**

- 2.5.1 Connecting and Supporting Devices:
  - .1 Stainless steel type 316 unless indicated otherwise.

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- .2 Hot dip galvanized plates, angles, items cast into concrete, items connected to steel framing members, and inserts: ASTM A123/A123M-09;
      - .3 Fasteners: ASTM A325.
    - 2.5.2 Miscellaneous Plates, Angles, Inserts: CAN/CSA-A23.1/A23.2.
    - 2.5.3 Protective Finish: Hot-dip galvanized to ASTM A123/A123M.
    - 2.5.4 Bolts, Nuts, and Washers: ASTM A307, or ASTM A325
    - 2.5.5 Prime Paint: CAN/CGSB-1.181, zinc rich paint.
  - 2.6 **Connector and Insulation system (Foundation Walls)**
    - 2.6.1 Connector Spacing: Manufacturer's standard spacing as determined by project requirements, but not more than 400 mm (16 in) on center in both directions.
    - 2.6.2 Fabrication: Pre-drilled insulation panels with precision-cut foam panels for openings and edge conditions.
    - 2.6.3 Insulation: Extruded polystyrene. Refer to Section 07 21 00.
      - .1 Insulation Thickness: As indicated on Drawings.
    - 2.6.4 Connectors: Manufacturer's standard connectors made from continuous glass fibers and vinyl ester polymer.
      - .1 Tensile Strength: Minimum 827 MPa (120,000 psi).
      - .2 Shear Strength: Minimum 4 kN (910 lbs) in double shear and 2 kN (450 lbs) in single shear.
    - 2.6.5 Concrete Wythe Thickness: As indicated on Drawings.
    - 2.6.6 Basis-of-Design: "Thermomass System NC" by Thermomass or approved equivalent.
  - 2.7 **Mixes**
    - 2.7.1 Proportion normal-weight concrete mixes to provide the following properties:
      - .1 Compressive Strength: Minimum 35 MPa at 28 days.
      - .2 Air Content: 5.5 to 7.5 percent for concrete exposed to freezing and thawing.
      - .3 Concrete Mixing: Comply with A23.4.
  - 2.8 **Fabrication**
    - 2.8.1 Fabricate architectural precast components to CSA-A23.4.
    - 2.8.2 Maintain plant records and quality control program during production of precast components. Make records available upon request.

- 2.8.3 Use rigid moulds, constructed to maintain precast components uniform in shape, size, and finish.
- 2.8.4 Utilize form liners in accordance with manufacturer's written instructions.
- 2.8.5 Maintain consistent quality during manufacture.
- 2.8.6 Fabricate connecting devices, plates, angles, items fit to steel framing members, inserts, bolts, and accessories. Fabricate to permit initial placement and final attachment.
- 2.8.7 Embed reinforcing steel, anchors, inserts plates, angles, and other cast-in items.
- 2.8.8 Design and locate hoisting devices so that they can be concealed when the structure is in service. These devices shall be treated so they will not corrode in service.
- 2.8.9 Cure components to develop concrete quality, and to minimize appearance blemishes such as non-uniformity, staining, or surface cracking. Cure according to CSA A23.4.
- 2.8.10 Minor patching in plant and field is acceptable, providing structural adequacy and appearance of components is not impaired.

## **2.9      Fabrication Tolerances**

- 2.9.1 Fabricate architectural precast concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with CSA A23.4 product tolerances as well as position tolerances for cast-in items.

## **2.10     Finishes**

- 2.10.1 Panel faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp. Finish exposed-face surfaces of architectural precast concrete units to match approved design reference sample and mockups and as follows:
  - .1 Design Reference Sample: Available at the offices of the Consultant. Allow for minimum of 2 colours for each precast panel type.
  - .2 For bidding purposes, base the design on the following:
    - .1 Mix Design: "2-DD-W-SI-P-P-8 #1414" by Resplast
  - .3 Minor modifications may be required to mix noted above to obtain final design acceptance based on design-reference sample and mock-up review. Submit range samples as noted herein.
- 2.10.2 Finish exposed top and bottom surfaces of architectural precast concrete units to match face-surface finish.



- 2.10.3 Finish exposed back surfaces of architectural precast concrete units by smooth, steel-trowel finish.
- 2.10.4 Finish unexposed surfaces of architectural precast concrete units by float finish.
- 2.10.5 Connecting Supporting Steel Devices: Hot dip galvanized unless indicated otherwise.

### **3 .     EXECUTION**

#### **3.1     Examination**

- 3.1.1 Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance.
- 3.1.2 Proceed with installation only after unsatisfactory conditions have been corrected. Manufacturer's Structural Engineer and General Contractor to sign off on building stability prior to precast erection.
- 3.1.3 Do not install precast concrete units until supporting cast-in-place building structural framing has attained minimum allowable design compressive strength or supporting steel or other structure is complete.

#### **3.2     Preparation**

- 3.2.1 Provide and install sufficient temporary bracing to brace precast components adequately, at all stages of construction, so that precast components will safely withstand loads to which they may be subjected. This temporary bracing shall remain in position until required connections have been completed. Any bracing required to the structural frame supporting the architectural precast concrete is to be provided by the General Contractor.

#### **3.3     Installation**

- 3.3.1 Erect precast work in accordance with CSA-A23.4.
- 3.3.2 Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.
- 3.3.3 Erect architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment as units are being permanently connected.

- 
- .1 Install temporary steel or plastic spacing shims or bearing pads as precast concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
  - .2 Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
  - .3 Remove projecting lifting devices and grout fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
  - .4 Unless otherwise indicated, maintain uniform joint widths of 19 mm (3/4 inch).
- 3.3.4 Connect architectural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.
- .1 Do not permit connections to disrupt continuity of roof flashing.
- 3.3.5 Welding: Comply with applicable CSA Standards for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
- .1 Protect architectural precast concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
  - .2 Welds not specified shall be continuous fillet welds, using no less than the minimum fillet as specified by AWS.
  - .3 Clean weld-affected metal surfaces with chipping hammer followed by brushing, and apply a minimum 0.1 mm (4.0-mil) thick coat of galvanized repair paint to galvanized surfaces according to ASTM A 780.
  - .4 Remove, reweld, or repair incomplete and defective welds.
- 3.3.6 At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
- .1 Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot. For friction connections, apply specified bolt torque and check 25 percent of bolts at random by calibrated torque wrench.
- 3.3.7 Grouting Connections: Grout connections where required or indicated. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces. Keep grouted joints damp for not less than 24 hours after initial set. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.

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**3.4     Erection Tolerances**

- 3.4.1 Erect architectural precast concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of CSA A23.4.

**3.5     Field Quality Control**

- 3.5.1 Special Inspections: Owner may engage a qualified special inspector to perform the following special inspections and prepare reports:
- .1 Erection of precast concrete members.
- 3.5.2 Field welds will be subject to visual inspections and nondestructive testing according to ASTM E 165 or ASTM E 709. High-strength bolted connections will be subject to inspections.
- 3.5.3 Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
- 3.5.4 Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

**3.6     Repairs**

- 3.6.1 Repair architectural precast concrete units if permitted by Consultant. The Consultant reserves the right to reject repaired units that do not comply with requirements.
- 3.6.2 Mix patching materials and repair units so cured patches blend with colour, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 6.1 m (20 feet).
- 3.6.3 Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780.
- 3.6.4 Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- 3.6.5 Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

**3.7     Cleaning**

- 3.7.1 Clean surfaces of precast concrete units exposed to view.
- 3.7.2 Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.

- 3.7.3 Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
- .1 Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fibre brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
  - .2 Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the hydraulic cement underlayment work specified herein. This includes, but is not necessarily limited, to:
  - .1 polymer-modified, self-leveling, hydraulic cement underlayment for application below interior floor coverings to achieve slab levelness and flatness requirements required for installation of flooring materials.
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

### **1.4 Measurement And Payment**

- 1.4.1 Provision for hydraulic cement underlayment specified on this Section is based on a fixed price for installation of specified product at thickness of 10 mm (3/8 inch). Such cost must be included in Contract Price.

### **1.5 Preinstallation Meetings**

- 1.5.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.

- 1.5.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
- .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.
  - .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.
  - .3 Agenda:
    - .1 Review progress of related construction activities and preparations for particular activity under consideration.
    - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
    - .3 Review of substrate types, compatibility, substrate moisture testing, substrate texture, concrete surface profile (CSP), surface porosity, and flatness as well as environmental requirements for installation of hydraulic cement underlayment.
    - .4 Review of minimum and maximum thickness of hydraulic cement underlayment that can be installed, noting that unacceptable substrate levels must be corrected.
    - .5 Review of flooring finishes that must be applied subsequently and installation requirements of such floor finishes.
  - .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
  - .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

## **1.6 Submittals**

- 1.6.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.6.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for hydraulic cement underlayment work specified in this Section.
- 1.6.3 Qualification Data: Provide written documentation from manufacturer confirming that installer meets qualifications as specified and is eligible for manufacturer's warranty.

- 1.6.4 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
- .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
  - .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
  - .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.6.5 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:
- .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.
  - .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.6.6 Low-Emitting Materials: For applicable Products specified or used for activities of this Section (i.e., site-applied coatings, adhesives, and sealants), submit certifications from third-party organizations indicating compliance with following:
- .1 VOC Emissions: California Department of Public Health (CDPH) Standard Method v1.2–2017, using applicable exposure scenario.
  - .2 VOC Content: SCAQMD Rule 1113 (for paints and coatings) and SCAQMD Rule 1168 (for adhesives and sealants).

**1.7 Closeout Submittals**

- 1.7.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.
- 1.7.2 Operating and Maintenance Data: Submit care and maintenance instructions for hydraulic cement underlayment to be included in building operation and maintenance manual.
- 1.7.3 Warranty Documentation: Submit copy of extended warranties specified in this Section.

**1.8 Quality Assurance**

- 1.8.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.

- 1.8.2 Installer Qualifications: Engage an entity with sufficient experience in installing work similar in material, design, and extent to that shown in Contract Documents, and whose work has resulted in construction with a track record of successful in-service performance.
- 1.8.3 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.

**1.9 Delivery, Storage And Handling**

- 1.9.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.
- 1.9.2 Deliver, store and handle hydraulic cement underlayment materials in accordance with manufacturer's written instructions.
- 1.9.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.9.4 Store products in a dry area with temperature maintained between 10° and 29°C (50° and 85°F) and protect from direct sunlight.
- 1.9.5 Store materials in off-ground, in clean, dry, well-ventilated area.
- 1.9.6 Replace defective or damaged materials with new.

**1.10 Field Conditions**

- 1.10.1 Place hydraulic cement underlayments only when ambient temperature and temperature of substrates are between 10 and 29 deg C (50 and 85 deg F). These temperatures must also be maintained during and for 48 hours after the installation of products included in this Section.
- 1.10.2 Do not install material below 10°C (50°F) surface and air temperatures. Maintain such temperatures during installation and for at least 48 hours after installation of products specified in this section.
- 1.10.3 Do not apply if rain is expected within 6 to 8 hours or if freezing temperatures are expected within 24 hours of application. Such conditions may influence aesthetic and functional properties of cementitious materials.
- 1.10.4 Expedite installation on warm substrates and adhere to manufacturer's guidelines for installation in warm weather.

**1.11 Warranty**

- 1.11.1 Extended warranty: Submit for Owner's review and acceptance, manufacturer's extended warranty in which manufacturer commits to repair or replace components of hydraulic cement underlayment



that fail within specified warranty period. Manufacturer's extended warranty is in addition to, and does not supersede, any other rights that Owner may have under Contract Documents.

- .1 Warranty Period: Not less than 5 years from date of Substantial Performance of The work.

## **2 . PRODUCTS**

### **2.1 Manufacturers**

2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:

- .1 ARDEX Engineered Cements; [www.ardexamericas.com](http://www.ardexamericas.com)
- .2 CPD Construction Products; [www.cpd.ca](http://www.cpd.ca)
- .3 Laticrete; [www.laticrete.com](http://www.laticrete.com)
- .4 MAPEI Corporation; [www.mapei.com](http://www.mapei.com)
- .5 Maxxon; [www.maxxon.ca](http://www.maxxon.ca).

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

### **2.2 Performance / Design Criteria**

2.2.1 Hydraulic cement underlayments specified in this Section must comply with ASTM C1708.

### **2.3 Hydraulic Cement Underlayment**

2.3.1 Polymer-modified, self-leveling, hydraulic cement product that can be applied in minimum uniform thickness of 6 mm (1/4 inch) and that can be feathered at edges to match adjacent floor elevations.

- .1 Primary Binder: Product must use ASTM C150/C150M or CSA A3000, portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C219. Gypsum-based products are not acceptable.
- .2 Compressive Strength: Not less than 27.6 MPa (4000 psi) at 28 days when tested according to ASTM C109/C109M.
- .3 Underlayment Additive: resilient-emulsion product from underlayment manufacturer, designed for use with underlayment on specified substrate and conditions.
- .4 Basis-of-Design Products: "V1200" by Ardex Engineered Cements.
  - .1 Acceptable Equivalents:
    - .1 "Level-Right FS 10" by Maxxon Canada
    - .2 "MAPEI Novaplan 2" by Mapei Corporation

- .3 "Topcrete SL" by CPD Construction Products
- .5 Aggregate: Well-graded, washed gravel, 3 to 9.5 mm (1/8 to 3/8 inch); or coarse sand as recommended by underlayment manufacturer.
- .6 Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.

## **2.4 Auxiliary Materials**

- 2.4.1 Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.
- 2.4.2 Patching Compound: formulated from a blend of Portland cement and other hydraulic cement
  - .1 Acceptable Products:
    - .1 "Plani/Patch" by Mapei Inc.
    - .2 "Feather Finish" Ardex Engineered Cements.
    - .3 Approved equivalent.
- 2.4.3 Screed mortars: concentrate of additives mixed with sand and gravel, to form fast setting, high strength cement screed in preparation of thick fast-setting screeds or leveling coats, mortar beds, and slopes.
  - .1 Acceptable Products:
    - .1 "Topcem Premix with Planigrout AC," Accelerated Cure thick bed Screed and additive by Mapei Inc.
    - .2 "ARDEX AM100" by Ardex Engineered Cements
    - .3 Approved equivalent.
- 2.4.4 Water: Potable and at a temperature of not more than 21 deg C (70 deg F).
- 2.4.5 Semi-Rigid Joint Sealant for moving joints: As recommended by manufacturer. Provide
- 2.4.6 Joint Filler for Saw Cuts, Control Joints and Dormant Cracks: As recommended by manufacturer.

## **3 . EXECUTION**

### **3.1 Examination**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.

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**3.2      Preparation**

- 3.2.1 Moisture testing: Test substrates in accordance with ASTM F2170. Rectify moisture-related issues or other conditions that might affect performance of underlayment or final floor covering. Do not proceed with installation until moisture-related issues and other deleterious conditions have been resolved.
- 3.2.2 General: Prepare and clean substrate according to manufacturer's written instructions.
- .1 Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
- .2 Fill substrate voids to prevent underlayment from leaking.
- 3.2.3 Mechanically abrade surfaces to remove laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants in accordance with manufacturer's written instructions and to avoid underlayment bond impairment.
- 3.2.4 Adhesive Residues:
- .1 Prior to installation over adhesive residues on concrete, test adhesive for water-solubility.
- .2 Mechanically remove water-soluble adhesives to expose clean concrete.
- .3 Prepare non-water-soluble adhesives to a thin, firmly-bonded residue using the wet scraping technique, as recommended by Resilient Floor Covering Institute ([www.rfci.com](http://www.rfci.com)).
- .4 Ensure residue after scraping appears only as a transparent stain on concrete.
- 3.2.5 Metal Substrates: Mechanically remove, according to manufacturer's written instructions, rust, foreign matter, and other contaminants that might impair underlayment bond. Apply corrosion-resistant coating compatible with underlayment if recommended in writing by underlayment manufacturer.
- 3.2.6 Nonporous Substrates: For ceramic tile, quarry tile, and terrazzo substrates, remove waxes, sealants, and other contaminants that might impair underlayment bond, and prepare surfaces according to manufacturer's written instructions.
- 3.2.7 Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions

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**3.3     Application**

- 3.3.1 Mix and apply underlayment components according to manufacturer's written instructions.
  - .1 Close areas to traffic during underlayment application and for time period after application recommended in writing by manufacturer.
  - .2 Coordinate application of components to provide optimum adhesion to substrate and between coats.
  - .3 At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.
- 3.3.2 Priming: Prime substrates in accordance with manufacturer's instructions for various substrate types; ensure proper application and drying times.
- 3.3.3 Apply underlayment to produce uniform, level surface.
  - .1 Mixing: Mix components in accordance with manufacturer's instructions. Respect proper water-to-product ratio and use appropriate mixing techniques.
  - .2 Apply a final layer without aggregate to product surface.
  - .3 Feather edges to match adjacent floor elevations.
- 3.3.4 Cure underlayment according to manufacturer's written instructions. Prevent contamination during application and curing processes.
- 3.3.5 Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.
- 3.3.6 Remove and replace underlayment areas that show a lack of bond with substrate, including areas that emit a "hollow" sound when tapped

**3.4     Protection**

- 3.4.1 Protect hydraulic cement underlayment from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades.
- 3.4.2 Prior to finish flooring installation, protect underlayment surface from abuse by other trades using plywood, Masonite or other protection course acceptable to underlayment manufacturer.
- 3.4.3 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in writing by affected material's manufacturer. Do not use materials or process that can damage finishes, surfaces, or construction.
- 3.4.4 Promptly replace hydraulic cement underlayment work damaged during construction that cannot be satisfactorily repaired.

**Regional Municipality  
of Peel  
Procurement Division**

**Document 2024-346P  
CONSTRUCTION OF THE  
DOCKSTEADER PRPS  
REPORTING STATION**

**Division 03  
03 54 16  
Hydraulic Cement  
Underlayment**

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**END OF SECTION**

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the masonry mortar and grout work specified herein. This includes, but is not necessarily limited, to:
  - .1 Pre-packaged dry combined materials
  - .2 Mixing procedures
  - .3 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

### **1.4 Submittals**

- 1.4.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.4.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for masonry mortar and grout work specified in this Section.
- 1.4.3 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs

conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:

- .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
  - .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
  - .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.4.4 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:
- .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.
  - .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.4.5 Samples: Submit selection and verification samples for Products requiring color, texture, or design selection. Provide manufacturer's list of finishes or color swatches for Consultant's review.
- .1 Submit two 300 mm (12 inch) size samples of coloured mortar.
- 1.4.6 Test Reports: submit certified test reports including sand gradation tests in accordance with CAN/CSA-A179 showing compliance with specified performance characteristics and physical properties.

## **1.5 Closeout Submittals**

- 1.5.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.
- 1.5.2 Operating and Maintenance Data: Submit care and maintenance instructions for masonry mortar and grout to be included in building operation and maintenance manual.

## **1.6 Quality Assurance**

- 1.6.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.
- 1.6.2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.
- 1.6.3 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and

secondary materials from sources recommended by manufacturers of primary materials.

1.6.4 Mock-Ups / First Installation Review: Construct mock-ups to verify selections made under submittals, demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

- .1 Location: In-situ (i.e. first installation), as directed on site by Consultant.
- .2 Sealant Joint: Include sealant-filled joint at least 400 mm (16 inches) in each mock-up.
- .3 Additional Components: Provide wall structural supports, sheathing, air barriers, vapor retarder membranes, flashing, cavity drainage materials, and weep holes.
- .4 Purpose: To set benchmarks for installation and to judge subsequent work. Maintain Mock-ups during construction in undisturbed condition.
- .5 Reviewed mock-ups: may become part of the completed work if undisturbed at the time of Substantial Performance of The work, provided they are undisturbed, and comply with requirements outlined in Contract Documents.

**1.7 Delivery, Storage And Handling**

- 1.7.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.
- 1.7.2 Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

**1.8 Site Conditions**

- 1.8.1 Ambient Conditions: maintain materials and surrounding air temperature to the most stringent requirements of manufacturer's recommendations, and CAN/CSA A371.

**2 . PRODUCTS**

**2.1 Manufacturers**

- 2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:
  - .1 King Packaged Materials (a Sika Company)
  - .2 Maxi-Mix
  - .3 Quikcrete



.4 Spec Mix

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

## **2.2 Performance / Design Criteria**

2.2.1 Use only pre-blended, prepackaged dry combined materials (mortar and grout) mixed under controlled factory conditions or in site silo. Ingredients batching limitations to be within 1% accuracy. Hand mixing of bags and sand is not permitted.

2.2.2 Water Repellent Admixture: Provide water-repellent admixture to all exterior masonry units and mortar to yield resistance to water penetration in accordance with ASTM E514 (Class E water permeance)

## **2.3 Materials**

2.3.1 Portland Cement: CAN/CSA-A3001, Type GU - General use hydraulic cement (Type 10), unless indicated otherwise.

.1 Colour: Provide natural colour or white cement as required to produce mortar colour indicated on Drawings and Schedules. At architectural concrete masonry units, provide white colour cement.

## **2.4 Mortar**

2.4.1 Pre-Packaged Dry Combined Materials: CAN/CSA-A179, factory-packaged blend of dry cementitious materials, lime and dry sand, proportioned and blended at a manufacturing plant, and requiring only the addition of water, and mixing at construction site; with Types as follows (based on Property Specifications):

.1 Mortar for exterior masonry above grade:

.1 Load Bearing: Type S (Portland Cement/Lime).

.2 Non-Load Bearing: Type N (Portland Cement/Lime).

.2 Parapet walls: Type S (Portland Cement/Lime).

.3 Mortar for interior masonry:

.1 Load Bearing: Type S (Portland Cement/Lime).

.2 Non-Load Bearing: Type N (Portland Cement/Lime).

.4 Mortar for foundation walls, manholes, sewers, pavements, walks, patios and other exterior masonry at or below grade: type M or Type S.

2.4.2 Aggregate: CAN/CSA-A179

2.4.3 Water: clean and potable.

2.4.4 Hydrated Lime: to ASTM C207, Type S.

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## **2.5     Auxiliary Materials**

### **2.5.1   Mortar Pigments: to ASTM C979.**

- .1   Composition: Utilize natural and synthetic iron oxides and chromium oxides, designed specifically for incorporation into mortar mixes. Employ only those pigments with a proven track record of satisfactory performance in masonry mortar.
- .2   Admixture Limit: Incorporate colouring admixture, ensuring it does not exceed 10% of the cement content by weight.
- .3   Masonry Cement Option: Alternatively, use integrally coloured masonry cement to achieve desired coloured mortar; match approved sample.
- .4   Admixtures: Ensure approvals for admixtures before application. Adhere strictly to recommendations provided by manufacturer.
- .5   Approved Manufacturers:
  - .1   BayFerrox
  - .2   Interstar Pigment, Admixture and Fibers
  - .3   Solomon Pigments
  - .4   Venator Pigments (formerly known as Rockwood Pigments)

### **2.5.2   Water-Repellent Admixture:   Low VOC, water-repellent mortar admixture intended for use with masonry units containing integral water repellent by same manufacturer.**

- .1   Acceptable Products:
  - .1   “RainBloc for Mortar” by ACM Chemistries
  - .2   “Rheopel Mortar Admixture” by Master Builders Solutions Canada Inc. (Formerly BASF Canada Inc.)
  - .3   “Dry-Block Mortar Admixture” by GCP Applied Technologies
  - .4   Approved equivalent.

## **2.6     Mortar Mixing**

- 2.6.1   Materials: Use only pre-packaged, dry combined materials that are pre-blended and pre-coloured, fabricated under stringent factory conditions or from on-site silo.
- 2.6.2   Mixing Procedure: Combine mortar ingredients as prescribed by CAN/CSA-A179 and in accordance with manufacturer’s instructions. Only prepare quantities that meet immediate needs.
- 2.6.3   Colour and Additives: Add mortar colour and additional admixtures in strict accordance with manufacturer's instructions; ensure consistent mix and colouration.

- 2.6.4 Equipment: Employ continuous silo mixer or a batch-type mixer, to CAN/CSA-A179.
- 2.6.5 Restricted Materials: inclusion of calcium chloride or any chloride-based admixtures is strictly prohibited.
- 2.6.6 Usage Window: Use mixed mortar within 2-hour time frame post-mixing. Mortar remaining unused after this period must be discarded.
- 2.6.7 Personnel: Contractor is obligated to designate a single individual responsible for mortar mixing for entire project. If there is change in designated personnel, mortar mixing operations must halt. Mixing can only resume once new individual receives adequate training and mortar mix undergoes testing.

**2.7     Grout Mixing**

- 2.7.1 Materials: Use only pre-packaged, pre-mixed, pre-bagged dry combined grout materials. Ensure materials are explicitly fabricated for indicated applications, and are either produced under strict factory conditions or sourced from on-site silo.
- 2.7.2 Compliance: to CSA A23.1/A23.2 and CAN/CSA-A179.

**3 .     EXECUTION**

**3.1     Examination**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.

**3.2     Preparation**

- 3.2.1 Plug clean-out holes with masonry units. Brace masonry for wet grout pressure.

**3.3     Mortar And Grout Work**

- 3.3.1 Do masonry mortar and grout work in accordance with CSA A371 and CAN/CSA-A179 except where specified otherwise.
- 3.3.2 Mix mortar and grout in accordance with manufacturer's instructions.
- 3.3.3 Clean mixing boards and mechanical mixing machine between batches.
- 3.3.4 Ensure mortar compressive strength is weaker than units it is binding.

- 3.3.5 Keep cavities clean of mortar droppings and other materials during construction.
- 3.3.6 Remove excess mortar from grout spaces.
- 3.3.7 Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
- 3.3.8 Work grout into masonry cores and cavities to eliminate voids.
- 3.3.9 Comply with requirements in CAN/CSA-A371 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
  - .1 Limit height of vertical grout pours to not more than 1.5m (60 inches).
  - .2 Do not install grout in lifts greater than 400 mm (16 inches), without consolidating grout by rodding.
  - .3 Do not displace reinforcement while placing grout.

#### **3.4     Tooling**

- 3.4.1 Provide joints in masonry, firmly pointed, compacted and tooled.
- 3.4.2 Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated on Drawings and Schedules.
- 3.4.3 Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated on Drawings and Schedules.
- 3.4.4 For parged masonry, provide raked joints, minimum 13 mm (1/2 inch) unless otherwise indicated on Drawings and Schedules.

#### **3.5     Cleaning**

- 3.5.1 Leave Work area clean at end of each day.
- 3.5.2 Remove droppings and splashings using clean sponge and water.
- 3.5.3 Clean masonry with low pressure clean water and soft natural bristle brush.
- 3.5.4 Upon completion remove surplus materials, rubbish, tools and equipment.

#### **3.6     Third-Party Inspection And Testing**

- 3.6.1 Owner reserves right to execute following procedure during underlayment application:
  - .1 Testing Engagement: Owner may engage a competent inspection and testing agency to evaluate underlayment material during application.
  - .2 Cost of testing: by Owner or via Cash Allowance.

- .3 Testing Method: to ASTM C780
- .4 Test results: to be relayed to Owner and Contractor for necessary actions.
- .5 Non-compliance Action: If materials fail to meet specified requirements, cost for retesting to be at Contractor's expense. Replace, at no extra cost to Owner, Products shown to not be in compliance with requirements of Contract Documents.

**3.7 Protection**

- 3.7.1 Protect masonry mortar and grout from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades.
- 3.7.2 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in writing by affected material's manufacturer. Do not use materials or process that can damage finishes, surfaces, or construction.
- 3.7.3 Promptly replace masonry mortar and grout work damaged during construction that cannot be satisfactorily repaired.
- 3.7.4 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each work day. Anchor securely in position.

**END OF SECTION**

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the masonry anchorage and reinforcing work specified herein. This includes, but is not necessarily limited, to:
  - .1 Masonry ties,
  - .2 Joint reinforcement,
  - .3 Masonry anchors,
  - .4 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

### **1.4 Definitions**

- 1.4.1 The following definitions as indicated in CSA A370 apply to this Section:
  - .1 Masonry Ties: masonry connectors used to interconnect the wythes of a masonry wall; or attach masonry veneer to its structural backing;
  - .2 Masonry Anchors: masonry connectors used to connect masonry walls to intersecting walls or to other structural

members, attach stone to its structural backing, or interconnect stone;

- .3 Masonry Fasteners: masonry connectors used to secure masonry ties and anchors to structural elements;
- .4 Repair Connectors: repair connectors used to restore or improve masonry construction.

## **1.5 Preinstallation Meetings**

- 1.5.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.
- 1.5.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
  - .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.
  - .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72-hour notice required.
  - .3 Agenda:
    - .1 Review progress of related construction activities and preparations for particular activity under consideration.
    - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
  - .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
  - .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

## **1.6 Submittals**

- 1.6.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.6.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for masonry anchorage and reinforcing work specified in this Section.
- 1.6.3 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:
  - .1 Indicate on Shop Drawings, bar bending details, lists, reinforcement quantities, sizes, spacings, reinforcement

locations, and mechanical splices, with identifying code marks to permit correct placement.

- .2 Indicate sizes, spacings and locations of chairs, spacers and hangers.
- .3 Prepare reinforcement drawings in accordance with Reinforcing Steel Manual of Standard Practice - by Reinforcing Steel Institute of Canada. ANSI/ACI 315 and ACI 315R.

1.6.4 Delegated Design Submittals:

- .1 Engineering design completion of masonry anchorage and reinforcing work is delegated to Contractor based on structural design criteria indicated in Contract Documents.
- .2 Submit Shop Drawings for work of this Section that bear the stamp of a Professional Engineer registered in Province of Ontario.
- .3 Submit copy of structural calculations upon request by Consultant.

1.6.5 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:

- .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
- .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
- .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.

1.6.6 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:

- .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.
- .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.

**1.7 Closeout Submittals**

1.7.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.

1.7.2 Operating and Maintenance Data: Submit care and maintenance instructions for masonry anchorage and reinforcing to be included in building operation and maintenance manual.



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**1.8     Quality Assurance**

- 1.8.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.
- 1.8.2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.
- 1.8.3 Professional Engineer's Qualifications: Employ Professional Engineer licensed to practice in Province of Ontario who carries professional liability insurance as noted in the Owner's supplementary conditions and has at least five years' experience providing engineering services of similar kind, scope, and complexity.
  - .1 Professional Engineer's Responsibility:
    - .1 production and review of Shop Drawings,
    - .2 design and certification of masonry anchorage and reinforcing, including attachments for building construction, in accordance with applicable codes and regulations,
    - .3 stamping and signing of each Shop Drawing and associated calculations
- 1.8.4 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.
- 1.8.5 Mock-Ups / First Installation Review: Construct mock-ups to verify selections made under submittals, demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - .1 Location: In-situ (i.e. first installation), as directed on site by Consultant.
  - .2 Sealant Joint: Include sealant-filled joint at least 400 mm (16 inches) in each mock-up.
  - .3 Additional Components: Provide wall structural supports, sheathing, air barriers, vapor retarder membranes, flashing, cavity drainage materials, and weep holes.
  - .4 Purpose: To set benchmarks for installation and to judge subsequent work. Maintain Mock-ups during construction in undisturbed condition.
  - .5 Reviewed mock-ups: may become part of the completed work if undisturbed at the time of Substantial Performance of The

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work, provided they are undisturbed, and comply with requirements outlined in Contract Documents.

**1.9 Delivery, Storage And Handling**

- 1.9.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.
- 1.9.2 Deliver, store and handle masonry anchorage and reinforcing materials in accordance with manufacturer's written instructions.

**1.10 Site Conditions**

- 1.10.1 Make site measurements necessary for proper fit of members.

**2 . PRODUCTS**

**2.1 Manufacturers**

- 2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:
  - .1 Blok Lok; a Hohmann & Barnard company.
  - .2 Fero Corporation.
  - .3 Heckmann Building Products Inc.;
- 2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

**2.2 Performance / Design Criteria**

- 2.2.1 Design masonry anchorage and reinforcing as per CSA A370, Ontario Building Code, and CSA S304 with these stipulations:
  - .1 Size units to suit wall assembly thickness, factoring in sheathing, air barrier, vapour retarder membranes, and insulation, as applicable.
  - .2 Mechanical free play: Ensure single and multi-component ties have maximum free play of 1.2 mm (0.05 inches) in configuration or adjustment position, inclusive of play between tie components and structural backing.
  - .3 Displacement: Limit single and multi-component ties to maximum displacement of 2.0 mm (0.08 inches) under load of 0.45 kN (100 lbs.).
  - .4 Positive restraint: Equip adjustable ties with features that prevent disengagement in all adjustment positions.
  - .5 Corrosion and material compatibility: Use Type 304 stainless steel for anchoring, reinforcing materials, and accessories in exterior areas and high-moisture interior areas (relative

humidity above 75%, e.g., pools, showers). Use mill galvanized in interior areas.

- .6 Expansion joints: Ensure expansion joints accommodate wall system movement and interaction with building structure due to structural shifts, preventing damage, joint racking, seal breakage, or water ingress.
- .7 Seismic Performance: Provide products and systems specified in this Section to withstand the effects of earthquake motions in accordance with OBC 4.1.8.18 and CAN/CSA S832.
  - .1 Professional engineer specified in Division 01 and referenced in this Section shall be responsible for designing systems and submitting signed and sealed analysis data and Shop Drawings illustrating seismic-resistant systems.
  - .2 Refer to Structural Drawings for seismic sensitivity values.

## **2.3     Joint Reinforcement**

- 2.3.1 Conform to CAN/CSA A370 and to suit application.
- 2.3.2 Interior dry locations: Mill galvanized, cold drawn steel wire.
- 2.3.3 Interior high-moisture locations; Steel wire, hot dip galvanized: to ASTM A 641, Class 3 after fabrication.
- 2.3.4 Exterior locations: Stainless steel conforming to ASTM A 580, Type 304.
- 2.3.5 Provide ladder type reinforcement unless indicated otherwise. Where vertical reinforcement is not required in masonry walls, truss types are permitted.
- 2.3.6 Provide shop fabricated corners, intersections and curved configuration where required.
- 2.3.7 Single Wythe Joint Reinforcement:
  - .1 "220 Ladder Mesh" or "230 Ladder Tri-Mesh" or "240 Ladder-Twin-Mesh" or "250 Ladder Box-Mesh" by Hohmann & Barnard Inc.
  - .2 "BL-10, BL-11 or BL-12" ladder reinforcement by Blok-Lok Limited
  - .3 Approved equivalent.
- 2.3.8 Multiple Wythe Joint Reinforcement:
  - .1 "270 Ladder Eye-Wire" or "280 Dub'l Loop-Lok™" or "Tie-HVR-295V Anchor System - Ladder Type" by Hohmann & Barnard Inc.
  - .2 "BL-40 Adjustable Ladder Reinforcement" or "BL-42 Adjustable Ladder Reinforcement" by Blok-Lok Limited

.3 Approved equivalent.

**2.4 Masonry Anchors**

2.4.1 Conform to CAN/CSA A370 and to suit application.

**2.5 Fabrication**

2.5.1 Fabricate reinforcing in accordance with CSA-A23.1/A23.2 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.

2.5.2 Fabricate connectors in accordance with CSA A370.

2.5.3 Obtain Consultant's confirmation for locations of reinforcement splices other than shown on reviewed Shop drawings.

2.5.4 Upon confirmation of Consultant, weld reinforcement in accordance with CSA W186.

2.5.5 Ship reinforcement and connectors, clearly identified in accordance with drawings.

**3 . EXECUTION**

**3.1 Examination**

3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.

**3.2 Installation**

3.2.1 Installation, generally: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.

3.2.2 Provide masonry connectors and reinforcement in accordance with CSA-A370, CSA-A371, CSA-A23.1/A23.2, and CSA-S304.1, unless indicated otherwise.

3.2.3 Prior to placing concrete, mortar, obtain Consultant confirmation of placement of reinforcement and connectors.

3.2.4 Install additional reinforcement to masonry as indicated.

**3.3 Bonding And Tying**

3.3.1 Bond walls of two or more wythes using metal connectors in accordance with CSA S304.1, CSA-A371, and as indicated.

- 3.3.2 Tie masonry veneer to backing in accordance with Ontario Building Code, CSA-S304.1, CSA-A371, and as indicated.

**3.4 Reinforced Lintels And Bond Beams**

- 3.4.1 Reinforce masonry lintels and bond beams as indicated.
- 3.4.2 Place and grout reinforcement in accordance with CSA-S304.1, CSA-A371 and CSA-A179.
- 3.4.3 Support and position reinforcing bars in accordance with CAN/CSA A371.

**3.5 Grouting**

- 3.5.1 Grout masonry in accordance with CSA-S304.1, CSA-A371 and CSA-A179, and as indicated.
- 3.5.2 Refer to Section 04 05 13 for additional requirements.

**3.6 Anchors**

- 3.6.1 Install metal anchors as indicated.

**3.7 Lateral Support And Anchorage**

- 3.7.1 Install lateral support and anchorage in accordance with CSA-S304.1 and as indicated.

**3.8 Movement Joints**

- 3.8.1 Ensure reinforcement is not continuous across movement joints unless otherwise indicated.

**3.9 Field Bending**

- 3.9.1 Do not field bend reinforcement and connectors except where indicated or authorized by Owner's Representative.
- 3.9.2 When field bending is authorized, bend without heat, applying a slow and steady pressure.
- 3.9.3 Replace bars and connectors which develop cracks or splits.

**3.10 Field Touch-Up**

- 3.10.1 Touch up damaged and cut ends of epoxy coated or galvanized reinforcement steel and connectors with compatible finish to provide continuous coating.

**3.11 Cleaning And Waste Management**

- 3.11.1 Cleaning and Waste Management, generally: in accordance with Section 01 74 00, Cleaning and Waste Management.

- 3.11.2 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
- 3.11.3 Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**END OF SECTION**

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the concrete unit masonry work specified herein. This includes, but is not necessarily limited, to:
  - .1 Concrete masonry units.
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

### **1.4 Preinstallation Meetings**

- 1.4.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.
- 1.4.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
  - .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.
  - .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.

- .3 Agenda:
  - .1 Review progress of related construction activities and preparations for particular activity under consideration.
  - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
- .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
- .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

## **1.5 Submittals**

- 1.5.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.5.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for concrete unit masonry work specified in this Section.
- 1.5.3 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:
  - .1 Include plans, elevations, sections and details as applicable.
  - .2 Indicate field-measured dimensions on Shop Drawings.
  - .3 Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
- 1.5.4 Delegated Design Submittals:
  - .1 Engineering design completion of load-bearing and reinforced concrete unit masonry work is delegated to Contractor based on structural design criteria indicated in Contract Documents.
  - .2 Submit Shop Drawings for work of this Section that bear the stamp of a Professional Engineer registered in Province of Ontario.
  - .3 Submit copy of structural calculations upon request by Consultant.
- 1.5.5 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
  - .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.



- .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
- .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.5.6 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:
  - .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.
  - .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.

**1.6 Closeout Submittals**

- 1.6.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.
- 1.6.2 Operating and Maintenance Data: Submit care and maintenance instructions for concrete unit masonry to be included in building operation and maintenance manual.
- 1.6.3 Warranty Documentation: Submit copy of extended warranties specified in this Section.

**1.7 Quality Assurance**

- 1.7.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.
- 1.7.2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.
- 1.7.3 Professional Engineer's Qualifications: Employ Professional Engineer licensed to practice in Province of Ontario who carries professional liability insurance as noted in the Owner's supplementary conditions and has at least five years' experience providing engineering services of similar kind, scope, and complexity.
  - .1 Professional Engineer's Responsibility:
    - .1 production and review of Shop Drawings,
    - .2 design and certification of concrete unit masonry, including attachments for building construction, in accordance with applicable codes and regulations,

- .3 stamping and signing of each Shop Drawing and associated calculations

1.7.4 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.

1.7.5 Mock-Ups / First Installation Review: Construct mock-ups to verify selections made under submittals, demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

- .1 Location: In-situ (i.e. first installation), as directed on site by Consultant.

- .2 Purpose: To set benchmarks for installation and to judge subsequent work. Maintain Mock-ups during construction in undisturbed condition.

- .3 Reviewed mock-ups: May become part of the completed work if undisturbed at the time of Substantial Performance of The work, provided they are undisturbed, and comply with requirements outlined in Contract Documents.

## **1.8 Delivery, Storage And Handling**

1.8.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.

1.8.2 Deliver, store and handle concrete unit masonry materials in accordance with manufacturer's written instructions and CSA A370.

1.8.3 Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

## **1.9 Field Conditions**

1.9.1 Field Measurements: Verify actual dimensions of construction contiguous with concrete unit masonry by field measurements before fabrication.

1.9.2 Ambient Conditions: maintain materials and surrounding air temperature to the most stringent requirements of manufacturer's recommendations, and CAN/CSA A371.

## **1.10 Warranty**

1.10.1 Provide warranty covering the Work of this Section in accordance with Supplementary Condition SC49 / GC 12.3 WARRANTY.

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## **2 .     PRODUCTS**

### **2.1     Manufacturers**

2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:

- .1 Basalite Concrete Products;
- .2 Brampton Brick Limited;
- .3 Day & Campbell Limited.
- .4 Permacon;
- .5 Richvale York Block Inc.
- .6 Thames Valley Brick.

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

### **2.2     Performance / Design Criteria**

2.2.1 Masonry Standards: Comply with Canadian Masonry Contractors Association (CMCA) Masonry Practices Manual, CSA-S304.1, and CSA-A371.

2.2.2 Professional Engineer's Design and Certification: to design and certify load-bearing masonry units, masonry lintels, supports, and attachment to building structures in accordance with CSA S304.1.

2.2.3 Defective Units: While standards specified in this Section may permit a percentage of units with defects (e.g., chips, cracks) exceeding standard limits, do not incorporate units with defects if exposed in final Work.

2.2.4 Fire-Resistance: Use units that meet fire-resistance ratings indicated on Drawings and Schedules based on equivalent masonry thickness calculations, testing to CAN/ULC S101, or other methods approved by authorities having jurisdiction.

- .1 Classification: Same as classifications specified in this Section, except with modifications based on aggregate in units and equivalent unit thickness. For fire ratings equal to, or greater than 3 hours, use CAN/ULC-S101 certified units.

### **2.3     Concrete Masonry Units**

2.3.1 Concrete Block Masonry Units (CMU): Metric modular units to CSA A165 Series (CSA A165.1).

- .1 Classification: Provide normal weight units conforming to the following requirements unless otherwise indicated.
  - .1 Hollow Units: Type H/15/A/O (typical assemblies, < 75% of the gross cross-sectional area)

- .2 Semi-Solid Units: Type SS/15/A/O (sound-rated and fire-resistance rated assemblies,  $\geq 75\%$  but  $< 100\%$  of the gross cross-sectional area)
- .2 Provide H/15/C/O lightweight units where required for fire-rating requirements or at suspended slabs.
  - .1 Hollow Units: Type H/15/A/O (typical assemblies,  $< 75\%$  of the gross cross-sectional area)
  - .2 Semi-Solid Units: Type SS/15/A/O (sound-rated and fire-resistance rated assemblies,  $\geq 75\%$  but  $< 100\%$  of the gross cross-sectional area)
- .3 Provide “moisture-controlled” units (Moisture Content Facet: Type “M”) where masonry will be exposed to moisture or changes in humidity.
- .4 Dimensions: As noted on Drawings.
- .5 Special shapes: provide bull-nosed units for exposed corners. Provide purpose-made shapes for lintels, beams and bond beams. Provide additional special shapes as indicated or required.

## **2.4 Mortar And Grout Materials**

- 2.4.1 Conform to requirements of Section 04 05 13.

## **2.5 Reinforcement**

- 2.5.1 Conform to requirements of Section 04 05 19 - Masonry Anchorage and Reinforcing
- 2.5.2 Provide wire reinforcement to CSA A371 with corrosion protection to CSA S304, CSA G30.3-M and CSA A370.
- 2.5.3 Provide masonry reinforcements as required to improve performance of masonry walls and control shrinkage cracking. Fabricate reinforcing in accordance with CSA-A23.1/A23.2 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
  - .1 Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 400 mm (16 inches) o.c.
  - .2 Provide in lengths of not less than 3 m (10 feet) , with prefabricated corner and tee units.

## **2.6 Auxiliary Materials**

- 2.6.1 Integral Water Repellent: Provide integral water repellent for all units unless indicated otherwise. Provide polymeric, integral water-repellent admixture, that does not reduce bond strength.
  - .1 Minimum performance: no visible water or leaks on back test specimen per ASTM E 514

.2 Acceptable Products:

- .1 "RainBloc" by ACM Chemistries, Inc.
- .2 "Rheopel Plus" by Master Builders Solutions Canada Inc.
- .3 "Dry-Block" by GCP Applied Technologies Inc.

2.6.2 Compressible Filler urethane filler to ASTM D1056, Grade 2A1, with minimum 35 percent compressibility.

2.6.3 Preformed Control-Joint Gaskets: SBS compound, to ASTM D 2000, Designation M2AA-805 designed to fit standard sash block and maintain lateral stability in masonry wall.

2.6.4 Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

2.6.5 Lateral Support Anchors: 12 ga thick metal plate, designed for block width and for optimal lateral shear resistance at top of masonry wall. Material to allow for slab vertical deflection above without transferring compressive loads to wall below.

- .1 Basis-of-Design: "BL-LSA Series" by Blok Lok or approved equivalent.

**2.7 Mortar And Grout Mixes**

2.7.1 Conform to requirements of Section 04 05 13.

**2.8 Tolerances**

2.8.1 Tolerances for standard concrete unit masonry tolerances in accordance with CAN/CSA-A165.1, supplemented as follows:

- .1 Maximum variation between units within specific job lot not to exceed 2 mm.
- .2 No parallel edge length, width or height dimension for individual unit to differ by more than 2 mm.
- .3 Out of square tolerance not to exceed 2 mm.

2.8.2 Tolerances for architectural concrete masonry units in accordance with CAN/CSA-A165.1, supplemented as follows:

- .1 Maximum variation in length or height between units within specific job lot for specified dimension not to exceed 2 mm.
- .2 No parallel edge length, width or height dimension for individual unit to differ by more than 2 mm.
- .3 Out of square tolerance not to exceed 2 mm.
- .4 Maximum variation in width between units within specific job lot for specified dimension not to exceed 2 mm.

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### **3 .     EXECUTION**

#### **3.1     Examination**

- 3.1.1   Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.
- 3.1.2   Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

#### **3.2     Installation**

- 3.2.1   Installation, generally: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.
- 3.2.2   Conform to requirements of CSA A371.
- 3.2.3   Build chases and recesses to accommodate items specified in this and other Sections.
- 3.2.4   Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- 3.2.5   Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- 3.2.6   Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- 3.2.7   Build around frames previously set and braced. Fill behind hollow frames within masonry walls with mortar or grout and embed anchors.
- 3.2.8   Fit masonry closely against electrical and plumbing outlets so collars, plates and covers overlap and conceal cuts.
- 3.2.9   Hollow Units: spread mortar setting bed from outside edge of face shells. Gauge amount of mortar on top and end of unit to create full joints, equivalent to shell thickness. Avoid excess mortar.

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- 3.2.10 Solid Units: apply mortar over entire vertical and horizontal surfaces. Avoid bridging of airspace between brick veneer and backup wall with mortar.
  - 3.2.11 Ensure compacted head joints. Use full or face-shell joint as indicated.
  - 3.2.12 Tamp units firmly into place.
  - 3.2.13 Do not adjust masonry units after mortar has set. Where resetting of masonry is required, remove, clean and reset units in new mortar.
  - 3.2.14 Unless indicated otherwise, tool joints as follows:
    - .1 Exterior: concave.
    - .2 Interior exposed: raked or concave as determined by Consultant during Shop Drawing review.
    - .3 Interior concealed: flush.
  - 3.2.15 After mortar has achieved initial set up, tool joints.
  - 3.2.16 Do not interrupt bond below or above openings.
  - 3.2.17 Bond Pattern for Exposed Masonry:
    - .1 Concrete block units:
      - .1 Bond: stack bond unless noted otherwise.
      - .2 Coursing height: 200 mm for one block and one joint.
    - .2 Do not use units with less than nominal 100-mm (4-inch) horizontal face dimensions at corners or jambs.
  - 3.2.18 Special Shapes:
    - .1 Install special units to form corners, returns, offsets, reveals and indents without cut ends being exposed and without losing bond or module.
    - .2 Install reinforced concrete block lintels over openings in masonry where steel or reinforced concrete lintels are not indicated.
    - .3 End bearing: not less than 200 mm, and as indicated on drawings.
  - 3.2.19 Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar before laying fresh masonry.
  - 3.2.20 Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
  - 3.2.21 Fill space between steel frames and masonry solidly with mortar unless otherwise indicated on Drawings and Schedules.

- 3.2.22 Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- 3.2.23 Fill cores in hollow CMUs with grout 600 mm (24 inches) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated on Drawings and Schedules.
- 3.2.24 Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated on Drawings and Schedules.
  - .1 Install compressible filler in joint between top of partition and underside of structure above.
  - .2 Fasten partition top anchors to structure above and build into top of partition. Space anchors in accordance with requirements of CSA S304.1 and CSA A370.
  - .3 At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 07 84 10.

### **3.3 Control Joints And Movement Joints**

- 3.3.1 Install continuous movement joint fillers in movement joints at locations indicated on reviewed Shop Drawings, and generally as follows:
  - .1 Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
  - .2 Conform to requirements of NCMA TEK 10-2C
  - .3 Locations: Generally, Provide control joints at following locations:
    - .1 at column grid locations,
    - .2 at changes in wall height,
    - .3 at changes in wall thickness, such as at pipe and duct chases and pilasters,
    - .4 at (above) movement joints in foundations and floors,
    - .5 at (above and below) movement joints in roofs and floors that bear on a wall,
    - .6 near one or both sides of door and window openings unless other crack control measures are used, such as joint reinforcement or bond beams, and
    - .7 adjacent to corners of walls or intersections within a distance equal to half the control joint spacing
  - .4 Spacing: Ensure distance between joints does not exceed length to height ratio of 1.5:1 or 7.6 m (25 ft), whichever is less.



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**3.4     Reinforcement**

3.4.1    Install reinforcing in accordance with Section 04 05 19.

**3.5     Connectors**

3.5.1    Install connectors in accordance with Section 04 05 19.

**3.6     Mortar Placement**

3.6.1    Place mortar in accordance with Section 04 05 13.

**3.7     Grout Placement**

3.7.1    Place grout in accordance with Section 04 05 19.

**3.8     Lintels**

3.8.1    Provide concrete or masonry lintels where shown and where openings of more than 300 mm (12 inches) for brick-size units and 600 mm (24 inches) for block-size units are shown without structural steel or other supporting lintels.

3.8.2    Provide minimum bearing of 200 mm (8 inches) at each jamb unless otherwise indicated on Drawings and Schedules.

**3.9     Parging**

3.9.1    Parge exterior faces of below-grade masonry walls, where indicated on Drawings and Schedules, in 2 uniform coats to a total thickness of 19 mm (3/4 inch). Dampen wall before applying first coat and scarify first coat to ensure full bond to subsequent coat.

3.9.2    Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 3 mm per 300 mm (1/8 inch per foot). Form a wash at top of parging and a cove at bottom.

3.9.3    Damp-cure parging for at least 24 hours and protect parging until cured.

**3.10    Repairing, Pointing, And Cleaning**

3.10.1    Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

3.10.2    Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated on Drawings and Schedules.

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**3.11 Cleaning And Waste Management**

- 3.11.1 Cleaning and Waste Management, generally: in accordance with Section 01 74 00, Cleaning and Waste Management.
- 3.11.2 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
- .1 In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- .1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block. Clean wall surface with suitable brush or burlap.
- .2 Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
- .1 Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
- .2 Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Consultant's approval of sample cleaning before proceeding with cleaning of masonry.
- .3 Protect adjacent nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
- .4 Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
- .5 Clean concrete masonry by cleaning method indicated on Drawings and Schedules in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
- 3.11.3 Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.
- 3.11.4 Salvageable Materials: Unless otherwise indicated on Drawings and Schedules, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

**END OF SECTION**

## 1.0 **GENERAL**

### 1.1 **Documents**

1.1.1 This Section, along with the Drawings, forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.1.2 Drawings include architectural, mechanical, and electrical Drawings.

### 1.2 **Description of Work Included**

1.2.1 Provide all labour, materials, equipment, access, cooperation, coordination, and services to allow testing of structural steel, open web steel joists, structural steel deck, and welds to be carried out by Testing Agency.

1.2.2 Scope of required quality assurance testing is described in this Section to inform Contractor of type and scope of testing on project and to allow Contractor to make appropriate allowances.

1.2.3 Testing required for Contractor's own quality control or as noted in clause 1.6.3 will be paid for by Contractor.

### 1.3 **Related Work Specified Elsewhere**

1.3.1 Section 05 12 00 – Structural Steel Framing

1.3.2 Section 05 31 00 – Steel Decking

1.3.3 Section 05 51 00 – Metal Stairs

### 1.4 **Reference Standards**

1.4.1 Testing of structural steel shall conform to requirements of the following Building Code and Standards unless otherwise required by this Specification:

- .1 Ontario Building Code - 2012 0 REG 88/19
- .2 CSA S16 – Limit States Design of Steel Structures
- .3 CSA W178.1 – Certification of Welding Inspection Organizations
- .4 CSA W59 – Welded Steel Construction (Metal Arc Welding)
- .5 CSA W47.1 – Certification of Companies for Fusion Welding of Steel Structures
- .6 CSA G40.20/G40.21 – General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel
- .7 CSA S136 – North American Specification for the Design of Cold-Formed Steel Structural Members
- .8 ASTM A6/A6M – Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

- .9 CSSBI 10M – Standard for Steel Roof Deck
  - .10 CSSBI 12M – Standard for Composite Steel Deck
  - .11 RCSC Specification for Structural Joints Using ASTM A325 or A490 Bolts
  - .12 SDI Manual of Steel Construction with Steel Deck
  - .13 ASTM A653/A653M – Standard Specification for Sheet Steel, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
  - .14 ASTM A435/A435M – Standard Specification for Straight-Beam Ultrasonic Examination of Steel Plates
- 1.4.2 Revision date of referenced codes, standards, and guidelines shall be as indicated in the above referenced Building Code. Where no reference is made within the Building Code, the latest published edition shall be used.
- 1.4.3 Where the Standard is referenced in this Specification, it means documents specified in this clause and their referenced Standards.
- 1.4.4 Where there are differences between the Specifications and Drawings and the codes, standards, or acts, the most stringent shall govern.

## 1.5 **Definitions - For This Section**

- 1.5.1 “Owner”, “Contractor”, and “Consultant” per the General Conditions and Definitions.
- 1.5.2 “Structural Engineer” means a representative of Read Jones Christoffersen Ltd.
- 1.5.3 “Testing Agency” means a third-party testing and inspection agency.
- 1.5.4 “Non-Destructive Testing” means liquid penetrant (LP), magnetic particle (MP), ultrasonic (UT), or radiographic testing (RT) as determined appropriate by Testing Agency.
- 1.5.5 “Standard” and “Standards” mean reference standards listed under “Reference Standards” in this Section.

## 1.6 **Appointment of Testing Agency**

- 1.6.1 A CSA-Approved Testing Agency (approved under W178.1 - Building Category) shall be appointed to test structural steel and connections in accordance with Part **Error! Reference source not found.**
- 1.6.2 Unless stated otherwise in Division 0 / Division 1, Testing Agency shall be engaged by Owner.
- 1.6.3 Contractor shall pay for testing not covered in clause 1.6.1, including but not be limited to:
- .1 Testing of pre-approved connections not on structural Drawings and required by Contractor for ease of fabrication, transportation, or erection.

- .2 Additional costs due to overtime, shift work, and holiday or weekend work required to meet schedule.
- .3 Costs for retesting or additional testing due to work having failed to meet specified requirements.
- .4 Non-destructive testing will be performed on samples of work as outlined in the Specification. Repair and re-testing shall be done at Contractor's expense.
- .5 Deficiencies in work will trigger required additional testing.

## **2.0 DUTIES**

### **2.1 Responsibility of Contractor**

- 2.1.1 Cooperate fully with Testing Agency. Allow free access to all parts of the work for testing and review at all times.
- 2.1.2 Notify Testing Agency and Structural Engineer when work is ready for review.
- 2.1.3 Prior to commencement of work, provide schedule of shop fabrication and erection to Testing Agency and Structural Engineer. Changes in this schedule shall be communicated to these parties in a timely fashion.
- 2.1.4 Provide quantity takeoff of all members in project for use in determining number of members required for testing. This takeoff should also indicate divisions in which members are to be fabricated to aid in shop inspection planning.
- 2.1.5 Provide mill certificates in accordance with the Standard, properly correlated to elements being fabricated.
- 2.1.6 Make available non-destructive testing reports performed in shop during fabrication.
- 2.1.7 Prep areas requiring NDE to an acceptable level. Preparation includes, but is not limited to:
  - .1 Ultrasonic Testing (UT) to 300 mm away from weld by grinding off weld splatter and buffing area with wire wheel.
  - .2 Provision of necessary access platforms or scaffolding to allow inspections to be carried out.
- 2.1.8 Contractor is solely responsible to provide finished product that meets Specifications and Contract Documents. Testing is not carried out for Contractor's benefit, nor does it make Structural Engineer or Testing Agency guarantors of Contractor's work.

### **2.2 Responsibility and Duties of Testing Agency**

- 2.2.1 Testing Agency has authority to, and is expected to, reject any work not meeting Specifications.

- 2.2.2 Identify number, type, and locations of members, connections, studs, etc. to be tested and coordinate required shop and site visits.
- 2.2.3 Review structural Drawings and Specifications prior to carrying out work.
- 2.2.4 Provide testing per the Standards and this Specification.
- 2.2.5 Provide timely test reports to Structural Engineer, Consultant, and Contractor.

### **3.0 TESTING AND INSPECTION**

#### **3.1 General**

- 3.1.1 Structural Engineer may reject, at any time during progress of work, a piece of material or member which Structural Engineer may find defective or not in accordance with detailed drawings. This material may be rejected notwithstanding any previous acceptance; replace rejected components at no expense to Owner. In case of dispute, decision of Structural Engineer will be final.
- 3.1.2 If initial tests indicate that work failed to meet Specification, Structural Engineer will decide if additional testing is necessary. This testing shall be done by Owner's agency. Proposed additional testing shall have prior approval of Structural Engineer.
- 3.1.3 Non-destructive testing operators shall have Level II qualification as a minimum.

#### **3.2 Documents and Materials**

- 3.2.1 Confirm that fabricator and erector are certified to CSA W47.1 and that welders are properly qualified.
- 3.2.2 Review mill certificates for all types of material used in project to ensure they meet requirements of 05 12 00 and forward to Structural Engineer.
- 3.2.3 Confirm welding consumables provided will meet levels of strength, notch toughness, and quality of base member and that they are properly stored in shop and field.
- 3.2.4 Review bolt storage, handling, and installation procedures including pre-installation verification testing as required depending on types of bolts or washers to be used.
  - .1 Tension Control (TC) Bolts
    - .1 Carry out pre-installation verification in accordance with CSA S16 to confirm bolts will function as intended.
  - .2 Direct Tension Indicator (DTI) Washers
    - .1 Review fabricator installation procedures.
    - .2 General review for damage to washers prior to installation.
- 3.2.5 Review available non-destructive testing reports performed by Contractor.

- 3.2.6 Where more than one type of paint is specified, colour of each coat of paint shall differ so they can be visually identified after applications.
- 3.2.7 Obtain invoices and product data from steel supplier for purchase of specified primers and paints required for project. Circulate these documents to Structural and Architectural Consultants.

**3.3 Visual Testing (VT) of Members and Connections (Welded or Bolted)**

- 3.3.1 Perform visual testing of structural components, framing, and connections through a combination of shop and field visits to meet requirements below.
- 3.3.2 Visual Testing (VT) requirements above include but are not limited to verifying:
- .1 Grade markings on structural steel in fabricator's plant prior to fabrication.
  - .2 Dimensions, including cross-section, in relation to specified members (in-house plant QC may be relied upon to perform this task assuming testing agency is satisfied with level of QC being carried out).
  - .3 Locations of holes, cuts, fittings, and milling of member ends.
  - .4 Tolerances of joint preparation and fit up (bevel angle, etc.) to be in accordance with CSA S16.1, clause 28.5 Joints in Contact Bearing.
  - .5 Preheat and interpass temperatures based on approved welding procedures.
  - .6 Snug tight bolted connections are properly compacted and brought to snug tight condition progressing outward from most rigid part.
  - .7 Specified beam and / or truss camber and cambering procedure do not reduce member capacity.
  - .8 Erection tolerances meet tolerances of CSA S16.
  - .9 Joist and truss erection tolerances meet CSA S16 requirements, and report twisting, sweeping, and local damage.
  - .10 Adequate joist bearing on supporting structure as detailed in Drawings.
  - .11 Truss permanent top and bottom chord bridging and end connections are complete.
  - .12 Number of headed studs per beam and that stud placement is properly offset towards closest beam support within composite deck flutes per typical details.
  - .13 Steel surface preparation prior to priming and / or painting is in conformance with requirements of Structural and Architectural Specifications.
  - .14 Steel that is exposed or in unconditioned spaces, such as canopies, parapet walls, steel lintels, shelf angles, etc., are galvanized and or painted in accordance with Contract Documents.

- 3.3.3 Defects noted during Visual Testing (VT) work shall be reviewed using appropriate comprehensive Non-Destructive Evaluation (NDE), which shall be in addition to requirements in clause 3.4.

**3.4 Comprehensive NDE Testing of Connections (Welded or Bolted)**

- 3.4.1 Perform testing of connections through combination of shop and field visits to meet sampling required in Tables 1 and 2.

- 3.4.2 Requirements of Tables 1 and 2 include but are not limited to verifying:

- .1 At least one type of unique connection shall be tested irrespective of sampling requirements.
- .2 Bolt types conform to Drawings and Specifications prior to start of bolting operations and that pre-installation verification has been completed.
- .3 Bolted connections shall be tested in accordance with CSA S16 with minimum two bolts tested for each pre-tensioned connection.
- .4 For bolted connections that are indicated as pre-tensioned or slip critical, pre-installation verification testing is performed by inspector in cooperation with Contractor.
- .5 For bolted connections indicated as pre-tensioned or slip critical, Testing Agency shall be present during installation with sufficient frequency so pre-tensioning methods of RCSC 8.2.1, 8.2.3, or 8.2.4, as appropriate, are performed.
- .6 Welded connections shall be tested in accordance with Annex P of CSA S16 clause 9.5 with an inspection class of IC3 (Critical).
- .7 When overall length of weld is less than 900 mm, test entire length.
- .8 Splices not shown on structural drawings shall be 100% ultrasonically tested (UT) at Contractor's expense.

- 3.4.3 Post-installation review of bolts using following techniques:

- .1 Conventional bolts
  - .1 Turn of nut method marked on washer and bolt head or calibrated torque wrench.
- .2 Tension Control (TC) Bolts
  - .1 Post-installation review should be carried out to ensure bolt tip is sheared off at tension control point.
- .3 Direct Tension Indicator (DTI) Washers
  - .1 Post-installation review shall be carried out to ensure even bearing of connection and no obstructions are present that would cause uneven pressure to be applied to DTI.

**3.5 Testing of Steel Deck**

- 3.5.1 Provide visual testing (VT) of steel deck gauge and connections to meet requirements below.



Deck Type (Composite / Non-Composite)	Comments (Deck Gauge)	Individual Item Sample Size	
		Material Thickness	Connections
Non-Composite	22 Gauge	10%	30%
Non-Composite	20 Gauge	10%	40%
Non-Composite	$t > 20$ Gauge	10%	50%
Composite	$t \leq 20$ Gauge	10%	30%
Composite	$t > 20$ Gauge	10%	40%

3.5.2 Sampling of deck connections shall be in a representative fashion for equal distribution between support, seam, and edge connections.

3.5.3 Visual Testing (VT) requirements above include but are not limited to verifying:

- .1 Types of connections (welds) or fasteners (mechanical) and verify they meet what has been specified in engineering Drawings.
- .2 That welds align with supporting structure below and proper fusion has been achieved.
- .3 Verify that localized deck supports are provided at discontinuous deck ends that do not bear on structure due to framing interruptions.
- .4 Verify deck galvanizing per Specifications by taking random zinc thickness measurements of 10% of supplied galvanized deck. Touch up areas where testing has taken place with zinc rich paint.

3.5.4 If Testing Agency determines that quality of welds appear deficient, they shall request a weld quality control test in accordance with SDI Manual of Steel Construction with Steel Deck. Structural Engineer shall be immediately notified of this requirement and may request to be present at time of test.

### **3.6 Testing of Headed Studs and Deformed Bar Anchors**

3.6.1 Shop welded studs may be fillet welded. Field applied studs shall be applied using manufacturer's stud gun and procedures or shall be rejected.

3.6.2 Reinforcing bars (Rebar) butt welded to plates shall be tested per this Section and be weldable grade (W) reinforcing.

3.6.3 Welding of rebar shall be carried out by a welder with appropriate qualifications.

3.6.4 Qualification Testing is required on a sample specimen with materials representative of conditions used in construction prior to performing stud welding in accordance with CSA W59, Cl 6.3.

3.6.5 Contractor shall be responsible for performance of qualification testing to establish proper weld procedure. Submit written procedure based on this testing to testing and inspection company for review and acceptance prior to commencement of work.

3.6.6 Preproduction Testing: Before production welding with particular set-up and given size and type of stud, and at beginning of each day or shift's production, testing shall be performed on first two studs that are welded. Testing requirements shall be conducted per CSA W59 Cl 6.5.

3.6.7 Perform Visual Testing (VT) of studs and anchors through a combination of shop and field visits to meet requirements below.

<b>Structural Framing</b>	<b>Minimum Total % Connection Testing</b>
Beams & Joists	17.5%
Girders & Joist Girders	37.5%

3.6.8 Visual Testing requirements above include but are not limited to verifying:

- .1 Inspect number of studs per beam
- .2 Verifying stud placement in deck cell is located closest to nearest end of beam.

3.6.9 Studs and anchors shall be tested by bending to an angle of 30° towards direction of nearest end of member. Testing shall be completed through a combination of shop and field visits to meet requirements below.

<b>Structural Framing</b>	<b>Minimum Total % Connection Testing</b>
Beams & Joists	1.10%
Girders & Joist Girders	1.70%

3.6.10 Perform destructive testing of studs and anchors through a combination of shop and field visits to meet requirements below.

<b>Structural Framing</b>	<b>Minimum Total % Connection Testing</b>
Beams & Joists	0.40%
Girders & Joist Girders	0.55%

3.6.11 Bend (3.6.9) and destructive (3.6.10) testing shall be subject to following additional requirements.

- .1 Studs testing to destruction shall be replaced by Contractor and retested.
- .2 Failure of weld of any studs will be cause for rejection of stud welding and cause for further testing at Structural Engineer's discretion. This additional testing shall be at Contractor's expense.
- .3 A 10% or greater failure rate at welds of tested studs will be cause for rejection of all studs.
- .4 Replacement of failed or rejected studs shall be at Contractor's expense.

**Table 1: Single Piece Members**

<b>Structural Framing</b>	<b>Minimum Total % Connection Testing</b>
Columns & Base Plates	10%
Bracing	10%
Beams & Joists	7.5%
Girders	10%
Moment Connections	10%
Splices	100%
Section Reinforcement & Stiffeners	25%

**Table 2: Multi-Piece Members**

<b>Structural Framing</b>	<b>Minimum Total % Connection Testing</b>
Trusses & Joist Girders	15%
Field Reinforcing Work	30%

**End of Section**

## **1.0 GENERAL**

### **1.1 Documents**

- 1.1.1 This section, along with the drawings, forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- 1.1.2 Drawings include architectural, mechanical, and electrical drawings.

### **1.2 Description of Work Included**

- 1.2.1 Provide all labour, materials, equipment, and services to supply, design, and erect structural steel required and/or indicated on the drawings or specified herein, including the supply of plates and/or angles for support of masonry, embedded steel parts, headed stud, mechanical couplers; deformed bar anchors, wedge anchors, and epoxy anchors that will form the connection between the structural steel, open web steel joists and masonry or concrete; and reinforcement of steel deck openings. Report any discrepancies between structural, mechanical, electrical, and architectural drawings to the Consultant and Structural Engineer immediately.
- 1.2.2 Co-ordinate with Section 03 30 00 – Concrete Framework and Section 03 20 00 – Concrete Reinforcement for the design, supply, installation, and erection of embedded steel parts.
- 1.2.3 Co-ordinate with Section 05 21 00 – Open Web Steel Joists for the design, fabrication, supply, installation, and erection of open web steel joists.
- 1.2.4 Co-ordinate with Section 05 31 00 – Steel Deck for the design, supply, and installation of headed stud shear connectors for composite beams and girders, and where required on other beams, girders, and drag struts.

### **1.3 Related Work Specified Elsewhere**

- 1.3.1 Section 03 11 00 – Concrete Forming and Accessories
- 1.3.2 Section 03 20 00 – Concrete Reinforcing
- 1.3.3 Section 03 30 00 – Structural Cast-in-Place Concrete
- 1.3.4 Section 04 22 00 – Concrete Unit Masonry
- 1.3.5 Section 05 00 50 – Testing of Structural Steel
- 1.3.6 Section 05 21 00 – Steel Joist Framing
- 1.3.7 Section 05 31 00 – Steel Decking
- 1.3.8 Section 05 51 00 – Metal Stairs
- 1.3.9 Section 07 81 00 – Applied Fireproofing
- 1.3.10 Section 09 91 13 – Exterior Painting
- 1.3.11 Section 09 91 23 – Interior Painting

**1.4      Reference Standards**

1.4.1    Structural steel shall conform to the requirements of the following Building Code and Reference Standards unless otherwise required by this specification:

.1      Building Code

.1      Ontario Building Code - 2012 0 REG 88/19

.2      Reference Standards

.1      General

.1      CSA S16 – Design of Steel Structures

.2      CSA G40.20 – General Requirements for Rolled or Welded Structural Quality Steel

.3      CSA G40.21 – Structural Quality Steel

.4      ASTM A1085/A1085M – Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS)

.5      CSA S136 – North American Specification for the Design of Cold-Formed Steel Structural Members

.6      ASTM A6/A6M – Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

.7      CISC Code of Standard Practice for Structural Steel

.8      ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

.9      ASTM F3125/F3125M – Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength

.10     ASTM A325 – Standard Specification for Structural Bolts, Steel, Heat Treated 120 / 105 ksi Minimum Tensile Strength

.11     ASTM A490 – Standard Specification for Structural Bolts, Alloy Steel, Heat Treated 150 ksi Minimum Tensile Strength

.12     ASTM F1554 – Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

.13     CSA W47.1 – Certification of Companies for Fusion Welding of Steel Structures

- .14 CSA W59 – Welded Steel Construction (Metal Arc Welding) (Metric version)
- .2 Surface Preparation and Finishes
  - .1 SSPC SP-6 – Commercial Blast Cleaning
  - .2 CSA G189 – Sprayed Metal Coatings for Atmosphere Corrosion Protection.
  - .3 CISC / CPMA Standard 1-73a – A Quick-Drying One-Coat Paint for Use on Structural Steel.
  - .4 Architectural Exposed Structural Steel shall conform to Appendix I of CISC Code of Standard Practice for Structural Steel.
- .3 Galvanizing
  - .1 ASTM A123/A123M – Standard Specification for Zinc (Hot-Dip Galvanizing) Coatings on Iron and Steel Products
  - .2 ASTM A143/A143M – Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
  - .3 ASTM A153/A153M – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
  - .4 ASTM A384/A384M – Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
  - .5 ASTM A385/A385M – Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
  - .6 ASTM A780/A780M – Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
  - .7 CGSB-85-GP-16M – Painting Galvanized Steel
- 1.4.2 The revision date of all referenced codes, standards, and guidelines shall be as indicated in the above referenced Building Code. Where no reference is made within the Building Code, the latest published edition shall be used.
- 1.4.3 Where the Standard is referenced in this specification, it shall mean the documents specified in this clause and their referenced Standards.
- 1.4.4 Where there are differences between the specifications and drawings and the codes, standards, or acts, the most stringent shall govern.

## 1.5 **Definitions - For This Section**

- 1.5.1 “Owner”, “Contractor”, and “Consultant” as per the General Conditions and Definitions.

- 1.5.2 “Structural Engineer” shall mean a representative of Read Jones Christoffersen Ltd., herein also referred to as RJC.
- 1.5.3 “Specialty Structural Engineer” is a Professional Engineer registered in Ontario responsible for components designed by the Contractor and who seals and signs shop drawings.
- 1.5.4 “Testing Agency” shall mean the testing agency responsible to the Owner.
- 1.5.5 “Standard” and “Standards” shall mean the reference standards listed under “Reference Standards” in this section.

## **1.6 Qualifications**

- 1.6.1 Fabricator, erector, and all subcontractors performing structural steel work shall be certified under the requirements of Division 1, or Division 2.1 of W47.1. Fabricator and erector shall have in place a Quality Control Program satisfying the requirements of ISO 9001-2008 or another quality control program that is acceptable to the Consultant. In any case, the Quality Control Program shall satisfy the minimum requirements specified in the contract documents.
- 1.6.2 Design calculations shall be carried out by or under the direct supervision of a qualified Specialty Structural Engineer licensed in the Province of Ontario, with a minimum of five years Canadian experience in the design of structural steel work and connections including design of weldments, as appropriate.
- 1.6.3 Engineers responsible for welding design, procedures, and practice shall be certified in accordance with CSA W47.1, section 6.1.
- 1.6.4 Specialty Structural Engineers responsible for the design of steel work, connections, and the like, shall be insured in accordance with the Professional Engineers Ontario Act and shall be covered under a General Liability Insurance Policy in accordance with the Provisions of the Contract.
- 1.6.5 Structural steel fabricator shall have not less than five year(s) experience in the fabrication of structural steel and hold the CISC Steel Structures Certification under the CISC Quality Certification Program.
- 1.6.6 Erector shall not have less than ten year(s) experience in the erection of structural steel.

## **1.7 Examinations**

- 1.7.1 All dimensions shall be taken from the drawings and verified by field measurement (including verification of interfacing with existing structures). Be responsible for the correctness of such measurements and report to the Consultant and Structural Engineer in writing all discrepancies between measurements in the field and those shown on drawings prior to commencing work. Verify location of anchor rods and embedded steel, and ensure that work prepared by other trades is at a proper elevation, on line, level, and true.

**1.8 Submittals**

1.8.1 Suppliers shall provide an embodied carbon breakdown for all structural steel utilized in the project for review and approval:

- .1 The breakdown shall be provided prior to or during the ordering material indicating the total embodied carbon (kg CO<sub>2e</sub>).
- .2 The breakdown shall also be provided at the end of the project with the values updated to reflect the final as-built quantities and resulting embodied carbon (kg CO<sub>2e</sub>).
- .3 The breakdown shall be a tabular submittal showing all members, materials, quantities and embodied carbon based on accompanying EPDs as outlined below.
- .4 Refer to Division 1 for the maximum allowable upfront (A1-A3) kgs of embodied carbon.
- .5 The maximum embodied carbon for each type of member utilized shall not exceed the values below unless approved by the Consultant.

Member Type	Maximum kg CO <sub>2e</sub> / tonne	Product
Steel Plate	1710	CISC Industry Average
Rolled Structural Steel Sections	820	Structural steel product, hot-rolled, North America average, 7850 kg/m <sup>3</sup> (Gerdau)
HSS Sections	1860	CISC Industry Average
Metal Deck	1740	Steel roof and floor deck using electric arc furnace (EAF) technology, North America average, 7800 kg/m <sup>3</sup> (Nucor Corporation's Vulcraft Group)
Open Web Steel Joists	840	Fabricated open-web steel joists and joist girders, 7800 kg/m <sup>3</sup> (Nucor)

1.8.2 Submit Environmental Product Declarations (EPDs) compliant with CSA-ISO 14025-07.

- .1 Product EPDs must be third party certified, including external verification.

1.8.3 Alternatively with written approval producers may submit an industry average EPD in which the manufacturer is explicitly recognized as a participant by the program operator.

1.8.4 Submit third party certified documentation identifying products that demonstrate item 1 and as many of the remaining items as possible:

- .1 global warming Potential (greenhouse gases), CO<sub>2e</sub>;
- .2 depletion of the stratospheric ozone layer, in kg CFC -11;
- .3 acidification of land and water sources, in moles H<sup>+</sup> or kg SO<sub>2</sub>;



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- .4 eutrophication, in kg nitrogen or kg phosphate;
  - .5 formation of tropospheric ozone, in kg NOx, kg O3, or kg ethane; and
  - .6 depletion of non-renewable energy resources, in MJ.
- 1.8.5 Submit documentation of recycled content of structural steel. A breakdown of post-consumer and post-industrial recycled content should be specified. A mill certificate shall be provided.
- 1.8.6 Submit documentation of where the structural steel was produced, processed, and manufactured.
- 1.8.7 Quality Control Program
- .1 Include with the tender documents a copy of fabricator's and erector's standard Quality Control Program.
  - .2 Prior to commencement of the work, the Contractor, with the fabricator and erector, shall submit a complete Quality Control Program for this specific project for review by the Consultant. The fabricator and erector shall revise and resubmit the Program if required by the Consultant.
- 1.8.8 Qualifications of Specialty Structural Engineer
- .1 Submit appropriate documentation for each Professional Engineer who will be responsible for the steel work; including the erection and design of connections, weldments (qualification of the steel fabricators and erectors for welding under Canadian Welding Bureau requirement and CSA W186), and the like, verifying the minimum qualification requirements outlined in this specification.
- 1.8.9 Proof of Insurance
- .1 Submit proof of adequate insurance coverage for each Professional Engineer who will be responsible for the steel work, connections, and the like, as outlined in this section.
- 1.8.10 The Contractor shall submit, with the tender, written evidence of qualification of the steel fabricators and erectors for welding under Canadian Welding Bureau requirements.
- 1.8.11 The Contractor shall submit, with the tender, written evidence of ability to weld reinforcing steel to structural steel in accordance with CSA W186.
- 1.8.12 The Contractor shall submit, prior to the commencement of fabrication, copies of mill test reports properly correlated to the materials used on the project. The Contractor shall also review clause 2.1.1.3 and provide reports as required in order to demonstrate conformance with the chemical content parameters.
- 1.8.13 The Contractor shall make available all non-destructive testing reports, steel testing, and weld testing reports performed in the shop during fabrication by the steel fabricator.

- 1.8.14 The Contractor shall submit accurate surveys of steel erection as noted in this section, and on the structural drawings.
- 1.8.15 The Contractor shall submit manufacturer's literature and certification that shop paint, primer, coatings, and galvanization meets the performance standards specified herein and related specified work elsewhere.
- 1.8.16 The Contractor shall submit a description of welding procedures for use on structural steel a minimum one month prior to fabrication or use.
- 1.8.17 Provide a schedule of fabrication to the Consultant, Structural Engineer, and Testing Agency prior to the commencement of the fabrication.

## **1.9 Shop and Erection Drawings**

- 1.9.1 Specialty Structural Engineer(s) responsible for the structural steel work, connections, joist systems, and the like shall either:
  - .1 Seal and sign all necessary shop drawings, or
  - .2 Submit a sealed and signed letter prior to commencement of shop drawing preparation identifying who that fabricator's engineer is that has been retained by the steel fabricator to carry out the design of steel connections, and the like AND shall submit a second letter after shop drawing preparation is complete stating that the design of the steel work, for which they are responsible, has been completed in accordance with the contract documents and relevant building codes, standards and acts. The letter shall identify what was designed by the Professional Engineer(s) and list the final shop drawings by number with dates and revision numbers.
  - .3 If the Professional Engineer(s) choose to seal and sign the shop drawings, as noted above, all shop drawings must be sealed and signed, except for erection diagrams which only contain design information (member sizes, forces, loads and the like) which is shown on the structural drawings. If any field work details, notes to the erector, or notifications are made on the erection diagrams then they must be sealed and signed.
- 1.9.2 The structural drawing, any structural models, and electronic files shall not be reproduced in whole or in part, and shall not be used to prepare shop, erection, or setting drawings. Structural models and electronic files may be used by the Contractor under the following conditions:
  - .1 Copyright remains with Read Jones Christoffersen Ltd.
  - .2 The drawings will only be used for shop drawings for this project and not be put to any other use.
  - .3 Read Jones Christoffersen Ltd. assumes no liability for errors or omissions in the drawings. The Contractor assumes all risk and expenses associated with the use of structural drawings in the production of their work.

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- .4 References to Read Jones Christoffersen Ltd. must be deleted from the title block.
  - .5 The Contractor signs a release available from Read Jones Christoffersen Ltd. that addresses the above items in more detail.
  - 1.9.3 Structural drawings shall not be scaled.
  - 1.9.4 Submit structural steel connection design details shop, erection, field work details, and setting drawings for review by the Consultant.
  - 1.9.5 Connection Design Details:
    - .1 Submit “design” drawings for review summarizing the proposed connection details to be used on the project. These drawings to be prepared by or under supervision of the Specialty Structural Engineer and submitted for review before the start of shop drawing production. These design drawings shall show the complete connection and:
      - .1 How the connection assembly fits with the connected members.
      - .2 Sizes of plates, bolts, welds, etc.
      - .3 Capacities of the connection.
      - .4 Assumed eccentricities, lines of action of forces, etc.
  - 1.9.6 Erection Drawings
    - .1 Submit erection drawings for review prior to preparation of detailed shop drawings.
    - .2 Erection drawings shall clearly show all setting out dimensions for the structural steel frame, including dimensions that have been confirmed by site measurement. Dimensions shall be tied into relevant grid lines or reference points wherever possible.
  - 1.9.7 Shop Drawings
    - .1 Submit detailed shop drawings for all structural members that show the details necessary for the fabrication of the component parts of the structure.
    - .2 Shop drawings as a minimum, show the following:
      - .1 layout;
      - .2 member sizes;
      - .3 connection details, including member cuts and copes where applicable;
      - .4 bearing details;
      - .5 splice locations and details (splices not shown on the shop drawings will be rejected);
      - .6 truss details;
      - .7 holes;

- .8 camber;
- .9 finishes;
- .10 grade(s) of steel;
- .11 bolt or threaded fastener material grade, size, and designation;
- .12 weld type, size, extent, and if shop or field applied with AWS welding symbols as specified in the CSA W59 Appendix D and E;
- .13 sliding expansion joint bearing pad details, including materials, size, and thickness of pads; setting out dimensions; and load capacity;
- .14 Architectural clearance lines and finishes where connection and the like may encroach with other work.
- .3 Provide a shop drawing clearly locating all anchor rods, embedded plates, baseplates, etc.
- .4 Provide setting drawings, templates, and directions for the installation of anchor rods, plates, and other devices.
- .5 Review of the shop drawings by the Structural Engineer is intended as an assistance to the Contractor and does not relieve the Contractor of their responsibility for the completeness or accuracy of their work and its conformance with the contract documents.
- .6 Fabrication that commences prior to shop drawing review by the Structural Engineer is at the risk of the Contractor.
- .7 Clearly identify on the shop drawing all revisions, changes, or modifications.
- .8 Resubmit reviewed shop drawings where noted in the Read Jones Christoffersen Ltd.'s review stamp, or when the Contractor makes revisions for their own purposes.
- .9 The Contractor shall perform and submit a complete survey, before steel erection commences, of position and alignment at all points where construction by other trades will support steel elements, including but not limited to pockets, embedded plates, anchor rods, rebar, and base plates. Include plan location positions relative to the building gridlines, and elevations of bearing surfaces and tops of bolts/rods relative to building Datum elevation.
- .10 The Contractor shall perform and submit a preconstruction survey where new steel work relies on existing construction. The survey of the existing structures/construction shall be completed prior to completing and submitting shop drawings for the related works and prepared by a professional surveyor employed by the Contractor. This survey shall include but not be limited to:
  - .1 Dimensions and elevations.

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- .2 Exact location of mass timber members supporting steel framing.
  - .3 Concrete scanning at locations of attachment for embedded rebar, concrete, etc.
  - .11 The Contractor shall submit a steel erection procedure prepared by Contractor's Specialty Engineer. Procedure to include any loading and temporary connections to base building structure. Refer to temporary works on General Notes for more information. No deviation from the approved procedure will be permitted without prior written approval by the Specialty Engineer and review by RJC.
  - .12 The Contractor shall complete and submit a comprehensive survey of the as-constructed steel structure at each level adequate to assess if the structure has been built within specified tolerances. Surveys are to be submitted to the Contractor's Specialty Engineer for approval. If deviations from tolerances are found, Contractor to propose corrective measures to RJC for approval.
  - .13 Allow at least two weeks (10 working days) for shop drawing review by the Structural Engineer.
- 1.9.8 Field Work Details
- .1 Submit details for all field work in accordance with the requirements of Division 1.
  - .2 The location of field work details shall be clearly identified or referenced on the erection drawings.
  - .3 Prepare setting drawings showing dimensions and details for setting structural steel bearings, anchorages, assemblies and the like where they interface with other building components and support the work of this section.
  - .4 The steel contractor shall incorporate other trade's work as directed by the Construction Manager.
  - .5 Submit all non-prequalified welding procedures, stamped as approved by the Canadian Welding Bureau and correlated to the appropriate shop and erection drawings.
  - .6 Submit details of methods proposed to achieve and verify the specified tension to bracing members within the specified tolerance.
  - .7 Furnish Inspection Company with a copy of each shop, erection, and setting drawing bearing the Consultant's shop drawing stamp marked reviewed.

**1.10 Supply of Alternate Products**

- 1.10.1 Should the rolled sections or any other structural steel element shown on the drawings not be available or procurable, or should substitution for those sections be desired, sections of equivalent or greater mechanical properties (strength, stiffness, etc.) may be substituted if approved by RJC in writing. In such cases, full particulars thereof must be submitted prior to the closing of Bid. Material and structural section substitutions after the closing of Bid, if accepted, will be at the Contractor's cost.

**1.11 Testing and Field Review**

- 1.11.1 See Section 05 00 50 – Testing of Structural Steel.
- 1.11.2 Prior to the commencement of work, provide a schedule of shop fabrication to the Testing Agency.
- 1.11.3 The Contractor shall advise the Testing Agency of the scheduling of all shop and field work pertaining to this Project. The Contractor shall permit the testing agency full access to the fabrication shop and the site for the purpose of carrying out their work and shall provide assistance required to aid in the performance of the inspection and testing.
- 1.11.4 The Specialty Structural Engineer (or approved representative) responsible for shop drawings shall visit the site to review in place the connections and components to ensure that these connections and components substantially comply with the design drawings. The Specialty Structural Engineer shall then provide a sealed and signed letter to the Consultant and Structural Engineer to this effect.

**1.12 Storage and Handling**

- 1.12.1 The Contractor shall be responsible for the protection of all steelwork during fabrication, shipping, storage, and construction. All small bends and damage shall be reported to the Structural Engineer for instructions. Steel work that is bent, broken, or otherwise damaged shall be repaired or replaced by the Contractor prior to erection, to the satisfaction of the Structural Engineer, and at no cost to the Owner.
- 1.12.2 The Contractor shall be responsible for proper scheduling of delivery and erection for the structural steel in accordance with the construction schedule.
- 1.12.3 Store structural steel members at the site above ground on platforms, skids, or other devices so that ground dampness will not affect the bottom members of the stacks.
- 1.12.4 Steel that is stored outdoors after fabrication shall be protected from accumulations of standing water.
- 1.12.5 Other materials shall be stored in a weather tight and dry place until ready for use in the Work.
- 1.12.6 Packaged materials shall be stored in their original unbroken packages or containers.

**1.13 Coordination with Other Trades**

- 1.13.1 Supply all necessary instructions and drawings to other trades for setting bearing plates, anchor rods, and other members that are built in with the work of other trades. Provide punched holes for the convenience of other trades in attaching wood blocking or other materials. Coordinate with drawings of other disciplines for locations and details. Supply the necessary material in accordance to the construction schedule.

**2.0 PRODUCTS****2.1 Materials****2.1.1 Structural Steel**

- .1 All steel shall be new unless otherwise indicated and be of sizes and shapes listed in the current CISC Handbook or AISC Handbook and as indicated on the drawings.
- .2 Provide only new material (including bolts) manufactured in Canada, United States, United Kingdom, or EU country mills. New materials are to be in accordance with the Referenced Standards. New materials are to be traceable and records of mill test certificates are to be provided to the Consultant by the Contractor.
- .3 Structural steel members as specified herein or on the drawings shall contain a minimum of 20% recycled content.
- .4 Where sections identified are not available from Canada, United States, United Kingdom, or EU country mills, or where the Contractor chooses to use sections produced by other mills, provide new materials of minimum strength and minimum quality noted in the Reference Standard. For steel that is not produced by Canada, United States, United Kingdom, or EU country mills, the Contractor shall make written requests for approval of the alternate mill to the Consultant before proceeding with material procurement. The Consultant reserves the right to require physical test data, in addition to the mill test reports, proving that the steel from the proposed mill meets the specification requirements prior to approving. Steel must conform to the following:
  - .1 A total maximum boron content of 0.0008%.
  - .2 Each steel batch is to be tested to confirm the steel meets or exceeds the Reference Standards, and does not exceed the maximum boron specified in 2.1.3.1 above.
  - .3 Testing of the steel is to be performed in Canada by an ISO 17025 accredited testing laboratory.
- .5 It is preferable that structural steel members used come from an electric arc furnace. The fabricator may provide an alternate price for EAF versus other sources in \$/tonne for review by the client.

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- .6 Structural wide flange shapes (W) to conform to CSA G40.20/ G40.21 grade 345WM.
  - .7 Angles (L), plates, channels (C, MC) and miscellaneous beams (S, ST, M and MT) to conform to CSA G40.20/ G40.21 grade 350W.
  - .8 Square and rectangular hollow structural sections (HSS) to conform to ASTM A500 Grade C.
  - .9 Round hollow structural sections (HSS) to conform to ASTM A500 Grade C.
  - .10 Rolled plates and bars shall conform to CSA G40.20/ G40.21 grade 300W.
  - .11 Rolled structural steel sections, except HSS sections shall be hot-rolled, North America average, 7850 kg/m<sup>3</sup>, produced by Gerdau.
  - .12 Anchor Rods: Conform to ASTM F1554 Grade 36, 55, 105 unless otherwise noted or shown.
  - .13 Bolts, Nuts and Washers: Conform to ASTM F3125. Galvanized grade 325 bolts over 22 mm (7/8") diameter shall have a dry lubricant, such as Johnson's Stick Wax #140, on threads before installation.
  - .14 High Strength Bolts: High strength bolting shall be of North American manufacture and shall conform to the provisions of the Research Council on Structural Connections (RCSC) "Specifications for Structural Joints Using High-Strength Bolts", latest edition.

#### 2.1.2 Concrete Anchors

- .1 Headed studs shall meet the requirements of CSA W59 Appendix H.
- .2 Types A and B shall be Nelson anchors (or pre-approved equivalent) with fluxed ends and shall meet the mechanical properties as specified in ASTM A29, Grades 1010 to 1020. Studs to be automatically end welded with suitable stud welding equipment or shop fillet welded to develop full strength of the stud. Field fillet welded studs will be rejected.
- .3 Type C shall be deformed steel bars meeting the mechanical properties of ASTM A496 and shall be welded per the manufacturer's recommendations. Reinforcing steel bars with Lenton weldable couplers or pre-approved equal couplers to be used as specified on drawings.
- .4 Unless noted otherwise, all studs shall be considered to be Type B and shall have a length equal to the deck profile depth plus half of the concrete topping above the high flute.

#### 2.1.3 Shop Paint/Primer



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- .1 Ensure that the shop primer or paint and joint filler is compatible with spray fireproofing intumescent paint and/or the top coat paint system specified, where applicable.
  - .2 Shop Primer: To CISC/CPMA Standard 2-75.
  - .3 Hot Dip Galvanizing: To CSA G164, minimum zinc coating of 600 g/m<sup>2</sup>.
  - .4 Zinc-Rich Primer: Catha-Coat 302 as supplied by Devoe Coating Company (3 mils dry film thickness) or Carbozinc 11 as supplied by Carboline Company (2 to 3 mils dry film thickness or approved alternative).
  - .5 Epoxy Paint: Devran 224 HS high build epoxy coating (4 to 6 mils dry film thickness) or approved alternative.
  - .6 Zinc-Rich Touch-up Paint: Galvalite as supplied by ZRC Products Company or Galvafrid as supplied by W. R. Meadows Limited or approved alternative.
  - .7 "Corrosion Protective" Paint: Tenemec Series 394 Perimeprime or Sherwin Williams Macropoxy 646 or approved alternative. Refer to drawings for extent of steel work to receive this paint. All field-applied paints shall meet the requirements of Section 01 52 00. The maximum allowable VOC content for anti-corrosive paint is 250 g/L.
- 2.1.4 Any structural steel element outside the building envelope, within an enclosed unconditioned space, or exposed to weather shall be galvanized in accordance with CSA G164. Examples of this include, but are not limited to, canopies, cladding back-up structure, air-well, grating and supporting structure, brick support angles, and related framing materials.
  - 2.1.5 Welding consumables for all processes shall be fully approved by the Canadian Welding Bureau and certified by the manufacturers as complying with the requirements of this specification. Such certificates shall be not more than two years old.
  - 2.1.6 Welding electrode strengths to be equal to E49XX (E70XX) or better, and to be matched to base metal capacity.
  - 2.1.7 Grout for column bases shall be non-metallic, non-expanding, and non-shrink type with a minimum strength of 35 MPa (minimum) at 28 days, unless noted otherwise on the drawings. Grout may be placed in a dry pack or flowable consistency.

## **2.2 Design**

### **2.2.1 General**

- .1 Design connections and the like for the loads shown or implied in accordance with requirements of S16.
- .2 If the fabricator's engineer requires additional information or clarification to aid in the design of their work, they shall request this information in a timely and appropriate manner.

### 2.2.2 Connections

- .1 Unless otherwise noted, the fabricator's Specialty Structural Engineer shall design and be solely responsible for all connections between all steel members, including but not limited to columns, beams, girders, trusses, and braces, and between such members as spandrel angles and beams, hangers, stiffeners, etc. and their supporting members be they steel or concrete. The design of the plates or anchors into concrete will be by the Consultant for load and required in the final building loading condition (temporary loading conditions requiring enhancements shall be by the Contractor).
- .2 Unless otherwise noted, the fabricator's engineer shall also design and be responsible for specifying stiffeners, doubler plates, and the like required to maintain the local strength and stability of a member and where these stiffeners and doubler plates become an integral part of the connection or where they affect the connection of other steel framing members. Typical examples include but are not limited to cranked sections, moment connections between columns and beams, connections to hollow structural sections, and the like. Where connections are exposed to view, the detailing of stiffeners, double plates, and the like is subject to review by the Architect and should conform to Architectural Exposed Structural Steel referred to herein.
- .3 Use types of shop or field connections shown, or in the absence of such indication, use most appropriate type of connections.
- .4 Design connections to safely withstand the combined primary effects of axial forces, shear, moment, and torque, and any secondary effects due to welding and bolting configurations.
- .5 Where no axial force is shown for beam-to-column connections, connect beams framing into column such that the combined capacities of the connection are able to resist a total horizontal force of 2% of the factored axial load in the column, in each direction.
- .6 Unless otherwise noted, the design of all beams and girders is based on the assumption that fastener holes through flanges will not exceed 15% of the gross flange area. If the area of holes exceeds 15%, the member size shall be altered or reinforced accordingly unless the member can be shown to have sufficient capacity to resist the factored loads with the presence of holes.
- .7 Design connections for fastening together double angles used to resist compression, tension, or bending in such a way that the slenderness ratio of any component, based on its least radius of gyration and the distance between interconnections, shall not exceed that of the built-up member.
- .8 All statically loaded bolted connections shall be designed as snug tight (ST) joints.

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- .9 The following types of connections shall be designed as bearing connections but shall be pre-tensioned (PT):
    - .1 Connections for wind or seismic lateral load-resisting elements, such as those noted below or as noted on the structural drawings.
      - .1 Vertical or horizontal bracing
      - .2 Moment connections
      - .3 Truss connections
      - .4 Transfer beams
      - .5 Diaphragm collectors / struts
    - .2 Connections where bolts are subject to tensile or tensile and shear loadings.
    - .3 Connections of all framing providing lateral support to columns in buildings over 40 m in height.
  - .10 Design connections that are exposed to weather so that moisture, foreign matter, and the like cannot be trapped or gain entry to the interior of hollow built up members.
  - .11 Design and detail connections so as not to encroach upon architectural clearance lines or finishes.
  - .12 Where connections between beams and columns and the like result in a loss of bearing to the steel deck, design and provide support for the steel deck.
  - .13 Design connections that are to be cast into concrete to provide for the maximum deviation that can occur in erection and based upon the following:
    - .1 Specified steel erection tolerances,
    - .2 Maximum permissible tolerances in the location of inserts cast into concrete, specified in Section 03 11 00.
  - .14 The connection design shall be for the forces and loads shown on the drawings and shall allow for the effects of beam deflections. Provide a minimum of two 19 mm (3/4") ASTM F3125 Grade 325 bolts or an equivalent weld for all beam-to-girder and beam-to-column connections
  - .15 Provide separators for all double members in accordance with CSA S16.

#### 2.2.3 Temporary Work

- .1 The structure as shown on Contract Documents is designed to withstand the design loads only when all structural elements are installed and fully connected. Analysis of all components and assemblies under temporary configurations, including but not limited to stability, stresses, displacements, fabrication, shipping, handling,

erection (at various stages), and construction loads, are the sole responsibility of the Contractor.

- .2 Erection procedures and the design of all erection bracing and related provisions are the sole responsibility of the Contractor.
- .3 Prepare a detailed sequence of construction method statement outlining all key assumptions and design considerations during construction.
- .4 Coordinate the overall sequence of construction and construction schedule with the Construction Manager. Agree with Construction Manager on all keys milestones and corresponding dates, as well as critical assumptions that effect the temporary stability of structure.
- .5 Bracing members and anchor rod assemblies shown are for the finished structure and may not be adequate to resist temporary forces during construction.
- .6 Design erection bracing to safety resist all dead loads, live loads, lateral loads, constructions loads, and other loads imposed during construction.
- .7 Design erection bracing to limit inter-storey and total drift as required for construction purposes and ensure that inter-storey drift does not exceed  $h/400$  at the floors where cladding has been installed by the cladding contractor.
- .8 During erection, forces or reaction in the steel frame members and their connections might exceed those on which the final or permanent building design is based. Determine the magnitude of such erection forces and reactions and take such necessary measures to ensure that the safety and stability of the structure is maintained during construction.

### **3.0 EXECUTION**

#### **3.1 Fabrication**

- 3.1.1 Fabrication shall confirm to the requirements of CSA S16 and the reviewed shop drawings.
- 3.1.2 Fabricated units shall be straight and true, without sharp kinks or bends, and accurate to sizes shown.
- 3.1.3 Flame cut steel columns shall have their ends milled. Steel base plates supporting columns shall be flat.
- 3.1.4 Prior to fabrication of structural steel, take field measurements where connections are to be made to existing work. Take any and all necessary field measurement.
- 3.1.5 Modify installation methods and methods for connecting to suit site conditions found and to the approval of the Consultant.

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- 3.1.6 Unless noted otherwise, provide holes up to 12 mm (1/2") in diameter, as required, to permit the attachment of other materials. Ensure cross sectional area of section is not reduced by more than 10% at any point on its length.
- 3.1.7 Provide drain holes in closed sections to prevent water build-up during erection.
- 3.1.8 Provide vent and drain holes in assemblies with closed sections or closed fabricated spaces that are to be hot dipped galvanized to provide full exterior and interior galvanization. Vent and drain holes shall be provided to RJC for review prior to fabrication.
- 3.1.9 Thickness of baseplates 100 mm or greater is nominal and allows for a maximum reduction of 6 mm for milling to the requirements of CSA S16.
- 3.1.10 Visually inspect all plates and shapes for laminations. Replace plates or shapes that contain laminations..
- 3.1.11 Headed shear stud connectors and deformed bar anchors shall be applied in strict accordance with the manufacturer's instructions and the Standards or shop fillet welded as per the Standards. Procedural control to be in accordance with W59 as a minimum. Field fillet welds will be rejected.
- 3.1.12 Splices
- .1 Splices in members, other than those shown, that are provided for ease of fabrication or transportation shall not be permitted without Consultant's approval.
- .1 These connections shall be designed to develop the full strength and stiffness of the member.
- .2 Welded splices shall be subject to non-destructive testing as directed by the Structural Engineer for which the full cost of such testing shall be borne by the Contractor.
- .3 Bolted splices shall be designed to ensure slip is not permitted in the connection assembly so as to have the same performance as a welded splice.
- 3.1.13 Cambers
- .1 Fabrication of rolled steel sections without specified camber shall account for any natural mill camber and/or sweep resulting from manufacturing and result in the orientation of that camber in a positive upward direction.
- .2 Provide the indicated camber to trusses, beams, and girders in such a manner as to provide a uniform parabolic profile. Ensure that the method used to provide camber does not reduce the safe load carrying capacity or cause distortion of the members.
- .3 Camber stated on the drawings is the required camber after fabrication.

**3.1.14 Openings**

- .1 Conform to the requirements shown for location, size, reinforcement, and cutting of openings through structural steel.
- .2 No openings through structural steel members will be permitted without the written approval of RJC.

**3.1.15 Bending Steel Sections**

- .1 Bend sections to geometry noted on contract documents in such a manner as to provide a smooth uniform profile. Ensure that the method used to bend the steel sections does not reduce the safe load carrying capacity or cause distortion of the members.

**3.1.16 Holes and Cutting**

- .1 All holes shall be accurately drilled or punched. Burning or drifting unfair holes will not be permitted. Holes that must be enlarged shall be reamed. Holes for the attachment of work by others shall be provided as required. Drift pins will be allowed only to bring together the several parts for connection.
- .2 Holes shall be drilled or punched at right angles to the surface of the metal, or CNC-guided plasma or flame-cut in accordance with CISC Specifications.
- .3 Holes shall be provided in members to permit connections to the work of other trades or contracts, as directed and located by the Construction Manager.
- .4 The use of manual gas-cutting in the shop may be used only if automatic or semi-automatic methods are not deemed practical. All burned cuts shall be ground and cleaned to remove notches. Cope for pipes and ducts as shown.

**3.1.17 Bolts, Anchor Rods and Embedded Parts**

- .1 Drive bolts accurately into the holes without damaging the threads and heads. Bolt heads and nuts shall rest squarely against metal surfaces.
- .2 Where bolts are to be used on beveled surfaces having slopes greater than 1 in 20 with a plane normal to the bolt axis, provide beveled washers to give full bearing to the thread or nut.
- .3 Bolt threads or unfinished bolts shall be upset and non-pretensioned bolts shall be nominally tightened to prevent the nuts from backing off.
- .4 Unless noted otherwise, all high strength bolts shall be installed with full pretension using Turn-of-Nut Pretensioning, Twist-Off Type Tension Control Bolt Pretensioning, or Direct-Tension-Indicator (DTI) Pretensioning in accordance with the "Specification for Structural Joints Using High-Strength Bolts". Calibrated Wrench Pretensioning shall only be used where specifically approved by RJC.

- .5 Comply with special washer requirements of the RCSC, such as those related to slotted and oversize holes, and tapered flanges. DTI "washers" shall not be substituted for such required washers.
- .6 All high strength bolt assemblies (including Tension Control bolts and DTIs) used in pretensioned connections shall be verified in accordance with the Pre-Installation Verification section of the RCSC.
- .7 Clean and re-lubricate bolts and nuts that become dry or rusty before use, except Tension Control bolts must be re-lubricated by manufacturer.
- .8 Label and ship anchor rods and base plates in sets indicating size and locations of columns and deliver in ample time prior to the start of related concrete work. Furnish templates together with instructions for setting of anchor rods. Ascertain that anchor rods are set properly during the progress of the work.
- .9 Label and ship other embedded parts, parts with welded couplers, and the like with locations and deliver in ample time prior to the start of related concrete work. Furnish templates together with instructions for setting of embedded parts where applicable. Ascertain that embedded parts are set properly during the progress of the work.

#### 3.1.18 Welding of Structural Steel

- .1 Pre-Weld Inspection
  - .1 The surface to be welded and the filler material to be used shall be subject to inspection by quality control personnel before welding is performed.
- .2 Method and Type
  - .1 All welding indicated on the contract drawings shall be electric arc welding and shall comply in all respects with the codes and specifications herein noted covering the specifications for design, fabrication, and inspection of welded structures and the qualifications of welders and supervisors. The heat, input, length of weld, and sequence weld and cooling process shall be controlled to prevent distortions.

#### 3.1.19 Stiffeners

- .1 Provide welded stiffeners in all girders, columns, and beams at points of concentrated loads where required by S16 or where specifically shown on the drawings. Fitted stiffeners shall be ground to fit closely against bearing surfaces.
- .2 In locations of concentrated loads or bearing points shown on the drawings, these stiffeners shall be fabricated to transfer their full compressive capacity through the top and bottom flange connection

through end bearing, fabricated by CISC approved methods, or by welds where the welds are designed to transfer this load.

- 3.1.20 Remove and replace any work that is not acceptable to the Consultant, when and as directed. Such operation shall not become an extra charge to the Owner.
- 3.1.21 Where roof slopes exceed 5% and do not permit flush bearing of the steel deck on the beams, provide continuous 3 mm bent plates to the pitch and necessary to ensure full bearing of the steel deck. Coordinate with the deck supplier for the locations that will require these bent plates.

### 3.2 Cleaning and Priming

- 3.2.1 All structural steel shall have surface contamination (salts, oils, grease, drilling and cutting compounds), rust, and mill scale removed and an adequate surface profile provided in accordance with the minimum surface preparation noted in the table below.
- 3.2.2 All surface preparation should be coordinated with finishes specified by the Architect in Section 09 91 00 – Painting. Should the material data sheets require a more stringent level of surface preparation, this shall take precedence over the following minimum requirements.
- 3.2.3 Architecturally exposed structural steel (AESS) members shall be cleaned and primed when applicable in accordance and in coordination with the intumescent paint fireproofing or finished paint system procedure. Application to be coordinated with specification Section 09 91 00 – Painting and fireproofing specifications and structural documents.
- 3.2.4 Apply primers in accordance with the manufacturer's instructions.
- 3.2.5 Use paint prepared by manufacturer without thinning or adding admixtures. Execute painting on dry surfaces, free from rust, scale, or grease. Do not paint in temperatures lower than 8°C or as indicated within the paint manufacturer's specification and application procedures.
- 3.2.6 Where finish painting to parts inaccessible for finish painting after final assembly is required, apply two coats of paint during fabrication. Apply paint of two different colours so that missed areas can be detected.
- 3.2.7 Interior Structural Steel

- .1 The following structural steel shall be located completely within the building envelope.

Zone	Description	Exposure Conditions		Expected Finish (Arch to Specify)	Minimum Surface Preparation
		Conditioned Space	Condensation		
I1	Embedded in concrete, encased in masonry, or protected by membrane or non-corrosive contact type fireproofing.	Yes	No	Bare Steel	N/A



Zone	Description	Exposure Conditions		Expected Finish (Arch to Specify)	Minimum Surface Preparation
		Conditioned Space	Condensation		
I2	Enclosed in architectural finishes but not exposed to condensation.	Yes	No	1. Bare Steel 2. Primed	1. N/A 2. CISC/CMPA 1-73a 3. CISC/CMPA 2-75
I3	Exposed within building but not defined as AECS.	Yes	No	2. Primed and Painted	SP3
I3	Enclosed in architectural finishes in areas adjacent to façade that cannot be fully conditioned and could lead to condensation.	Yes	No	1. Primed 2. Primed and Painted	SP6
I4	Steel supporting members that penetrate building envelope (such as canopies, signage, etc.)	Yes / No	Yes	1. Primed and Painted 2. Galvanized	SP6
I5	Exposed in an enclosed area that is tempered or not conditioned.	No	Yes	1. Primed and Painted 2. Galvanized	SP6
I6	Interior space exposed to high humidity (such as laundry facilities, foot plants, breweries, wash areas, etc.)	Yes / No	Yes	1. Primed and Painted 2. Galvanized	SP6

- 2 Steel that will be non-intumescent paint fireproofed, zinc coated or galvanized, welded, receive shear studs, faying surfaces of slip resistant connections, and the underside of base plates and bearing plates steel shall not be primed unless specifically noted by the applied coating manufacturers specifications.

### 3.2.8 Exterior Structural Steel

Zone	Description	Expected Finish	Minimum Surface Preparation
E1	Standard exposure to exterior elements.	1. Primed and Painted 2. Galvanized	SP3
E2	Frequently exposed to fresh water. Involves condensation, splash, spray, or immersion.	1. Primed and Painted 2. Galvanized	SP6
E3	Frequently exposed to water with chlorides. Involves condensation, splash, spray, or immersion.	1. Primed and Painted 2. Galvanized	SP10

- 3.2.9 Provide the following touch-up for steel in an exterior exposure or which has a finish paint coat: After erection and after connections are completed, provide a field touch-up coat of primer to all surfaces that had no paint shop coat and have been chipped or scraped. Touch up with primer and paint all shop coat painted areas that have been chipped or scraped.

### 3.2.10 Hot Dip Galvanized Structural Steel

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- .1 When fabricating steel that is to be galvanized, it is recommended that uncoated electrodes be used wherever possible. The electrodes must still adhere to all CSA requirements referenced in previous sections.
  - .2 To ensure a high quality galvanized finish, the fabricator shall ensure that the following items are removed:
    - .1 Weld slag as well as welding flux residues
    - .2 Burrs (including those excessive rough edges derived from flame cutting)
    - .3 Heavy or probably extremely adherent type of mill scale
    - .4 Asphalt, vinyls, or epoxies
    - .5 Mill coatings like lacquers or varnishes (typically found on pipes)
    - .6 Sand, other impurities present on castings
    - .7 Thick or heavy grease or wax deposits
  - .3 The fabricator shall also avoid using the following items during the fabrication stage for steel that is to be galvanized:
    - .1 Welding rods high in silicon
    - .2 Anti-spatter sprays or materials
    - .3 Markers, crayon, or oil-based paints
  - .4 Should the fabricator desire to use the following items, they must provide a written proposal to the Structural Consultant that includes the proposed cleaning method and an approval letter from the galvanizer.
  - .5 The steel fabricator shall also be responsible for consulting each galvanizer to determine any other individual surface preparation requirements on a case-by-case basis.
  - .6 Painted materials or materials with a black lacquer coatings must first be abrasive shot blasted or wheel abraded.
  - .7 In cases where members that are galvanized are to have a secondary finish applied on top, ensure that the Architect and finish supplier are consulted about post galvanizing treatments including but not limited to surface smoothing, cleaning, preparation, and profiling.
  - .8 Provide the following touch-up for galvanized steel: After erection and after connections are completed, provide a field touch-up coat of zinc-rich paint to all surfaces that have been chipped or scraped.

**3.3     Erection**

- 3.3.1   At least 60 days prior to the commencing of steel erection, the Contractor shall hold a meeting to review the detailed requirements and staging for the steel erection. A detailed schedule should be developed with:
- .1     Construction Manager
  - .2     Steel Trades (Fabricator, Deck Contractor and Erector)
  - .3     Erector's Surveyor
  - .4     Project's Surveyor
  - .5     Concrete Contractor
  - .6     Curtain wall Contractor
  - .7     All Inspection and Testing Agencies
  - .8     Consultant
  - .9     Owner's Representative
- 3.3.2   Structural steel shall be assembled and erected in accordance with the approved erection drawings and specified reference Standards.
- 3.3.3   The erector is fully responsible for erection methods, equipment, workmanship, and safety precautions.
- 3.3.4   Confirm the setting of anchor rods and bearing plates and make an instrument survey to verify the setting prior to erection of steel members.
- .1     Column Base Plates: Column base plates shall be supported and aligned on steel shims or setting bolts. After the supported members have been plumbed and properly positioned, the anchor nuts shall be tightened in preparation for grouting. Wedges and shims shall be cut off flush with the edges of plates and shall be left in place. All base plates greater than 500 mm in any dimension shall be set on steel angle seats or shim packs.
- 3.3.5   Cutting or burning of baseplates to accommodate anchor rods shall be cause for rejection of baseplates. Costs associated with replacement or remedial work cause by field modifications of baseplates shall be covered by the steel fabricator.
- 3.3.6   The Contractor is responsible for providing all temporary bracing required to stabilize the work against wind, earthquake, and construction loads during all phases of the project. The timing of installation and removal of temporary bracing shall ensure the structure is true and plumb until completion of the building.
- 3.3.7   The Contractor shall be responsible for the design of all hooks, erection connections, and handling gear.
- 3.3.8   The Contractor shall ensure that all construction loads due to temporary storage of materials, erection equipment, or any other loads during the construction phase are adequately distributed so as to not exceed the capacity of any member.

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- 3.3.9 Proper fit up of members in compression is critical to ensure members are loaded correctly. Tolerance for joint fit up to be in accordance with CSA S16, clause 28.5 Joints in Contact Bearing.
- 3.3.10 Temporary bolts, clips, angles, etc. used to facilitate erection shall be removed unless noted otherwise on the drawings.
- .1 Splices: Fastening of splices of compression members shall be done after the abutting surfaces have been brought completely into contact. Splices will be permitted only where indicated on the contract drawings or the reviewed shop drawings.
- .2 Errors: Immediately report to the Contractor any errors in shop fabrication or deformations resulting from handling and transportation that prevent the proper assembly and fitting of parts or in the erection operation. Make suggestions for corrective work and obtain approval of the method of correction. Approved corrections shall be made expeditiously and costs shall be addressed in accordance with the terms of the Contract.
- 3.3.11 Structural steel work on concrete shall be carefully located at the proper grade and rigidly secured in place using steel shims. Spaces under the steel shall then be filled with non-shrink premix grout as soon as possible, and before placing any concrete toppings or precast concrete units.
- 3.3.12 The various members forming parts of complete frame or structure after being assembled shall be aligned and adjusted accurately before being fastened.

#### **3.4 Temporary Flooring**

- 3.4.1 Provide all temporary flooring, planking, and scaffolding necessary in connection with erection of structural steel or support of erection machinery in accordance with governing regulations and by-laws.

#### **3.5 Welding**

- 3.5.1 Welding shall be done by the shielded metal-arc method in accordance with the requirements CSA W59. The welding operators shall be currently certified under CSA W47.1 for the work they are performing.
- 3.5.2 Submit, when requested, welding procedures prepared and sealed by a Specialty Structural Engineer for review.
- 3.5.3 Surfaces to be welded shall be free from loose scale, rust, paint, or other foreign matter. Where weld material is deposited in two or more layers, each layer shall be cleaned before the next layer is deposited. Care shall be taken to minimize stresses due to heat expansion, contraction, and distortion by using proper sequence in welding and by approved methods.
- 3.5.4 Appearance, quality of welds made, and methods of correcting defective work shall be in accordance with CSA W59.
- 3.5.5 Welding of reinforcing bars to structural steel as per CSA W186.

**3.6     Completion**

- 3.6.1   The Specialty Structural Engineer responsible for the sealed shop drawings or their representative shall visit the site to review in place connections and components designed by that Specialty Structural Engineer to ensure substantial compliance with their sealed shop drawings. They shall then submit a sealed and signed letter of substantial compliance to the Consultant and Structural Engineer.
- 3.6.2   On completion of the work of this section, all protection erected in conjunction with the structural steel work shall be removed, all damage to this work and adjoining work shall be made good, and all surplus materials and debris and all tools, plant, and equipment shall be removed from the site.

**End of Section**

## 1.0 **GENERAL**

### 1.1 **Documents**

- 1.1.1 This Section, along with the Drawings, forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- 1.1.2 Drawings include architectural, mechanical, and electrical Drawings.
- 1.1.3 For definitions of Categories AESS 1, 2, 3, 4, and C as listed in AESS Matrix (see Table 1), refer to CISC Code of Standard Practice Appendix I.

### 1.2 **Description of Work Included**

- 1.2.1 This Section includes requirements regarding appearance and surface preparation of Architecturally Exposed Structural Steel (AESS) only. Refer to Section 05 12 00 for all other requirements regarding steel work not included in this Section. This Section applies to members noted on Architectural and Structural drawings as AESS. AESS members must also be identified by their category.

### 1.3 **Related Work Specified Elsewhere**

- 1.3.1 Section 05 00 50 – Testing of Structural Steel
- 1.3.2 Section 05 12 00 – Structural Steel Framing
- 1.3.3 Section 05 31 00 – Steel Decking
- 1.3.4 Section 09 91 23 – Painting

### 1.4 **Reference Standards**

- 1.4.1 Architecturally exposed structural steel shall conform to requirements of the following Standards unless otherwise required by the Specification:
  - .1 CISC Code of Standard Practice, Appendix I – Latest Edition
- 1.4.2 Where the Standard is referenced in this Specification, it means documents specified in this clause and their referenced Standards.

### 1.5 **Definitions - For This Section**

- 1.5.1 “Owner”, “Contractor”, and “Consultant” per the General Conditions and Definitions.
- 1.5.2 “Structural Engineer” means a representative of Read Jones Christoffersen Ltd., herein also referred to as RJC.
- 1.5.3 “Specialty Engineer” is a Professional Engineer registered in Ontario responsible for components designed by Contractor and who seals and signs shop drawings.
- 1.5.4 “Testing Agency” means the testing agency responsible to Owner.

- 1.5.5 “Standard” and “Standards” mean reference standards listed under “Reference Standards” in this Section.

**1.6 Qualifications**

- 1.6.1 Fabricator Qualifications: In addition to those qualifications listed in Section 05 12 00, engage a firm experienced in fabricating AESS similar to that indicated for this Project with a record of successful in-service performance, as well as sufficient production capacity to fabricate AESS (without delaying the Work).
- 1.6.2 Erector Qualifications: In addition to those qualifications listed in Section 05 12 00, engage an experienced Erector who has completed AESS work similar in material, design, and extent to that indicted for this Project and with a record of successful in-service performance.
- 1.6.3 Comply with applicable provisions of following Specifications and Documents:
- .1 CISC “Code of Standard Practice,” as amended herein.

**1.7 Examinations**

- 1.7.1 Take dimensions from Drawings and verify by field measurement. Be responsible for correctness of such measurements and report to Consultant and Structural Engineer in writing of discrepancies between field measurements and those shown on Drawings prior to commencing work. Verify location of anchor bolts and embedded steel, and confirm that work prepared by other trades is at proper elevation, on line, level, and true.

**1.8 Submittals**

- 1.8.1 Product Data for each type of product specified.
- 1.8.2 Submit, before starting work, qualification data for firms and persons to demonstrate their capabilities and experience. Include lists of completed projects names and address, names and addresses of Consultants and owners, and other information specified. For each project referenced, submit photographs showing detail of installed AESS.
- 1.8.3 Submit, before starting work, LEED supporting documentation in accordance with Division 01 LEED requirements for approval by Consultant.
- 1.8.4 Submit components/procedures of paint system for AESS as a single coordinated submittal. As minimum, identify required surface preparation, primer, intermediate coat (if applicable), and finish coat. All items shall be coordinated with finish coat specified in Section 09 91 23.
- 1.8.5 Submit, before starting work, detailed quality control (QC) plan to Consultant for shop and field work.
- 1.8.6 Submit, before starting work, detailed quality control (QC) plan to aid with inspection and approvals process and include:

- .1 A fabrication plan with completion of fabrication, delivery, and erection dates.
  - .2 A review form that includes for QC sign off by Consultant to clearly communicate remedial work required and or approval of each item.
  - .3 Provide revisions to dates in writing three days prior to milestones noted in plan to allow QC team to react accordingly.
- 1.8.7 Submit unit pricing breakdown matrix for the following items, which can be used as a reference in event that revisions are made to engineering drawings after tender close.
- .1 Welds by type utilized in shop drawings (time, cost, etc.)
  - .2 Member preparation (in-shop preparation required to produce required visual appearance of each member).

## **1.9 Shop Drawings**

- 1.9.1 Shop Drawings detailing fabrication of AESS components.
- .1 Provide erection drawings clearly indicating which members and connections are considered as AESS members, their category, and any associated preparation or finish requirements.
- 1.9.2 Include details that clearly identify requirements listed in Articles 3.1 “Fabrication” and 3.2.3 “Priming: Immediately after surface preparation, apply primer according to manufacturer’s instructions to provide dry film thickness of not less than 0.038 mm. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
- .1 Stripe paint corners, crevices, bolts, welds, and sharp edges.
  - .2 Apply two coats of shop primer to surfaces that are inaccessible after assembly or erection.
- 1.9.3 Hot-Dip Galvanized Finish: Apply zinc coating by hot-dip process to AESS indicated for galvanizing according to CSA G164. Fabricate such that connections of assemblies are made in field with bolted connections. Provide galvanized finish on members and assemblies within range of colour and surface textures presented in visual samples where applicable.
- 1.9.4 Erection” of this Section. Provide connections for exposed AESS consistent with concepts shown on architectural or structural drawings.
- .1 Indicate welds by standard CWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Identify grinding, finish, and profile of welds as defined herein.
  - .2 Indicate where caulking or body filler will be utilized to provide visually continuous welds.
  - .3 Indicate type, size, finish, and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tensioned shear/bearing connections. Indicate to which side of connection bolt heads should be oriented.



- .4 Clearly indicate which surfaces or edges are exposed and what class of surface preparation is being used.
- .5 Indicate special tolerances and erection requirements as noted on Drawings or defined herein.

#### **1.10 Quality Assurance**

1.10.1 At least four weeks prior to commencing fabrication of any AESS, submit required samples (as defined below) for Consultant review and approval to demonstrate aesthetic effects as well as quality of material and execution.

1.10.2 Samples required shall be defined by Architect and can be in the form of:

- .1 3-D Renderings
  - .1 3-D renderings shall be prepared to scale and developed by fabricators manufacturing software utilized in production process.
- .2 Mock-Up Models of Structural Framing
  - .1 Mock-ups shall be constructed using exact materials and finishes as indicated in construction documents.
  - .2 Mock-ups shall be fabricated to full scale unless Consultant accepts smaller scale models.
  - .3 Viewing of mock-up shall take place at either project site or fabricator's shop as dictated by Architect.
  - .4 Retain and maintain mock-ups in an undisturbed condition until project is completed as a standard for judging completed work.
  - .5 Approved full-scale mock-ups may become part of completed work upon completion and approval of components similar to mock-up.
- .3 Physical samples of surface preparation and welds.
- .4 Site trips to projects of a similar nature completed by Contractor.
- .5 Other forms as dictated by Architect.

1.10.3 Demonstrate proposed range of aesthetic effects regarding each element listed under fabrication heading below.

1.10.4 Architect's approval of each mock-up is required before starting fabrication of similar final units. Notify Consultants one week in advance of dates and times when mock-ups will be available for review.

1.10.5 Fabricator shall allow for additional time required for rework associated with imperfections as noted in QC plan.

- 1.10.6 At least two weeks prior to delivery of AESS to site, schedule and conduct pre-installation meeting at project site. As minimum, meeting shall include Contractor, fabricator, erector, finish-painting subcontractor, and Consultant. Coordinate requirements for shipping, special handling, attachment of safety cables and temporary erection bracing, touch-up painting, and other requirements for AESS.

**1.11 Testing and Field Review**

- 1.11.1 Owner will engage an independent testing and inspecting agency to perform field inspections and tests and to prepare test reports. Refer to Section 05 12 00 for detailed testing requirements.

**1.12 Storage and Handling**

- 1.12.1 Contractor shall be responsible for proper scheduling of delivery and erection of AESS in accordance with construction schedule.
- 1.12.2 Store materials properly to prevent damage and permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration. Use special care in handling to prevent twisting or warping of AESS members.
- 1.12.3 Handle, ship, and erect pre-painted finish pieces using padded slings or other methods, so they are not damaged. Provide padding as required to protect while rigging and aligning member's frames.
- 1.12.4 During handling, steel fabricator shall ensure members are not lifted or supported in ways that warp or twist members.
- 1.12.5 Remove field welding aids by grinding and blending as required to meet visual requirements.
- 1.12.6 Provide connections for temporary bracing, shoring, and safety cabling in locations that shall only be concealed from view in completed structure or where approved by Consultant. Methods of removing temporary erection devices and finishing AESS members shall be approved by Consultant prior to erection.
- 1.12.7 Erector shall check all AESS members upon delivery for twists, kinks, gouges, or other imperfections that might result in rejection of appearance of member. Coordinate remedial action with fabricator prior to erecting damaged steel.

**1.13 Coordination with Other Trades**

- 1.13.1 Supply necessary instructions and drawings to other trades for setting bearing plates, anchor bolts, and other members that are built in with work of other trades. Provide punched holes for convenience of other trades in attaching wood blocking or other materials. Coordinate with drawings of other disciplines for locations and details. Supply necessary material in accordance with construction schedule.

## 2.0 PRODUCTS

### 2.1 Materials

- 2.1.1 Unless noted otherwise, materials shall meet requirements in Division 5 Section Structural Steel.
- 2.1.2 High-Strength Bolts, Nuts, and Washers: Per Section 05 12 00, heavy hex heads and nuts. Provide standard carbon steel or cadmium-plated or mechanically galvanized finish as indicated on Drawings.
- 2.1.3 Primer: Fabricator's standard alkyd red oxide, rust-inhibiting primer.
- 2.1.4 Primer: Fast curing, universal modified alkyd, rust-inhibiting shop coat with good resistance to normal atmospheric corrosion. Primer shall comply with federal standards for VOC, lead, and chromate levels.
- 2.1.5 Primer: Acrylic water-soluble shop coat with good resistance to normal atmospheric corrosion. Primer shall comply with federal standards for VOC, lead, and chromate levels.
- 2.1.6 Primer: Fast-curing two-part epoxy. Primer shall comply with all federal standards for VOC, lead, and chromate levels.
- 2.1.7 Primer: Organic, epoxy/zinc-rich, meeting class B surface requirements for slip-critical connections. Primer shall comply with federal standards for VOC, lead, and chromate levels.
- 2.1.8 Primer: Inorganic zinc-rich meeting class B surface requirements for slip-critical connections. Primer shall comply with federal standards for VOC, lead, and chromate levels.
- 2.1.9 Galvanizing Repair Paint: High-zinc-dust-content paint for galvanizing welds and repair-painting galvanized steel, with dry-film coating not less than 90% zinc dust by weight.

### 2.2 Design

- 2.2.1 Unless noted otherwise, noted connections shall meet requirements in Division 5 Section Structural Steel.
- 2.2.2 Bolted connections shall have bolt heads aligned as indicated on approved shop erection drawings.
- 2.2.3 Weld connections shall have appearance and quality consistent with category and visual samples as applicable. Assemble and weld built-up sections by methods that will maintain alignment of members without warp exceeding tolerance of this Section.
- 2.2.4 Obtain Consultant's approval for appearance of welds in repaired or field modified work.

### 3.0 **EXECUTION**

#### 3.1 **Fabrication**

- 3.1.1 For special fabrication characteristic, see Table 1 - AESS Category Matrix.
- 3.1.2 Fabricate and assemble AESS in shop to greatest extent possible. Locate field joints in AESS assemblies at concealed locations or as approved by Consultant. Detail AESS assemblies to minimize field handling and expedite erection.
- 3.1.3 Fabricate AESS with surface quality consistent with AESS category and visual samples where applicable. Use special care in handling and shipping of AESS both before and after shop painting.
- 3.1.4 Splice members only where indicated on approved shop drawings or as agreed upon with written consent from Consultant.
- 3.1.5 In addition to special care used to handle and fabricate AESS, employ following fabrication techniques:
  - .1 Fabrication Tolerance: Fabricate steel to one-half normal tolerance as specified in CISC Code of Standard Practice Section 7.
  - .2 Welds Ground Smooth: Fabricator shall grind welds of AESS smooth. For groove welds, weld shall be made flush to surfaces each side and be within +1.5 mm, -0 mm of plate thickness.
  - .3 Contouring and Blending of Welds: Where fillet welds are indicated to be ground-contoured or blended, oversize welds as required and grind to provide smooth transition and to match profile on approved mock-up.
  - .4 Continuous Welds: Where welding is noted on Drawings, provide continuous welds of uniform size and profile.
  - .5 Minimize Weld Show-Through: At locations where welding on far side of exposed connection occurs, grind distortion and marking of steel to smooth profile with adjacent material.
  - .6 Close weld access holes.
  - .7 Coping and Blocking Tolerance: Maintain uniform gap of 3 mm  $\pm$  0.7 mm at all copes and blocks.
  - .8 Joint Gap Tolerance: Maintain uniform gap of 3 mm  $\pm$  0.7 mm.
  - .9 Piece Marks Hidden: Fabricate so piece marks are fully hidden in final structure or made with such media to permit full removal after erection.
  - .10 Mill Mark Removal: Fabricator shall deliver steel with no mill marks (stenciled, stamped, raised, etc.) in exposed locations. Mill marks shall be omitted by cutting of mill material to appropriate lengths where possible. Where not possible, fabricator can fill and/or grind to surface finish consistent with approved mock-up.

- .11 Grinding of Sheared Edges: Fabricator shall grind edges of sheared, punched, or flame-cut steel to match approved mock-up.
- .12 Rolled Members: Member specified to be rolled to final curved shape shall be fully shaped in shop and tied during shipping to prevent stress relieving. Distortion of web or stem, and of outstanding flanges or legs of angles, shall be visibly acceptable to Consultant from a distance of 6 m under any lighting condition determined by Consultant. Tolerances for vertical and horizontal walls of rectangular HSS members after rolling shall be specified dimension  $\pm 13$  mm.
- .13 Seal weld open ends of round and rectangular hollow structural section with 9.5 mm closure plates. Provide continuous, sealed welds at angle to gusset-plate connections and similar locations where AECS is exposed to weather.

### **3.2 Surface Preparation, Shop Priming, and Finishing**

- 3.2.1 Surface Preparation: Clean surfaces to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Prepare surfaces according to SSPC Specifications as follows:
  - .1 SSPC-SP 1 "Solvent Cleaning"
  - .2 SSPC-SP 2 "Hand Tool Cleaning"
  - .3 SSPC-SP 3 "Power Tool Cleaning"
  - .4 SSPC-SP 6 "Commercial Blast Cleaning"
  - .5 Coordinate required blast profile with approved paint submittal prior to beginning surface preparation.
- 3.2.2 Shop-prime steel surfaces, except the following:
  - .1 Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to depth of 50 mm.
  - .2 Surfaces to be field welded.
  - .3 Surfaces to be high strength bolted with slip critical connections, if primer does not meet specified CISC slip coefficient.
- 3.2.3 Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions to provide dry film thickness of not less than 0.038 mm. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
  - .1 Stripe paint corners, crevices, bolts, welds, and sharp edges.
  - .2 Apply two coats of shop primer to surfaces that are inaccessible after assembly or erection.

- 3.2.4 Hot-Dip Galvanized Finish: Apply zinc coating by hot-dip process to AESS indicated for galvanizing according to CSA G164. Fabricate such that connections of assemblies are made in field with bolted connections. Provide galvanized finish on members and assemblies within range of colour and surface textures presented in visual samples where applicable.

### **3.3 Erection**

- 3.3.1 Obtain permission for torch cutting or field fabrication from Consultant. Finish sections thermally cut during erection to surface appearance consistent with visual samples as applicable.
- 3.3.2 Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts. Replace connection plates that are misaligned where holes cannot be aligned with acceptable final appearance.
- 3.3.3 Where access holes must be cut in web at intersection with flanges on W shapes and structural tees to permit field welding of flanges, they shall be filled. Filling shall be executed with proper procedures to minimize restraint and address thermal stresses in group 4 and 5 shapes.
- 3.3.4 Set AESS accurately in locations and to elevations indicated according to CSA S16 and as referenced in this Section.
- 3.3.5 In addition to special care used to handle and erect AESS, employ following erection techniques to meet requirements of this specified AESS category:
- .1 AESS Erection Tolerances: Erection tolerances shall meet requirements of standard frame tolerances for structural steel per Chapter 7 of CISC Code of Standard Practice.
  - .2 Welds Ground Smooth: Erector shall grind welds smooth in connections of AESS members. For groove welds, weld shall be made flush to surfaces of each side and be within + 1.5 mm, -0 mm of plate thickness.
  - .3 Contouring and Blending of Welds: Where fillet welds are indicated to be ground-contoured or blended, oversize welds as required; grind to provide smooth transition and to match profile on approved mock-up.
  - .4 Continuous Welds: Where noted on Drawings, provide continuous welds of uniform size and profile.
  - .5 Minimize Weld Show-Through: At locations where welding on far side of exposed connection occurs, grind distortion and marking of steel to smooth profile with adjacent material.
  - .6 Bolt Head Orientation: Orient bolt heads as indicated on Contract Documents. Where bolt-head alignment is specified, orientation shall be noted for each connection on erection drawings. Where not noted, bolt heads in a given connection shall be oriented to one side.

- .7 Removal of Field Connection Aids: Run-out tabs, erection bolts, and other steel members added to connections to allow for alignment, fit-up, and welding in field shall be removed from structure. Field groove welds shall be selected to eliminate need for backing bars or to permit their removal after welding. Remove welds at run-out tabs to match adjacent surfaces and ground smooth. Holes for erection bolts shall be plug welded and ground smooth.

**3.4 Welding**

- 3.4.1 Weld appearance (profile, quality, and finish) shall be consistent with category and visual markups, as applicable, approved prior to fabrication.

**3.5 Adjusting and Cleaning**

- 3.5.1 Cleaning and touch-up painting of field welds, bolted connections, and abraded areas of shop paint shall be finished to blend with adjacent surfaces of AESS. Such touch-up work shall be done in accordance with manufacturer's instructions as specified in Section 09 91 00.
- 3.5.2 Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

Table 1 – AECS Category Matrix

	Category	AECS C	AECS4	AECS 3	AECS 2	AECS1	SSS
		Custom Elements	Showcase Elements	Feature Elements	Feature Elements	Basic Elements	Standard Structural Steel
Id	Characteristics			Viewed at a Distance $\leq 6$ m	Viewed at a Distance $>6$ m		CSA S16
1.1	Surface Preparation to SSPC-SP 6		✓	✓	✓	✓	
1.2	Sharp edges ground smooth		✓	✓	✓	✓	
1.3	Continuous weld appearance		✓	✓	✓	✓	
1.4	Standard structural bolts		✓	✓	✓	✓	
1.5	Weld spatters removed		✓	✓	✓	✓	
2.1	Visual Samples		Optional	Optional	Optional		
2.2	One-half standard fabrication tolerances		✓	✓	✓		
2.3	Fabrication marks not apparent		✓	✓	✓		
2.4	Welds uniform and smooth		✓	✓	✓		
3.1	Mill marks removed		✓	✓			
3.2	Butt and plug welds ground smooth and filled		✓	✓			
3.3	HSS weld seam oriented for reduced visibility		✓	✓			
3.4	Cross sectional abutting surface aligned		✓	✓			
3.5	Joint gap tolerances minimized		✓	✓			
3.6	All welded connections		Optional	Optional			
4.1	HSS seam not apparent		✓				
4.2	Welds contoured and blended		✓				
4.3	Surfaces filled and sanded		✓				
4.4	Weld show-through minimized		✓				



**NOTES**

- 1.1 Prior to blast cleaning, remove deposits of grease or oil by solvent cleaning, SSPC-SP 1.
- 1.2 Rough surfaces are to be deburred and ground smooth. Sharp edges resulting from flame cutting, grinding, and especially shearing are to be softened.
- 1.3 Intermittent welds are made continuous, either with additional welding, caulking, or body filler. For corrosive environments, joints should be seal welded. Seams of hollow structural sections shall be acceptable as produced.
- 1.4 Bolt heads in connections shall be on same side, as specified, and consistent from one connection to another.
- 1.5 Remove weld spatter, slivers, and surface discontinuities. Weld projection up to 2 mm is acceptable for butt and plug-welded joints.
- 2.1 Visual samples are either a 3-D rendering, physical sample, first-off inspection, scaled mock-up, or full-scale mock-up as specified in Contract Documents.
- 2.2 These tolerances are required to be one-half of those of standard structural steel as specified in CSA S16.
- 2.3 Members marked with specific numbers during fabrication and erection processes are not to be visible.
- 2.4 Welds should be uniform and smooth, indicating a higher level of quality control in welding process.
- 3.1 Mill marks are not to be visible in finished product.
- 3.2 Caulking or body filler is acceptable.
- 3.3 Seams shall be oriented away from view or as indicated in Contract Documents.
- 3.4 Matching of abutting cross-sections shall be required.
- 3.5 Characteristic is similar to 2.2 above. Clear distance of 3 mm between abutting members is required.
- 3.6 Hidden bolts may be considered.
- 4.1 HSS seams shall be treated so they are not apparent.
- 4.2 In addition to a contoured and blended appearance, welded transitions between members are also required to be contoured and blended.
- 4.3 Steel surface imperfections should be filled and sanded.
- 4.4 Back face of welded element caused by welding process can be minimized by hand grinding backside of weld. Degree of weld-through is a function of weld size and material.
- 4.5 Additional characteristics may be added for custom elements.

**End of Section**

## 1.0 **GENERAL**

### 1.1 **Documents**

- 1.1.1 This Section, along with the Drawings, forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- 1.1.2 Drawings include architectural, mechanical, and electrical Drawings.

### 1.2 **Description of Work Included**

- 1.2.1 Provide labour, materials, equipment, and services to supply, design, and erect open web steel joists required and/or indicated on Drawings or specified herein. Report discrepancies between structural, mechanical, electrical, and architectural Drawings to Consultant and Structural Engineer immediately.
- 1.2.2 Co-ordinate with Section 05 12 00 for design, fabrication, supply, installation, and erection of structural steel and accessories.
- 1.2.3 Co-ordinate with Section 05 31 00 for design, supply, and installation of headed stud shear connectors for composite beams and girders, and where required on other beams, girders, and drag struts.

### 1.3 **Reference Standards**

- 1.3.1 Structural steel shall conform to requirements of following Building Code and Standards unless otherwise required by this Specification:
  - .1 Ontario Building Code - 2012 0 REG 88/19
  - .2 CSA S16 – Design of Steel Structures
  - .3 CSA S136 – North American Specification for the Design of Cold-Formed Steel Structural Members
  - .4 CSA W47.1 – Certification of Companies for Fusion Welding of Steel Structures
  - .5 CSA W59 – Welded Steel Construction (Metal Arc Welding) (Metric version)
  - .6 CSA G40.20/G40.21 – General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel
  - .7 CSA G30.18 – Carbon Steel Bars for Concrete Reinforcement
  - .8 ASTM F1554 – Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
  - .9 ASTM A193/A193M – Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

- .10 ASTM F3125/F3125M – Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength
- .11 CISC / CPMA Standard 1-73a – A Quick-Drying One-Coat Paint for Use on Structural Steel.
- .12 SSPC SP-6 – Commercial Blast Cleaning
- 1.3.2 Revision date of referenced codes, standards, and guidelines shall be as indicated in the above-referenced Building Code. Where no reference is made within the Building Code, the latest published edition shall be used.
- 1.3.3 Where the Standard is referenced in this Specification, it means documents specified in this clause and their referenced Standards.
- 1.3.4 Where there are differences between the Specifications and Drawings and the codes, standards, or acts, the most stringent shall govern.

#### **1.4 Definitions - For This Section**

- 1.4.1 “Owner”, “Contractor”, and “Consultant” per the General Conditions and Definitions.
- 1.4.2 “Structural Engineer” means a representative of Read Jones Christoffersen Ltd., herein also referred to as RJC.
- 1.4.3 “Specialty Engineer” is a Professional Engineer registered in Ontario responsible for components designed by Contractor and who seals and signs shop drawings.
- 1.4.4 “Testing Agency” means the testing agency responsible to Owner.
- 1.4.5 “Standard” and “Standards” mean reference standards listed under “Reference Standards” in this Section.

#### **1.5 Qualifications**

- 1.5.1 Open web steel joist fabricator shall have minimum five years experience in fabrication of open web steel joists.
- 1.5.2 Erector shall have minimum five years experience in erection of open web steel joists.
- 1.5.3 Steel fabricators and erectors must be certified under requirements of CSA W47.1 as required by CSA S16.
- 1.5.4 Welding procedures, welders, and welding operations to be qualified in accordance with Canadian Welding Bureau Standards.

**1.6 Examinations**

- 1.6.1 Take dimensions from Drawings and verify by field measurement. Be responsible for correctness of such measurements and report to Consultant and Structural Engineer in writing of discrepancies between field measurements and those shown on Drawings prior to commencing work. Verify location of embedded steel and confirm that work prepared by other trades is at proper elevation, on line, level, and true.

**1.7 Submittals**

- 1.7.1 Submit, before starting work, written evidence of qualification of steel fabricators and erectors for welding under Canadian Welding Bureau requirements.
- 1.7.2 Submit, before starting work, written evidence of ability to weld reinforcing steel to structural steel in accordance with CSA W186.
- 1.7.3 When requested, submit copies of mill test reports properly correlated to materials used on project.
- 1.7.4 Suppliers shall provide an embodied carbon breakdown for all structural steel utilized in the project for review and approval:
- .1 The breakdown shall be provided prior to or during the ordering material indicating the total embodied carbon (kg CO<sub>2</sub>e).
  - .2 The breakdown shall also be provided at the end of the project with the values updated to reflect the final as-built quantities and resulting embodied carbon (kg CO<sub>2</sub>e).
  - .3 The breakdown shall be a tabular submittal showing all members, materials, quantities and embodied carbon based on accompanying EPDs as outlined below.
  - .4 Refer to Division 1 for the maximum allowable upfront (A1-A3) kgs of embodied carbon.
  - .5 The maximum embodied carbon for the steel joists shall not exceed 840 kg CO<sub>2</sub>e / tonne unless approved by the Consultant.
  - .6 Submit Environmental Product Declarations (EPDs) compliant with CSA-ISO 14025-07.
  - .7 Product EPDs must be third party certified, including external verification.
- 1.7.5 Alternatively with written approval producers may submit an industry average EPD in which the manufacturer is explicitly recognized as a participant by the program operator.
- 1.7.6 Submit third party certified documentation identifying products that demonstrate item 1 and as many of the remaining items as possible:
- .1 global warming Potential (greenhouse gases), CO<sub>2</sub>e;
  - .2 depletion of the stratospheric ozone layer, in kg CFC -11;
  - .3 acidification of land and water sources, in moles H<sup>+</sup> or kg SO<sub>2</sub>;

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- .4 eutrophication, in kg nitrogen or kg phosphate;
  - .5 formation of tropospheric ozone, in kg NO<sub>x</sub>, kg O<sub>3</sub>, or kg ethane;  
and
  - .6 depletion of non-renewable energy resources, in MJ.
- 1.7.7 Submit documentation of recycled content of the metal deck. A breakdown of post-consumer and post-industrial recycled content should be specified. A mill certificate shall be provided.
  - 1.7.8 Submit documentation of where the steel joists were produced, processed, and manufactured.
  - 1.7.9 Provide schedule of fabrication to Consultant, Structural Engineer, and Testing Agency prior to commencement of fabrication.
  - 1.7.10 Notify Consultant and Structural Engineer, in writing and before submission of shop drawings, as to which Specialty Structural Engineer will be designing and providing field review for components designed by Contractor.
  - 1.7.11 Submit shop drawings prepared under direction of Specialty Structural Engineer. Drawings of open web steel joists are to be sealed and signed by this Specialty Structural Engineer.
  - 1.7.12 Shop drawings to show complete shop and erection details necessary for fabrication and erection of joists, including connections, splices, and location, type, size, and extent of welds. Splices not shown on shop drawings will be rejected. Indicate welds, both shop and field, by AWS Welding Symbols as specified in CSA W59 Appendix D and E.
  - 1.7.13 Review of shop drawings by Structural Engineer is intended as an assistance to Contractor and does not relieve Contractor of responsibility for completeness or accuracy of work and its conformance to contract documents.
  - 1.7.14 Fabrication that commences prior to shop drawing review by Structural Engineer is at risk of Contractor.
  - 1.7.15 Clearly identify revisions, changes, or modifications on shop drawing.
  - 1.7.16 Resubmit reviewed shop drawings where noted in Read Jones Christoffersen Ltd.'s review stamp, or when Contractor makes revisions for own purposes.
  - 1.7.17 Allow at least two weeks for shop drawing review by Structural Engineer.
  - 1.7.18 Structural drawings are not prepared to be used as erection or shop drawings. However, electronic files or sepias can be used by Contractor under the following conditions:
    - .1 Copyright remains with Read Jones Christoffersen Ltd.
    - .2 Drawings will only be used for shop drawings for this project and not put to any other use.
    - .3 Read Jones Christoffersen Ltd. assumes no liability for errors or omissions in drawings. Contractor assumes all risk and expenses
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associated with use of structural drawings in production of their work.

.4 References to Read Jones Christoffersen Ltd. must be deleted from title block.

.5 Contractor signs a release available from Read Jones Christoffersen Ltd. that addresses the above items in more detail.

## **1.8 Testing and Field Review**

1.8.1 See Section 05 00 50.

1.8.2 Prior to commencement of work, provide schedule of shop fabrication to Testing Agency.

1.8.3 If requested, submit certified mill tests in accordance with the Standards.

1.8.4 Advise Testing Agency of scheduling of all shop and field work pertaining to this Project. Permit testing agency full access to fabrication shop and site for purpose of carrying out their work and provide assistance required to aid in performance of inspection and testing.

## **1.9 Storage and Handling**

1.9.1 Protect joists during fabrication, shipping, storage, and construction. Handle steel joists at job site in a manner that prevents bending or damage of joist. Report small bends and damage to Structural Engineer for instructions. Do not use damaged joists. Replace or repair joists that are bent, broken, or otherwise damaged prior to erection, to satisfaction of Structural Engineer, and at no cost to Owner.

1.9.2 Co-ordinate proper scheduling for delivery and erection of joists in accordance with construction schedule.

1.9.3 Store joists at site above ground on platforms, skids, or other devices so that ground dampness will not affect bottom members of stacks. Do not stack joists to a height that will cause bending in bottom members.

1.9.4 Protect joists that are stored outdoors after fabrication from accumulations of standing water.

1.9.5 Store other materials in a weather tight and dry place until ready for use in Work.

1.9.6 Store packaged materials in their original unbroken packages or containers.

## **1.10 Coordination with Other Trades**

1.10.1 Provide punched holes for convenience of other trades in attaching wood blocking or other materials. Coordinate with drawings of other disciplines for locations and details. Supply necessary material in accordance with construction schedule.

**2.0 PRODUCTS****2.1 Materials**

- 2.1.1 Steel shall be new unless otherwise indicated and be of sizes and shapes listed in current CISC Handbook or AISC Handbook and as indicated on Drawings.
- 2.1.2 Steel to be to CSA G40.21.
- 2.1.3 Steel to be fabricated open-web steel joists and joist girders, 7800 kg/m<sup>3</sup>, produced by Nucor.
- 2.1.4 Primer for interior exposure not to receive a shop or field paint finish is to be to CISC/CPMA Standard 1-73a or other pre-approved, unless noted otherwise.
- 2.1.5 Primer used in multi-coat system where final shop or field paint finish is to be applied is to conform to Section 09 91 00 and be selected and pre-approved based on surface preparation, exposure conditions, and compatibility with subsequent coatings, unless noted otherwise.
- 2.1.6 Welding consumables for processes to be fully approved by Canadian Welding Bureau and certified by manufacturers as complying with requirements of this specification. Such certificates must be less than two years old.
- 2.1.7 Electrode strengths to be equal to E49XX (E70XX) or better.

**2.2 Design**

- 2.2.1 Unless otherwise noted, open web steel joists are to be designed by Contractor to reference Standards by Specialty Structural Engineer.
- 2.2.2 Open web steel joists spliced for ease of fabrication or transportation to have splices designed to develop full strength and stiffness of member. Splices are subject to non-destructive testing as directed by Structural Engineer. Cost for such testing to be borne by Contractor.
- 2.2.3 Provide separators for double members in accordance with CSA S16.
- 2.2.4 Design of bridging for steel joists to conform to requirements of CSA S16, unless otherwise indicated on Drawings. Refer to Drawings for areas of non-typical joist bridging and bracing.
- 2.2.5 Design joists of depth and spacing shown on Drawings and to carry loads shown on Drawings in accordance with CSA S16.
- 2.2.6 Unless noted otherwise, joists shall be designed to meet deflection requirements noted below.

**.1 Roof Joists**

Application	Loading	Limit	Max
Supporting finishes not susceptible to cracking	LL	Span / 300	25 mm
	Total	Span / 180	35 mm
Supporting finishes susceptible to cracking	LL	Span / 360	20 mm
	Total	Span / 240	30 mm

- 
- 2.2.7 If joists support green roof, solar panels, or similar loads, they shall be considered as dead load for purposes of calculating deflection.
  - 2.2.8 Line up openings and webs in adjacent to allow for passage of pipe, ducts, conduits, etc. Make allowance in joist design for support of pipes, ducts, conduits, etc.
  - 2.2.9 Upon request by Consultant or Authority Having Jurisdiction, submit calculations and such further proof as may be necessary to show that steel joist construction conforms to requirements set forth herein, as well as municipal building bylaws.
  - 2.2.10 Joist manufacturer may be required, at Structural Engineer's and Consultant's option, to demonstrate by testing or analysis, which includes effects of actual joint eccentricities, that joists provided have capacity to resist loads specified.
  - 2.2.11 In addition to point loads called for in governing building code, design joists for a 1.8 kN (0.4 kip) factored additional point load at any location on top chord and bottom chord (including effects of local bending) concurrent with other design loads. Over mechanical areas, additional point loads to be 4.5 kN (1.0 kip) factored. Additional point loads noted above on each chord need not be applied concurrently with each other.
  - 2.2.12 Joists shoes shall be designed for minimum roll over force of 4.5 kN (1.0 kip) and shall be connected to base structure for this force unless noted otherwise.
  - 2.2.13 Where joists frame into both sides of a support, extend top chord of joists to center of support, unless shown otherwise.
  - 2.2.14 Where joists frame into one side of a support, extend top chord of joists to far side of support, unless shown otherwise.
  - 2.2.15 Provide extended ends of joists as required to support edges of roofs, floors, walls, and where shown.
  - 2.2.16 Extended ends of joists to have load-carrying capacity at least equal to loads shown on Drawings.
  - 2.2.17 Provide bracing as required for lateral stability of bottom chords in compression due to wind uplift, bottom chord extensions, and other effects causing compression in bottom chord.

### **3.0 EXECUTION**

#### **3.1 Fabrication**

- 3.1.1 Fabrication to conform to requirements of CSA S16 and reviewed shop drawings.
- 3.1.2 Welding to be to CSA W59.
- 3.1.3 Joist work to be executed by skilled and experienced workers.



- 3.1.4 Fabricated units to be straight, true, without sharp kinks or bends, and accurate to sizes shown.
- 3.1.5 Refer to architectural Drawings for extent and location of architecturally exposed joist elements.
- 3.1.6 Provide bridging for steel joists conforming to requirements of CSA S16, unless otherwise indicated on Drawings. Refer to Drawings for areas of non-typical joist bridging and bracing.
- 3.1.7 Remove and replace work that is not acceptable to Consultant, when and as directed. Such operation is at own expense.
- 3.1.8 Joist and other steel members spliced for ease of fabrication are to develop full strength and stiffness of member.
- 3.1.9 Where roof slopes exceed 5% and do not permit flush bearing of steel deck on joist top chords, provide continuous 3 mm bent plates to pitch as necessary for full bearing of steel deck. Co-ordinate with deck supplier for locations that will require these bent plates.

### **3.2 Cleaning and Priming**

- 3.2.1 Thoroughly clean steel of loose mill scale, loose rust, oil, or dirt.
- 3.2.2 Prime architecturally exposed joists, related framing and bridging, and exterior steel.
- 3.2.3 Do not prime joists that will be encased in concrete, fireproofed, zinc coated, galvanized, or welded.
- 3.2.4 Shop prime all other steel joists.
- 3.2.5 Clean joists that will not receive a finish paint coat and are required to be primed for interior exposure in accordance with CISC/CPMA Standard 1-73 (minimum).
- 3.2.6 Clean joists to receive a shop or field paint finish in accordance with Section 09 91 23 or SSPC-SP 6 "Commercial Blast Cleaning", whichever produces a surface that has less rust and mill scale.
- 3.2.7 Apply primers in accordance with manufacturer's instructions.
- 3.2.8 Use paint prepared by manufacturer without thinning or adding admixtures. Execute painting on dry surfaces, free from rust, scale, or grease. Do not paint in temperatures lower than 8°C.
- 3.2.9 Where finish painting to parts inaccessible for finish painting after final assembly is required, apply two coats of paint during fabrication. Apply paint of two different colours so that missed areas can be detected.
- 3.2.10 Provide following touch up for steel in an exterior exposure or which has a finish paint coat: After erection and after connections are completed, provide a field touch-up coat of primer to surfaces that had no paint shop coat and have been chipped or scraped. Touch up with primer and paint shop coat painted areas that have been chipped or scraped.

**3.3     Erection**

- 3.3.1 Erector is fully responsible for erection methods, equipment, workmanship, and safety precautions.
- 3.3.2 Install temporary bracing required to stabilize work against wind, earthquake, and construction loads. Assume complete responsibility for extent and timing of removal of such bracing. Bracing members indicated on Drawings are required for finished structure and not considered adequate for temporary bracing. Failure to make proper and adequate provision for stresses occurring during erection from any causes whatsoever is responsibility of Contractor.
- 3.3.3 As erection progresses, securely connect work to take care of loads, including wind and seismic during erection. Failure to make proper and adequate provisions for loads during erection is responsibility of Contractor.
- 3.3.4 Contractor is responsible for design of all hooks, erection connections, and handling gear.
- 3.3.5 Whenever piles of materials, erection equipment, or other loads are carried during erection, make proper provisions to take care of stresses resulting from same. Adequately distribute construction loads to not exceed capacity of any joist.
- 3.3.6 Assemble and erect joists and bridging in accordance with approved erection drawings and specified reference Standards.
- 3.3.7 Co-ordinate with mechanical and electrical trades prior to erection of steel joists so that joists and bridging will not interfere with installation of mechanical and electrical equipment.
- 3.3.8 Support joists at two or more points during handling and erection.
- 3.3.9 Steel joists are to bear on beams in accordance with article 2.2, but in no case shall less than 65 mm be on supporting steel members. Connect to supporting steel with 5 mm x 30 mm long fillet weld at each side. Secure to bearing plates on masonry walls in same manner, bearing 100 mm minimum.
- 3.3.10 Plumb, level, and align individual joists as specified in CSA S16.
- 3.3.11 Remove temporary bolts, clips, angles, etc. used to facilitate erection unless noted otherwise on drawings.

**3.4     Joist Bridging**

- 3.4.1 Install bridging for steel joists conforming to requirements of CSA S16, unless otherwise indicated on Drawings. Refer to Drawings for areas of non-typical joist bridging and bracing.
- 3.4.2 Where required for stability of bottom chord, provide additional bridging. Such stability requirement to be designed by supplier using loads provided on Drawings.

- 3.4.3 Butt splice architecturally exposed joist bridging and bracing and grind splices smooth to receive finish painting as specified in Architectural Finishes. Lap splices in architecturally exposed bridging are not permitted.

**3.5 Welding**

- 3.5.1 Welding shall be done by shielded metal-arc method in accordance with requirements CSA W59. Welding operators shall be currently certified under CSA W47.1 for work they are performing.
- 3.5.2 Submit for review, when requested, welding procedures prepared and sealed by a Specialty Structural Engineer.
- 3.5.3 Surfaces to be welded are to be free from loose scale, rust, paint, or other foreign matter. Where weld material is deposited in two or more layers, clean each layer before depositing next layer. Take care to minimize stresses due to heat expansion, contraction, and distortion by using proper sequence in welding and by approved methods.
- 3.5.4 Appearance, quality of welds made, and methods of correcting defective work are to be in accordance with CSA W59.

**End of Section**

## 1.0 **GENERAL**

### 1.1 **Documents**

- 1.1.1 This Section, along with the Drawings, forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- 1.1.2 Drawings include architectural, mechanical, and electrical Drawings.

### 1.2 **Description of Work Included**

- 1.2.1 Provide labour, materials, closures, equipment, and services necessary to design, supply, fabricate, erect, and install steel deck and field-welded shear connectors to structural steel as indicated on Drawings and as hereinafter specified. Provide gauge metal formwork at deck edges for composite deck or concrete-filled deck and reinforcement for deck openings as required herein.
- 1.2.2 Co-ordinate with Section 05 12 00 for design, fabrication, supply, installation, and erection of structural steel and accessories.

### 1.3 **Related Work Specified Elsewhere**

- 1.3.1 Section 03 11 00 – Concrete Forming and Accessories
- 1.3.2 Section 03 20 00 – Concrete Reinforcing
- 1.3.3 Section 03 30 00 – Structural Cast-in-Place Concrete
- 1.3.4 Section 05 00 50 – Testing of Structural Steel
- 1.3.5 Section 05 12 00 – Structural Steel Framing
- 1.3.6 Section 05 12 50 – Architecturally Exposed Structural Steel
- 1.3.7 Section 05 21 00 – Steel Joist Framing
- 1.3.8 Section 05 51 00 – Metal Stairs

### 1.4 **Reference Standards**

- 1.4.1 Structural steel shall conform to requirements of following Building Code and Standards unless otherwise required by this Specification:
  - .1 Ontario Building Code - 2012 0 REG 88/19
  - .2 CSA S136 – North American Specification for the Design of Cold-Formed Steel Structural Members
  - .3 CSA W47.1 – Certification of Companies for Fusion Welding of Steel Structures
  - .4 CSA W59 – Welded Steel Construction (Metal Arc Welding) (Metric version)

- .5 ASTM A653/A653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- .6 CSSBI 10M – Standard for Steel Roof Deck
- .7 CSSBI 12M – Standard for Composite Steel Deck

- 1.4.2 Revision date of referenced codes, standards, and guidelines shall be as indicated in the above-referenced Building Code. Where no reference is made within the Building Code, the latest published edition shall be used.
- 1.4.3 Where the Standard is referenced in this Specification, it means documents specified in this clause and their referenced Standards.
- 1.4.4 Where there are differences between the Specifications and Drawings and the codes, standards, or acts, the most stringent shall govern.

## **1.5 Definitions - For This Section**

- 1.5.1 “Owner”, “Contractor”, and “Consultant” per the General Conditions and Definitions.
- 1.5.2 “Structural Engineer” means a representative of Read Jones Christoffersen Ltd., herein also referred to as RJC.
- 1.5.3 “Specialty Structural Engineer” is a Professional Engineer registered in Ontario responsible for components designed by Contractor and who seals and signs shop drawings.
- 1.5.4 “Testing Agency” means the testing agency responsible to the Owner.
- 1.5.5 “Standard” and “Standards” mean reference standards listed under “Reference Standards” in this Section.

## **1.6 Qualifications**

- 1.6.1 Steel deck fabricator shall have minimum five projects experience in fabrication of steel deck and be a member of the Steel Deck Institute.
- 1.6.2 Erector shall have minimum five projects experience in erection of steel deck.
- 1.6.3 Certificates of Qualification for light gauge structural welding.
- 1.6.4 Deck erectors must be certified under requirements of CSA W47.1.

## **1.7 Examinations**

- 1.7.1 Examine and verify necessary measurements and dimensions of previously executed work that may affect work of this Contract.
- 1.7.2 Examine surfaces that work is to be placed on or against to confirm they are square, true, level, plumb, of correct slope or shape, and of proper surface to receive such work.
- 1.7.3 Report discrepancies to Consultant and Structural Engineer immediately so that instructions may be given for necessary remedial work.

- 1.7.4 Commencement of work shall be construed as acceptance of conditions and surfaces.

## **1.8 Submittals**

- 1.8.1 Submit shop drawings prepared under supervision of Specialty Structural Engineer. Drawings of components designed by Contractor shall be sealed and signed by this Specialty Structural Engineer.
- 1.8.2 Shop drawings shall show position, extent, type, and arrangement of units, their relationship to other materials, depth, core thickness, coating thickness, connections, openings, accessories, closures, light gauge formwork and reinforcement for openings, and complete stud shear connector details for composite beams.
- 1.8.3 Shop drawings for acoustic deck shall indicate reduction in strength and stiffness related to acoustic perforations.
- 1.8.4 Calculations and/or test data may be requested with shop drawings to justify deck design and shear connector design.
- 1.8.5 Show deck load capacities, including point load capacities, and for composite deck confirm these load capacities are compatible with zinc coating.
- 1.8.6 Suppliers shall provide an embodied carbon breakdown for all structural steel utilized in the project for review and approval:
- .1 The breakdown shall be provided prior to or during the ordering material indicating the total embodied carbon (kg CO<sub>2</sub>e).
  - .2 The breakdown shall also be provided at the end of the project with the values updated to reflect the final as-built quantities and resulting embodied carbon (kg CO<sub>2</sub>e).
  - .3 The breakdown shall be a tabular submittal showing all members, materials, quantities and embodied carbon based on accompanying EPDs as outlined below.
  - .4 The maximum embodied carbon for the steel joists shall not exceed 840 kg CO<sub>2</sub>e / tonne unless approved by the Consultant.
  - .5 The maximum embodied carbon for the deck shall not exceed 1740 kg CO<sub>2</sub>e / tonne unless approved by the Consultant.
- 1.8.7 Submit Environmental Product Declarations (EPDs) compliant with CSA-ISO 14025-07.
- .1 Product EPDs must be third party certified, including external verification.
- 1.8.8 Alternatively with written approval producers may submit an industry average EPD in which the manufacturer is explicitly recognized as a participant by the program operator.
- 1.8.9 Submit third party certified documentation identifying products that demonstrate item 1 and as many of the remaining items as possible:

- .1 global warming Potential (greenhouse gases), CO<sub>2</sub>e;
  - .2 depletion of the stratospheric ozone layer, in kg CFC -11;
  - .3 acidification of land and water sources, in moles H<sup>+</sup> or kg SO<sub>2</sub>;
  - .4 eutrophication, in kg nitrogen or kg phosphate;
  - .5 formation of tropospheric ozone, in kg NO<sub>x</sub>, kg O<sub>3</sub>, or kg ethane; and
  - .6 depletion of non-renewable energy resources, in MJ.
- 1.8.10 Submit documentation of recycled content of the metal deck. A breakdown of post-consumer and post-industrial recycled content should be specified. A mill certificate shall be provided.
- 1.8.11 Submit documentation of where the structural steel was produced, processed, and manufactured.

## **1.9 Testing and Field Review**

- 1.9.1 Per Section 05 00 50.

## **1.10 Storage and Handling**

- 1.10.1 Bundles of decking shall be stacked on wood blocking, clear of ground and tilted so that no water lies on material.

## **2.0 PRODUCTS**

### **2.1 General**

- 2.1.1 Products shall satisfy requirements of the Standard unless otherwise specified herein or on Drawings.

### **2.2 Materials**

- 2.2.1 Steel deck units shall be formed of zinc-coated sheet steel minimum CSSBI 10M Grade A with base steel nominal thickness of 0.76 mm or greater. Unless noted otherwise, zinc coatings for following conditions shall be:
- .1 Interior Exposure
    - .1 Floor Deck – ZF75 - Galvanneal
    - .2 Roof Deck – Z275 - Galvanized
  - .2 Exterior Exposed Deck – Z275 Galvanized.
- 2.2.2 Steel deck to be fabricated using electric arc furnace (EAF) technology, North America average, 7800 kg/<sup>3</sup>, produced by Nucor Corporation's Vulcraft Group.

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- 2.2.3 Touch-up paint for welds shall conform to CGSB –1.181 Ready-Mixed Organic Zinc Rich Coating.
  - 2.2.4 Cover plates, cell closures, etc. shall be of same material as deck with minimum nominal thickness of 0.76 mm.
  - 2.2.5 Deck shall conform to depths shown on Drawings. Deck receiving composite shear studs shall have average bottom flute width equal to twice deck depth.
  - 2.2.6 Shear stud connectors shall be Nelson headed anchors or other preapproved. Studs to be automatically end welded with suitable stud welding equipment in field. Fillet welded studs will be rejected.
  - 2.2.7 Steel deck to receive concrete topping shall be composite deck unless noted otherwise.
  - 2.2.8 Steel deck that is indicated to be painted on underside shall have factory-applied Perspectra Plus Series paint finish (ArcelorMittal Dofasco) unless otherwise specified. Painted steel deck shall be connected with mechanical fasteners that do not damage paint finish. Painted steel deck shall not be connected with welds. Painted deck to be co-ordinated with Section 05 12 50.
  - 2.2.9 Mechanical Fasteners
    - .1 At Structural Steel Support: Hilti X-ENP-19 L15, X-EDN19 THQ12, or X-EDNK22 THQ12 as recommended by manufacturer for application.
    - .2 At Structural Wood Support: 6 mm x 25 mm HHA weather-guard screws at 300 mm maximum centers at all bearing points (minimum 4 screws per sheet) for use on wood trusses.
    - .3 Deck Side Laps: No. 10 screws or Hilti S-SLC01 M HWH or S-SLC02 M HWH, as recommended by manufacturer for application, are acceptable (refer to Article 3.1 for execution).

## **2.3 Fabrication**

- 2.3.1 Composite steel deck shall be formed with integral locking lugs to provide mechanical lock between concrete and steel.
- 2.3.2 Steel deck shall have interlocking male and female side laps.
- 2.3.3 Provide cell closures where required by architectural drawings and specifications at open ends of cell runs at columns, openings, walls, etc., and where cells change direction.
- 2.3.4 For deck with concrete topping, provide necessary metal gauge formwork at deck edges for full deck and concrete depth to prevent leaking of concrete topping. This includes, but is not limited to, edges formed by building edges, openings framed by structural steel, elevator shafts, stairwells, and around webs and flanges of columns.



**2.4     Design**

- 2.4.1 Steel deck to be designed by Contractor to reference Standards and loads on Drawings unless otherwise noted.
- 2.4.2 Steel deck shall span over three or more supports unless prevented by structural steel layout.
- 2.4.3 Required deck material thickness may be greater than minimum thickness shown on Drawings.
- 2.4.4 Unless noted otherwise, metal deck shall be designed to meet deflection requirements noted below.

**.1     Floor Deck**

- .1 Support construction loading without temporary shoring and with deflection not exceeding span/180.
- .2 Deflection under live load shall be limited to span/360.

**.2     Roof Deck**

Application	Loading	Limit	Max
Supporting finishes susceptible to cracking	LL	Span / 360	10 mm
	Total	Span / 240	13 mm
Supporting finishes not susceptible to cracking	LL	Span / 300	12 mm
	Total	Span / 200	15 mm

- 2.4.5 If roof deck supports green roof, this load shall be considered a dead load for purposes of calculating deflection.
- 2.4.6 Unless noted otherwise, floor deck deflection under construction loading loads without temporary shoring shall be limited to Span/180.
- 2.4.7 Decking used as formwork shall conform to WCB formwork requirements.
- 2.4.8 Deck thickness, spacing of puddle welds or mechanical fasteners, and type and extent of side connections shall be proportioned to resist forces and loads shown on Drawings, or as designated on Drawings.
- 2.4.9 Where diaphragm loads are not shown on Drawings or where shear requirements are not provided, design of decking and its fastenings shall meet minimum diaphragm shear requirement of 5.0kN/m.
- 2.4.10 Shear stud connectors shall be designed for forces indicated on Drawings. If capacities of individual studs are reduced because of geometry of particular deck profile used, provide additional studs so that total shear transfer capacity provided is at least that indicated on Drawings.

**3.0     EXECUTION****3.1     Erection**

- 3.1.1 Erection of steel deck shall be carried out by personnel experienced in installation of steel deck.

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- 3.1.2 Obtain and verify dimensions at project site or from approved shop drawings.
  - 3.1.3 Contractor shall be solely responsible for accuracy of such measurements and precise fitting and assembly of finished product.
  - 3.1.4 Use special care in unloading, handling, and erecting deck to avoid bending, twisting, or otherwise distorting panels.
  - 3.1.5 Steel deck units shall be laid in accordance with approved shop drawings.
  - 3.1.6 At splice locations, steel decking shall be installed with sufficient laps so both pieces of deck are properly fastened to supporting member. As a minimum, over supporting members with uninterrupted top surfaces, such as W-beams and channels, lap shall be 100 mm and welds or deck fasteners shall be at or near centerline of supporting members. Over supporting members with interrupted top surfaces, such as OWSJs with double angle or hat-shaped top chords, each sheet shall extend minimum 25 mm past opposite edge of joist chord, and sheets shall lap not less than 100 mm total. In this case, welds or deck fasteners shall be centered on supporting surface nearer the end of top deck sheet. See General Notes and Typical Details for clarification.
  - 3.1.7 Metal closures and flashing shall be fastened in place by welding, sheet metal screws, or structural adhesive as recommended by decking manufacturer.
  - 3.1.8 Unless noted otherwise in Contract Documents, decking shall be fastened to structural supports and interconnected at sidelaps with minimum connection patterns:
    - .1 38 mm Deck Profiles
      - .1 Connect deck to structural support at first, third, fifth, and seventh low corrugations (36/4 connection configuration), at 300 mm (12") maximum centres, and at each side of each sheet. Connections are to be either minimum 19 mm (3/4") nominal diameter fusion weld or Hilti powder actuated fasteners Hilti X-ENP-19 L15, X-EDN19 THQ12, X-EDNK22 THQ12, or equivalent.
      - .2 Side lap connections of adjacent nested units shall be mechanically fastened (clinched) at 600 mm (24") maximum centres, welded using minimum 25 mm (1") nominal diameter fusion weld at 600 mm (24") maximum centres, or fastened with Hilti S-SLC01 M HWH, S-SLC02 M HWH, or equivalent at 900 mm (36") maximum centres.
      - .3 Discontinuous edge (side) connections shall be either a minimum 19 mm (3/4") nominal diameter fusion weld or Hilti powder actuated fasteners Hilti X-ENP-19 L15, X-EDN19 THQ12, X-EDNK22 THQ12, or equivalent spaced at 300 mm (12") centres maximum.
    - .2 76 mm Deck Profiles
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- .1 Connect deck to structural support at first, third, and fifth low corrugations (24/3 connection configuration), at 300 mm (12") maximum centres and at each side of each sheet. Connections are to be either minimum 19 mm (3/4") nominal diameter fusion weld or Hilti powder actuated fasteners Hilti X-ENP-19 L15, X-EDN19 THQ12, X-EDNK22 THQ12, or equivalent.
  - .2 Side lap connections of adjacent nested units shall be mechanically fastened (clinched) at 600 mm (24") maximum centres, welded using minimum 25 mm (1") nominal diameter fusion weld at 600 mm (24") maximum centres, or fastened with Hilti S-SLC01 M HWH, S-SLC02 M HWH, or equivalent at 900 mm (36") maximum centres.
  - .3 Discontinuous edge (side) connections shall be either minimum 19 mm (3/4") nominal diameter fusion weld or Hilti powder actuated fasteners Hilti X-ENP-19 L15, X-EDN19 THQ12, X-EDNK22 THQ12, or equivalent spaced at 300 mm (12") centres maximum.
  - .3 Powder actuated and screw fasteners are to be installed according to manufacturer's recommendations.
- 3.1.9 Mechanical fasteners may be substituted for welded fasteners as noted in this specification, provided written approval from RJC is received and is in accordance with execution requirements.
  - 3.1.10 When mechanical fasteners have been specified in Contract Documents, they may not be substituted for welded connection without written approval from RJC. Substitution of mechanical fasteners will also entail magnification of deck diaphragm design loads provided for mechanical fasteners. Provision is to be made by steel deck contractor/trade for increased design loads if a fastener substitution is desirable.
  - 3.1.11 Place steel deck on supporting steel framework and adjust to final position before permanently fastening. Bring each section to proper bearing. If supporting framework is not in proper alignment or at proper level, advise Consultant and Structural Engineer of such irregularities and do not make final placement until corrections are made.
  - 3.1.12 For steel deck that will not receive concrete topping, immediately after steel deck is welded in place, steel deck surface shall be inspected, and all areas where zinc coating has been burned by welding shall be covered by a suitable zinc enriched paint, applied to paint manufacturer's instructions.

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- 3.1.13 Cut openings in metal decking at locations shown on Drawings. These openings shall be located and dimensioned in cooperation with various trades at time of erecting steel deck. Unless noted otherwise, openings up to 150 mm (6") need not be reinforced. Openings between 150 mm (6") and 400 mm (16") in size shall be reinforced by this trade, using 75 mm x 75 mm x 5.0 mm x 1200 mm (48") steel angles welded to flutes on either side of those cut.
  - 3.1.14 Contractor shall accommodate erection and welding sequence of structural steel as required.
  - 3.1.15 Shear stud connectors to be applied in accordance with manufacturer's instructions and Standards. Procedural control to be in accordance with W59 as a minimum and tested in accordance with Section 05 00 50.
  - 3.1.16 Place studs in bottom flutes of steel deck on side closest to nearest end of beam.
  - 3.1.17 After welding studs, ceramic ferrule shall be removed and stud fillet visually inspected by operator. If fillet is less than 360° around base of stud, then stud is to be hammer tested by operator by bending stud 30° from the vertical away from side of no fillet. If weld fails, replace stud. Bent studs may be left bent.
  - 3.1.18 If studs are welded to steel plates or members with temperature below 0°C, 1 stud in each 100 is to be tested by operator by bending 30° from the vertical. This requirement is in addition to requirements of Section 05 00 50.
  - 3.1.19 No stud welding is to be done when base metal temperature is less than -15°C, when deck surface is wet, or when structural steel surface below deck is wet.
  - 3.1.20 Sound absorption insulation material shall be dry prior to installation and prior to application of roofing membrane.

### **3.2 Cover Plates and Closures**

- 3.2.1 Furnish, install, and weld in position, sheet metal cover plates to close openings between deck sections and columns and to cover gaps where deck sections abut or change direction.
- 3.2.2 For deck with concrete topping, install light gauge metal closures and edge strips necessary as formwork for concrete.
- 3.2.3 Install closures as required by architectural Drawings and Specifications.

### **3.3 Clean Up**

- 3.3.1 Clean up steel deck cuttings, strappings, packaging material, and other debris pertaining to steel deck units.
- 3.3.2 Remove debris and excess material at completion of erection of steel deck and leave work ready for other trades.

- 3.3.3 Touch up welds and other areas of damaged galvanizing with zinc rich paint.
- 3.3.4 Repair defects. Leave steel deck free of oil, grease, paint, and dirt.

**End of Section**

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the structural metal stud framing work specified herein. This includes, but is not necessarily limited, to:
  - .1 Wall studs subjected to lateral loads—with no axial loads other than their own weight and the weight of applied finishes.
  - .2 Additional components including, but not limited to steel bridging, top and bottom tracks, head, sill, and jamb members for wall openings; stud, bridging, and track connections; and top and bottom connections to the main structure to accommodate floor and roof deflections.
  - .3 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

### **1.4 Related Requirements**

- 1.4.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

- 1.4.2 Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

## **1.5 Definitions**

### **1.5.1 Steel Thickness:**

- .1 Base Steel Thickness: Thickness of bare steel exclusive of coatings.
- .2 Design Thickness: Target or "nominal" thickness used to determine structural properties of the cold formed Products.
- .3 Minimum Thickness: Design thickness minus minimum allowable under-tolerance required by CSA S136 (95% of design thickness) or material specification; whichever is more stringent.
- .4 Designation Thickness: For the purposes of this specification; thicknesses provided will be minimum base steel thicknesses in accordance with CSA S136.

## **1.6 Preinstallation Meetings**

- 1.6.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.
- 1.6.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
  - .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.
  - .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72-hour notice required.
  - .3 Agenda:
    - .1 Review progress of related construction activities and preparations for particular activity under consideration.
    - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
  - .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
  - .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

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**1.7     Submittals**

- 1.7.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.7.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for structural metal stud framing work specified in this Section.
- 1.7.3 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:
  - .1 Include plans, elevations, sections and details as applicable.
  - .2 Indicate field-measured dimensions on Shop Drawings.
  - .3 Include all necessary shop details and erection diagrams. Indicate member sizes, locations, thicknesses exclusive of coating, coatings, and material types. Include connection details for attaching framing to itself and for attachment to the structure. Show splice details where permitted. Indicate dimensions, openings, requirements of related work and critical installation procedures. Show temporary bracing required for erection purposes.
  - .4 Submit on request copies of engineering calculations or data verifying the capacity of the members, including masonry connectors if specified, and the ability of the assemblies to meet the design requirements.
  - .5 Indicate design loads.
- 1.7.4 Welding certificates: Submit welding certificates showing compliance with CSA standards.
- 1.7.5 Delegated Design Submittals:
  - .1 Engineering design completion of structural metal stud framing work is delegated to Contractor based on structural design criteria indicated in Contract Documents.
  - .2 Submit Shop Drawings for work of this Section that bear the stamp of a Professional Engineer registered in Province of Ontario.
  - .3 Submit copy of structural calculations upon request by Consultant.
- 1.7.6 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
  - .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.



- .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
- .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.7.7 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:
  - .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.
  - .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.7.8 Welding Certificate: Submit certification for welding firms and welders to verify compliance with welding qualifications specified in this section.
- 1.7.9 Product Certification: Upon request, submit valid copy of product certification demonstrating compliance with CSSBI 61-21.

## **1.8 Closeout Submittals**

- 1.8.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.
- 1.8.2 Operating and Maintenance Data: Submit care and maintenance instructions for structural metal stud framing to be included in building operation and maintenance manual.

## **1.9 Quality Assurance**

- 1.9.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 3 years' experience manufacturing such materials.
  - .1 Structural metal stud framing manufacturer must be member in good standing with CSSBI.
- 1.9.2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.
- 1.9.3 Welding Qualifications: Qualify procedures and personnel in accordance with the following:
  - .1 Steel: to CSA W47.1 and CSA W59
- 1.9.4 Professional Engineer's Qualifications: Employ Professional Engineer licensed to practice in Province of Ontario who carries

professional liability insurance and has at least five years' experience providing engineering services of similar kind, scope, and complexity.

.1 Professional Engineer's Responsibility:

- .1 production and review of Shop Drawings,
- .2 design and certification of structural metal stud framing, including attachments for building construction, in accordance with applicable codes and regulations,
- .3 stamping and signing of each Shop Drawing and associated calculations

1.9.5 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.

**1.10 Delivery, Storage And Handling**

- 1.10.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.
- 1.10.2 Deliver, store and handle structural metal stud framing materials in accordance with manufacturer's written instructions.
- 1.10.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.10.4 Store materials in off-ground, in clean, dry, well-ventilated area.
- 1.10.5 Replace defective or damaged materials with new.

**1.11 Site Conditions**

- 1.11.1 Existing Conditions: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

**1.12 Warranty**

- 1.12.1 Provide warranty covering the Work of this Section in accordance with Supplementary Condition SC49 / GC 12.3 WARRANTY.

**2 . PRODUCTS**

**2.1 Manufacturers**

- 2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:
  - .1 Bailey Metal Products Limited
  - .2 Dass Metal Products

- .3 DCM Metal Corp
- .4 Trebor Building Products Ltd

2.1.2 Basis-of-Design: This Specification is based on Products by Bailey Metal Products Ltd. Products from other manufacturers listed in this Section offering functionally and aesthetically equivalent products may be acceptable subject to Consultant's approval.

2.1.3 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

## **2.2 Performance / Design Criteria**

2.2.1 Architectural Drawings and details are diagrammatic and are only intended to show design concept, aesthetics, interfacing requirements, configuration, components and arrangements. They are not intended to identify or solve completely structural fixings, problems of thermal and structural movements, assembly framing, engineering design, and anchorages.

2.2.2 Design exterior envelope cladding systems based on rain screen principle advocated by NRCC and provide for drainage of water entering building envelope wall systems.

2.2.3 Work of this Section shall be designed by a professional engineer as specified herein.

2.2.4 Design shall be based on Limit States Design principles using factored loads and resistances.

2.2.5 Loads and load factors shall be in accordance with the Ontario Building Code. For wind load calculations the reference velocity pressure (q), shall be based on a 1 in 50 probability of being exceeded in any one year.

2.2.6 Resistances and resistance factors shall be determined in accordance with the Ontario Building Code and CAN/CSA-S136.

2.2.7 Conform to the requirements of fire-rated assemblies specified, which have been tested in accordance with CAN/ULC-S101. Provide fire resistance as noted on Drawings and based on tested ULC designs.

2.2.8 Design metal stud exterior wall systems and their connections to withstand, within acceptable deflection limitations, their own weight, the weight of sheathing, the loads imposed by the motion of operable elements and minimum design loads and combinations of loads due to live and dead loads including, but not limited to, pressure and suction of wind and internal pressure.

2.2.9 Stud depths are as shown on Drawings. Adjust stud material thickness and spacing as required by design and performance requirements. Use greater or lesser stud and joist depths only if approved by Consultant.

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- 2.2.10 Space wall studs at 400 mm maximum unless specified otherwise. Use lesser stud spacing if required by design and performance requirements.
- 2.2.11 Use wall studs with 1.087 mm (43 mils - 0.0428 inch - 18 ga) thickness unless specified otherwise. Use greater stud thickness if required by design and performance requirements or engineering design.
- 2.2.12 Minimum thickness for bridging channel: 1.087 mm (43 mils - 0.0428 inch - 18 ga). Use greater bridging channel design thickness if required by the design and performance requirements or engineering design.
- 2.2.13 Minimum thickness for clip angles: 1.367 mm (54 mils - 0.0538 inch - 16 ga). Use greater clip angle thickness if required by the design and performance requirements or engineering design.
- 2.2.14 Maximum flexural deflections under specified wind loads shall conform to the following:
- .1 Wall studs supporting masonry veneer: L/360 per CSA-S304.1
  - .2 Wall studs supporting other finishes: L/360.
  - .3 Deflection limit shall be such that integrity of air/vapour barrier will be maintained at design loading. Permanent deformation of members due to applied loads is not permitted.
  - .4 Notwithstanding limits specified herein, structural steel framing system shall not deflect under design loads sufficient to cause noise, breaking of sealants, or to break integrity of insulation thermal blanket or air/vapour barrier seal
- 2.2.15 Ensure connections are designed to:
- .1 Allow for the vertical deflection of structure.
  - .2 Compensate for frame shortening.
  - .3 Absorb vertical tolerances.
- 2.2.16 Prevent axial loads from being transferred to framing. Maintain minimum gap of 12mm (1/2 inch) at connections. Depending on anticipated structural movement, larger gap may necessary. Refer to Structural Drawings and Specifications prepared for additional requirements.
- 2.2.17 Free play in connections perpendicular to plane of framing must be limited to  $\pm 0.5$  mm relative to building structure.
- 2.2.18 Design components and assemblies to accommodate specified erection tolerances of structure.
- 2.2.19 Design bridging to prevent member rotation and member translation perpendicular to minor axis. Provide for secondary stress effects due to torsion between lines of bridging

- 2.2.20 Do not rely on collateral sheathing to help restrain member rotation and translation perpendicular to minor axis. Provide bridging at 1200 mm (40 inches) o.c. maximum. Space bridging at equal intervals over the span length of the member. Provide minimum of two rows of equally spaced bridging. Closer spacing may be required to satisfy structural requirements.
- 2.2.21 Design metal stud exterior wall system to support fenestration elements (i.e. windows, curtain walls and similar openings) and cladding loads and superimposed loads transferred from fenestration elements, window washing activities, and cladding loads.
- 2.2.22 Design responsibility for managing loads from exterior wall fenestration elements and cladding — both in terms of transferring such loads and supporting fenestration elements and cladding — falls under the scope of this Section.
- 2.2.23 Design anchorage and splice details for bridging.
- 2.2.24 Design for local loading due to anchorage of cladding and interior wall-mounted fixtures where shown.
- 2.2.25 Connections between wind-bearing steel stud members shall be by bolts, welding or sheet metal screws.
- 2.2.26 Provide head, sill and jamb members and connections to frame openings larger than 100 mm (4 inches) in any dimension.
- 2.2.27 Anchor top and bottom track to the structure at a maximum spacing of 813 mm (32 inches) o.c. Closer spacing may be required to satisfy structural requirements.
- 2.2.28 Thermal Movements: fabricate and install to prevent buckling, opening up of joints and overstressing of welds and fasteners under the following temperature conditions:
  - .1 Temperature Change: ambient temperature cycling of - 30 deg C (-22 deg F) to 82 deg C (180 deg F) over a 12-hour period.
- 2.2.29 Steel Stud Designations: Colour code studs to CSSBI Technical Bulletin Vol.7.

## **2.3 Steel Framing**

- 2.3.1 CSA S136, fabricated from ASTM A653/A653M, identified as to specification, grade, mechanical properties, coating type and thickness.
  - .1 Steel studs: CSA S136, fabricated from metallic coated steel, depth as indicated.
  - .2 Stud tracks: fabricated from same material and finish as steel studs, depth to suit.
  - .3 Bottom track: single piece.

- .4 Top track: two-piece telescoping.
- .5 Tension straps and accessories: as recommended by manufacturer.

## **2.4 Auxiliary Materials**

- 2.4.1 Zinc coated steel sheet: ASTM A653/A653M, with minimum Z275 (G90) designation coating.
- 2.4.2 Welding materials: to CSAW59 and certified by Canadian Welding Bureau.
- 2.4.3 Anchors: concrete expansion anchors or other suitable drilled type fasteners.
- 2.4.4 Bolts, nuts, washers: hot dipped galvanized to CAN/CSA G164, 600 g/m2 zinc coating.
- 2.4.5 Touch up primer: zinc rich, to CAN/CGSB 1 GP 181 or MPI #18.
- 2.4.6 Miscellaneous Steel Shapes including Plate and Hollow Sections: CSA G40.21, Grade 300W, or ASTM A36/A36M complete with shop applied primer of either CPMA/CISC 1-73 or CGSB 1-GP-140M.
- 2.4.7 Fasteners and Welds:
  - .1 Hot-dip galvanize anchors, bolts, nuts and washers to provide equal or better corrosion protection than corrosion protection used for metal framing members.
  - .2 Bolts and nuts shall conform to the requirements of ASTM A307 or ASTM A325. Provide washers.
  - .3 Welding electrodes shall be of the 490 MPa minimum tensile strength series (e.g. E49XX).
- 2.4.8 Exterior Sheathing: Refer to Section 06 16 00, Sheathing.

## **2.5 Fabrication**

- 2.5.1 Fabricate in accordance with reviewed shop and erection drawings.
- 2.5.2 Provide cutouts centred in the webs of members to accommodate services. Limit dimensions of unreinforced cutouts to suit design requirements and effects on the strength and stiffness of the members.
- 2.5.3 Fabricate structural metal stud framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced specifications and standards, manufacturer's written instructions, and requirements in this Section.
- 2.5.4 Take field measurements and levels required to verify or supplement those shown on the Drawings for the proper layout and installation of the work. Coordinate dimensional tolerances in

adjacent building elements and confirm prior to the commencement of the work.

- 2.5.5 Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- 2.5.6 Accurately fit frames rigidly together at all joints, corners and mitres. Match components carefully to produce perfect continuity of line and design.
- 2.5.7 Fabrication Tolerances:
  - .1 Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1:960 (1/8 inch in 10 feet) and as follows:
    - .1 Member Depth:  $\pm 0.76$  mm, ( $\pm 0.03$  inch).
    - .2 Flange Width:  $\pm 0.76$  mm ( $\pm 0.03$  inch) (where exterior board is attached directly to flange.) Minimum flange width shall be 32 mm (1-1/4 inch).
    - .3 Lip length: -0, +3 mm (+1/8 inch).
    - .4 Thickness: -0 mm (-0 inch).
    - .5 Corner Angles:  $\pm 3$  deg.
    - .6 Framing Length:  $\pm 3$  mm ( $\pm 1/8$  inch).
  - .2 Spacing: Space individual framing members no more than plus or minus 3 mm (1/8 inch) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
  - .3 Squareness: Fabricate steel framing assembly to a maximum out-of-square tolerance of 3 mm (1/8 inch).

### **3 . EXECUTION**

#### **3.1 Examination**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.

#### **3.2 Temporary Bracing**

- 3.2.1 Employ temporary bracing wherever necessary to withstand all loads applied to steel stud wall systems during erection and subsequent construction. Leave temporary bracing in place for wall system safety and integrity.

- 3.2.2 During erection, maintain a safety margin consistent with Ontario Building Code and CAN/CSA-S136 requirements. Ensure structure safety during this period.

### **3.3 Erection**

- 3.3.1 Methods of construction may be either piece by piece (stick-built) or by fabrication into panels (panelized) either on or off site.
- 3.3.2 Install studs at spacing indicated herein. Ensure studs seat into top and bottom tracks. Ensure gap between end of stud and web of track does not exceed 4.8 mm (3/16 inch).
- 3.3.3 Allow minimum 25 mm (1inch) minimum at top of framing for anticipated floor slab deflection, unless otherwise noted on Structural Drawings.
- 3.3.4 Wind bearing studs shall be erected true and plumb within the specified tolerances.
- 3.3.5 Cutting of members may be by saw or shear. Torch cutting is not permitted.
- 3.3.6 Reinforce cut-outs where the distance from the centerline of the cut-out to the end of the member is less than 300 mm. Submit the reinforcing detail to the Consultant for approval.
- 3.3.7 Replace members with localized damage.
- 3.3.8 Unless a closer spacing is shown on the shop drawings, anchor top and bottom tracks securely to structure at 813 mm (32 inch) o.c. maximum. Place one additional anchor within 102 mm (4 nches) of the end of each piece of track and additionally as required by the shop drawings.
- 3.3.9 Install additional studs at abutting walls, openings, terminations against other materials and on each side at corners unless explicitly detailed otherwise on the shop drawings.
- 3.3.10 Insulation equal to that specified shall be placed in jamb and header assemblies that will be non-accessible after their installation into the wall. Ensure that insulation is kept dry and not compressed.
- 3.3.11 Handling and lifting of prefabricated panels shall not cause permanent distortion to any member or collateral material.
- 3.3.12 Secure framing at top with sliding connection. Provide inner and outer track deflection head under steel beams and decks.

### **3.4 Fasteners And Welds**

- 3.4.1 Ensure that connected parts are in contact. Provide clamping before welding or installing screws as required.
- 3.4.2 Welds shall conform to CAN/CSA S136, CSA W59 and ANSI/AWS D1.3, whichever is applicable.



- 3.4.3 For material less than 3 mm thick, shop drawings may show nominal weld leg sizes. For such material, the effective throats of welds shall not be less than the thickness of the thinnest connected part.
- 3.4.4 Touch-up welds and coatings damaged by welding with zinc rich paint. Prior to touching-up prepare surface in accordance with paint manufacturer's recommendations.
- 3.4.5 Sheet metal screws shall be of minimum diameter indicated on Shop Drawings but not less than a #8.
- 3.4.6 Penetration of sheet metal screws beyond joined materials shall be not less than three exposed threads.
- 3.4.7 Sheet metal screw thread types, drilling capability and installation shall conform to manufacturer's recommendations.
- 3.4.8 Sheet metal screws covered by sheathing materials shall have low profile heads.
- 3.4.9 Install concrete anchors in accordance with manufacturer's recommendations.

### **3.5 Tolerances**

- 3.5.1 For the purpose of this section, camber is defined as the deviation from straightness of a member or any portion of a member with respect to its major axis, and sweep is defined as the deviation from straightness of a member or any portion of a member with respect to its minor axis.
- 3.5.2 For wind bearing studs, out of plumbness shall not exceed 1/500th of the member length.
- 3.5.3 Out of straightness (camber and sweep) shall not exceed 1/1000th of the member length.
- 3.5.4 For track, camber shall not exceed 1/1000th of the member length.
- 3.5.5 Squareness of prefabricated panels shall be not more than 3 mm out of square within the length of that panel.
- 3.5.6 Align adjacent or abutting members in the same plane to within  $\pm$  0.5 mm maximum.
- 3.5.7 Spacing of studs shall not be more than  $\pm$  3 mm from design spacing. The cumulative error in spacing shall not exceed the requirements of the finishing materials.

### **3.6 Field Quality Control**

- 3.6.1 Engineering Inspection Services: Provide field services by engineer specified in this Section consisting of periodic site visits for inspection of product installation in accordance with specifications.
  - .1 Field reviews shall include, but are not limited to: review of mill test reports, welded and screwed connections, connections to

the main structure, member sizes, location and material thickness, coating thickness, erection tolerances, and all field cutting.

- .2 Inspection provided in this section does not relieve the contractor of his responsibility for the performance of the contract. The Contractor is solely responsible for quality control and shall implement his own supervisory and quality control procedures.
  - .3 Materials or workmanship not conforming to the requirements of the contract may be rejected at any time during the progress of work at no cost to Owner even if Contractor has to destroy and rebuild other work as a result.
  - .4 As a minimum, schedule site visits to review work at stages listed:
    - .1 After delivery and storage of products, and when preparatory activities on which work of this Section depends is complete, but before installation begins.
    - .2 Twice during progress of work: at 25% and 60% complete.
    - .3 Upon completion of Work, after cleaning is carried out.
  - .5 Report any inconsistencies from manufacturer's recommendations immediately to Consultant.
- 3.6.2 Obtain field reports within three days of review and submit immediately to Consultant.

### **3.7 Protection**

- 3.7.1 Protect structural metal stud framing from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades.
- 3.7.2 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in writing by affected material's manufacturer. Do not use materials or process that can damage finishes, surfaces, or construction.
- 3.7.3 Promptly replace structural metal stud framing work damaged during construction that cannot be satisfactorily repaired.

### **3.8 Cleaning And Waste Management**

- 3.8.1 Cleaning and Waste Management, generally: in accordance with Section 01 74 00, Cleaning and Waste Management.
- 3.8.2 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.

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- 3.8.3 Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**END OF SECTION**

**1. GENERAL**

**1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

**1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the metal fabrications work specified herein. This includes, but is not necessarily limited, to:
  - .1 Steel framing and supports for overhead doors and grilles.
  - .2 Steel framing and supports for mechanical and electrical equipment.
  - .3 Steel framing and supports for applications where framing and supports are not specified in other Sections.
  - .4 Elevator machine beams, hoist beams, and divider beams.
  - .5 Steel shapes for supporting elevator door sills.
  - .6 Sump pit covers.
  - .7 Metal ladders and ladder safety cages where shown on Drawings.
  - .8 Metal floor plate and supports.
  - .9 Miscellaneous steel trim including steel angle corner guards, steel edgings and loading-dock edge angles where shown on Drawings.
  - .10 Metal bollards.
  - .11 Shade canopy.
  - .12 Loose bearing and leveling plates for applications where they are not specified in other Sections.
  - .13 Steel framing and supports for washroom and shower accessories supporting downward loads, including shower seats, grab bars and change tables.
  - .14 Steel framing and supports for fire valve cabinets.

- .15 Miscellaneous sections and framing as required to complete the Work and as indicated in the Canadian Institute for Steel Construction (CISC) - Handbook of Steel Construction "Appendix F" for applications where framing and supports are not explicitly specified in this section.
  - .16 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

### **1.3      References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

### **1.4      Definitions**

- 1.4.1 Workmanship (as defined by AMP 555 – Draft Edition) for this Section must be in accordance with one of the following classes:
- .1 Class 1:
    - .1 Exposed surfaces are finished smooth with pits, mill marks, nicks and scratches filled or ground off. Defects are not apparent when painted or polished.
    - .2 Welds are concealed where possible. Exposed welds are ground to small radius with uniform sized coves unless indicated otherwise.
    - .3 Distortions are not visible to the naked eyes.
    - .4 Exposed joints are fitted to a hairline finish.
  - .2 Class 2:
    - .1 Exposed surfaces retain mill marks and moderate irregularities, but are generally not visible to the naked eye when viewed at 10 m (30 ft)
    - .2 Exposed welds are ground to a uniform sized cove.
    - .3 Exposed joints are fitted to a maximum gap of 1.6 mm (1/16 inch)
  - .3 Class 3:
    - .1 Exposed surfaces have no improvement from mill finish except preparation necessary for galvanizing, or priming.
    - .2 Exposed welds are not ground.
    - .3 Bolt, when used, may be exposed.

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**1.5     Coordination**

- 1.5.1 Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- 1.5.2 Coordinate installation of metal fabrications that are anchored to or that receive other work. Supply setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

**1.6     Preinstallation Meetings**

- 1.6.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.
- 1.6.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
  - .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.
  - .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.
  - .3 Agenda:
    - .1 Review progress of related construction activities and preparations for particular activity under consideration.
    - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
  - .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
  - .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

**1.7     Submittals**

- 1.7.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.7.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for metal fabrications work specified in this Section.

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- 1.7.3 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:
- .1 Include plans, elevations, sections and details as applicable.
  - .2 Indicate field-measured dimensions on Shop Drawings.
  - .3 Member sizes, locations, thickness (exclusive of coatings), metallic coatings and mechanical properties,
  - .4 Connection details for attaching framing to itself and to the structure,
  - .5 Dimensions, requirements of related work, and critical installation procedures,
  - .6 Temporary bracing required for erection purposes,
  - .7 Design loads,
  - .8 Welds indicated by welding symbols as defined in CSA-W59.
- 1.7.4 Delegated Design Submittals:
- .1 Engineering design completion of metal fabrications work is delegated to Contractor based on structural design criteria indicated in Contract Documents.
  - .2 Submit Shop Drawings for work of this Section that bear the stamp of a Professional Engineer registered in Province of Ontario.
  - .3 Submit copy of structural calculations upon request by Consultant.
- 1.7.5 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
- .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
  - .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
  - .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.7.6 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:
- .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.
  - .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.

- 1.7.7 Welding Certificate: Submit certification for welding firms and welders to verify compliance with welding qualifications specified in this section.

**1.8 Closeout Submittals**

- 1.8.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.
- 1.8.2 Operating and Maintenance Data: Submit care and maintenance instructions for metal fabrications to be included in building operation and maintenance manual.
- 1.8.3 Warranty Documentation: Submit copy of extended warranties specified in this Section.

**1.9 Quality Assurance**

- 1.9.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 5 years' experience manufacturing such materials.
- 1.9.2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.
- 1.9.3 Welding Qualifications: Qualify procedures and personnel in accordance with the following:
- .1 Steel: to CSA W47.1 and CSA W59
  - .2 Aluminum: to CSA W47.2 and CSA W59.2
  - .3 Stainless Steel: to CSA W47.1 (Annex K) and CSA W59.
- 1.9.4 Professional Engineer's Qualifications: Employ Professional Engineer licensed to practice in Province of Ontario who carries professional liability insurance and has at least five years' experience providing engineering services of similar kind, scope, and complexity.
- .1 Professional Engineer's Responsibility:
    - .1 production and review of Shop Drawings,
    - .2 design and certification of metal fabrications, including attachments for building construction, in accordance with applicable codes and regulations,
    - .3 stamping and signing of each Shop Drawing and associated calculations
- 1.9.5 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and



secondary materials from sources recommended by manufacturers of primary materials.

1.9.6 Mock-Ups / First Installation Review: Construct mock-ups to verify selections made under submittals, demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

- .1 Location: In-situ (i.e. first installation), as directed on site by Consultant.
- .2 Purpose: To set benchmarks for installation and to judge subsequent work. Maintain Mock-ups during construction in undisturbed condition.
- .3 Reviewed mock-ups: May become part of the completed work if undisturbed at the time of Substantial Performance of The work, provided they are undisturbed, and comply with requirements outlined in Contract Documents.

**1.10 Delivery, Storage And Handling**

- 1.10.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.
- 1.10.2 Deliver, store and handle metal fabrications materials in accordance with manufacturer's written instructions.
- 1.10.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.10.4 Store materials in off-ground, in clean, dry, well-ventilated area.
- 1.10.5 Replace defective or damaged materials with new.

**1.11 Field Conditions**

- 1.11.1 Environmental Restrictions: Do not deliver or install metal fabrications until building is enclosed, wet work is complete, and HVAC system is operational and will maintain temperature and relative humidity levels equal to occupancy levels for remainder of construction period.
- 1.11.2 Field Measurements: Verify actual dimensions of construction contiguous with metal fabrications by field measurements before fabrication.

**1.12 Warranty**

- 1.12.1 Provide warranty covering the Work of this Section in accordance with Supplementary Condition SC49 / GC 12.3 WARRANTY.

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## **2 .     PRODUCTS**

### **2.1     Performance / Design Criteria**

- 2.1.1 Delegated Design: Employ a qualified professional engineer, as specified in this Section, to design elements of this section requiring structural performance and based on the following:
  - .1 Steel Elements: to CSA S16, unless indicated otherwise.
  - .2 Cold-Formed Steel: to CSA S136.
  - .3 Aluminum: to CSA S157/S157.1
  - .4 Where components specified in this Section will be subject to upward or downward pull by human interaction (e.g. supports for grab bars, shower seats, etc.) provide elements capable of withstanding the following loads under conditions indicated:
    - .1 Minimum load ratings: 1.3 kN (292 lb-f)
    - .2 Maximum Deflection between supports: L/144 or 3 mm (1/8") whichever is less.
- 2.1.2 Seismic Performance: Provide products and systems specified in this Section to withstand the effects of earthquake motions in accordance with OBC 4.1.8.18 and CAN/CSA S832.
  - .1 Professional engineer specified in Division 01 and referenced in this Section shall be responsible for designing systems and submitting signed and sealed analysis data and Shop Drawings illustrating seismic-resistant systems.
  - .2 Refer to Structural Drawings for seismic sensitivity values.
- 2.1.3 Metal Surfaces - Appearance:
  - .1 Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
    - .1 Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
  - .2 Provide metal fabrications complying with the following classes as defined in this Section:
    - .1 Class 1 Workmanship: Items that are exposed to view in finished spaces in completed Work.
    - .2 Class 2 Workmanship: Items that are exposed to view in utility areas of the completed Work.
    - .3 Class 3 Workmanship: Items that are concealed from view in the completed Work

2.1.4 Exterior Metal Fabrications: fabricate and install to prevent buckling, opening up of joints and overstressing of welds and fasteners under the following temperature conditions:

- .1 Temperature Change: ambient temperature cycling of - 30 deg C (-22 deg F) to 82 deg C (180 deg F) over a 12 hour period.

## **2.2 Ferrous Metals**

- 2.2.1 Steel Plates, Shapes, and Bars: CSA G40.20/G40.21, Grade 350W or equivalent to ASTM A36/A36M
- 2.2.2 Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or CSA G40.20/G40.21 or ASTM A283/A283M, Grade C or D.
- 2.2.3 Rolled-Stainless Steel Floor Plate: ASTM A793.
- 2.2.4 Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.
- 2.2.5 Steel Pipe: ASTM A53/A53M, Standard Weight Schedule 40 unless otherwise indicated.
- 2.2.6 Slotted Channel Framing (Unistrut): Cold-formed metal box channels struts complying with MFMA-4.
  - .1 Size of Channels: As indicated on reviewed Shop Drawings.
  - .2 Material: Galvanized steel, ASTM A653/A653M, structural steel, Grade 230 (Grade 33), with Z275 (G90) coating; minimum 2-mm (0.079-in.) nominal thickness.

## **2.3 Non-Ferrous Metals**

- 2.3.1 Aluminum Plate and Sheet: ASTM B209M (ASTM B209), Alloy 6061-T6.
- 2.3.2 Aluminum Extrusions: ASTM B221M (ASTM B221), Alloy 6063-T6.
- 2.3.3 Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.
- 2.3.4 Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.
- 2.3.5 Stainless Steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, Type 304 for interior and Type 316L for exterior.
- 2.3.6 Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 304 for interior and Type 316L for exterior.

## **2.4 Fasteners**

- 2.4.1 General Requirements: Unless otherwise indicated, provide stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

- 2.4.2 Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM F568M, Property Class 4.6 (ASTM A307, Grade A); with hex nuts, ASTM A563M (ASTM A563); and, where indicated, flat washers.
- 2.4.3 Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F738M (ASTM F593); with hex nuts, ASTM F836M (ASTM F594); and, where indicated, flat washers; Alloy Group A1 (1) .
- 2.4.4 Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563M (ASTM A563); and, where indicated, flat washers.
  - .1 Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- 2.4.5 Anchors - General Requirements: Capable of sustaining, without failure, loads imposed with appropriate safety factors, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.
- 2.4.6 Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels struts complying with MFMA-4, 41 by 22 mm (1-5/8 by 7/8 in.) by length indicated with anchor straps or studs minimum 75 mm (3 in.) long at maximum 200 mm (8 in.) o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

## **2.5 Auxiliary Installation Materials**

- 2.5.1 Welding materials: to CSA W59.
- 2.5.2 Welding electrodes: to CSA W48 Series.
- 2.5.3 Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with CISC/ CPMA Standards 1-73a and 2-75 and MPI#79 and compatible with topcoat.
  - .1 Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- 2.5.4 Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- 2.5.5 Galvanizing Repair Paint: High-zinc-dust-content paint (not less than 93 percent) complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- 2.5.6 Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.5.7 Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M with compressive strength of 15 MPa at 24 hours. Provide grout specifically recommended by manufacturer for interior and exterior applications.

.1 Acceptable Product: 'Sika Grout 212' by Sika Canada Inc., or approved equivalent.

2.5.8 Concrete: Comply with requirements in Section 03 30 00.

## **2.6 Fabrication - General Requirements**

2.6.1 Fabricate work square, true, straight, and accurate to required size, with joints closely fitted and properly secured.

2.6.2 Weld connections unless indicated otherwise.

2.6.3 Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

2.6.4 Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1 mm (1/32 in.) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

2.6.5 Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

2.6.6 Form exposed work with accurate angles and surfaces and straight edges.

2.6.7 Weld corners and seams continuously to comply with the following:

.1 Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

.2 Obtain fusion without undercut or overlap.

.3 Remove welding flux immediately.

.4 At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

2.6.8 Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head countersunk fasteners unless otherwise indicated. Locate joints where least conspicuous.

2.6.9 Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

- 2.6.10 Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- 2.6.11 Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- 2.6.12 Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 3.2 by 38 mm (1/8 by 1-1/2 in.), with a minimum 150-mm (6-in.) embedment and 50-mm (2-in.) hook, minimum 200 mm (8 in.) from ends and corners of units and 600 mm (24 in.) o.c., unless otherwise indicated.
- 2.6.13 Make exposed metal fastenings and accessories of same material, texture, colour and finish as base metal on which they occur unless otherwise shown or specified. Keep exposed fastenings to an absolute minimum evenly spaced and neatly laid out. Make fastenings of permanent type unless otherwise indicated.

## **2.7     General Finish Requirements**

- 2.7.1 Finish metal fabrications after assembly.
- 2.7.2 Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.
- 2.7.3 Galvanize miscellaneous framing and supports at exterior locations; prime paint miscellaneous framing and supports at interior locations.

## **2.8     Steel And Iron Finishes**

- 2.8.1 Galvanizing: Hot-dip galvanize items to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A 123/A 123M or equivalent to CAN/CSA-G164 for other steel and iron products.
  - .1 Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
  - .2 Preparation for Shop Priming of Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- 2.8.2 Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
  - .1 Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - .2 Items Indicated to receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - .3 Other Steel Items: SSPC-SP 3, "Power Tool Cleaning."

- .4 Galvanized-Steel Items: SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."

2.8.3 Shop Priming:

- .1 Shop prime items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated. Shop prime with universal shop primer unless indicated otherwise.
- .2 Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
- .3 Stripe paint corners, crevices, bolts, welds, and sharp edges.

**2.9 Aluminum Finishes**

- 2.9.1 As-Fabricated Finish: AA-M12.
- 2.9.2 Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.

**3 . EXECUTION**

**3.1 Examination**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.

**3.2 Installation**

- 3.2.1 Installation, generally: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.
- 3.2.2 Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- 3.2.3 Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
- 3.2.4 Field Welding: Comply with CSA W59 and the following requirements:

- 
- .1 Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - .2 Obtain fusion without undercut or overlap.
  - .3 Remove welding flux immediately.
  - .4 At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- 3.2.5 Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, and other connectors.
- 3.2.6 Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- 3.2.7 Corrosion Protection / Isolation Coating: Isolate aluminum from following components, by means of bituminous paint:
- .1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.
  - .2 Concrete, mortar and masonry.
  - .3 Wood.
- 3.2.8 Provide separator membrane/mastic between steel and substrates of concrete, masonry, or dissimilar metals.
- 3.3 Installation Of Miscellaneous Framing And Supports**
- 3.3.1 General Requirements: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- 3.3.2 Anchor supports securely to, and rigidly brace from, building structure.
- 3.4 Repairs**
- 3.4.1 Touchup Painting:
- .1 Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
    - .1 Apply by brush or spray to provide a minimum 0.05-mm (2.0-mil) dry film thickness.
- 3.4.2 Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.



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**3.5     Metal Fabrication Schedule**

- 3.5.1 Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- 3.5.2 Where items are required to be built into masonry, concrete or other work, supply such items to respective Sections with required anchors and accessories for building in.
- 3.5.3 Following Schedule is a list of principal items only and is not necessarily exhaustive. Review Drawings Sheet A053 for Miscellaneous Metals Schedule and other Specifications, including those pertaining to structural, mechanical, and electrical work, to determine full scope of metal fabrications required for this Project.
- 3.5.4 STEEL FRAMING AND SUPPORTS FOR GLASS DOORS, ENTRANCE AND PARTITIONS
  - .1 Fabricate and install partition framing such that, when installed, it is capable of supporting required deadloads and withstanding live loads imposed on it from operation of the partitions.
- 3.5.5 STEEL THRESHOLDS AND SUPPORTS FOR DOORS
  - .1 Fabricate and install door thresholds and supports such that, when installed, it is capable of supporting required deadloads and withstanding live loads imposed on it from operation of the doors.
- 3.5.6 ELEVATOR MACHINE BEAMS, HOIST BEAMS, DIVIDERS AND STEEL SHAPES SUPPORTING DOOR SILLS
  - .1 Provide elevator divider beams, doors and framing supports, and miscellaneous supports for elevators complying with requirements in Division 14 specifications
- 3.5.7 LATERAL SUPPORT FOR MASONRY WALLS
  - .1 Provide steel angles, minimum 75 mm x 75 mm x 6 mm thick, secured to underside of structure to anchor freestanding masonry. Unless indicated otherwise, space lateral support as follows:
    - .1 At loadbearing walls: Not exceeding 20 times the actual wall thickness.
    - .2 At non-loadbearing partitions: Not exceeding 36 times the actual wall thickness.
  - .2 Refer to structural Drawings for design of lateral supports, spacing and other requirements.
- 3.5.8 METAL LADDERS
  - .1 Comply with Ontario Ministry of Labour Fixed Access Ladders Engineering Data Sheet 2-04 and ANSI A14.3, except for elevator pit ladders.

- .2 For elevator pit ladders, comply with ASME A17.1/CSA B44 and requirements in Division 14 specifications.
- .3 Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.
- .4 Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 12 mm (1/2 in.) in least dimension.
- .5 Galvanize exterior ladders, including brackets.
- .6 Prime paint interior ladders, including brackets and fasteners.

#### 3.5.9 LADDER SAFETY CAGES

- .1 Fabricate ladder safety cages to comply with ANSI A14.3. Assemble by welding or with stainless steel fasteners.
- .2 Provide primary hoops at tops and bottoms of cages and spaced maximum 6 m (20 ft.) o.c. Provide secondary intermediate hoops spaced maximum 1200 mm (48 in.) o.c. between primary hoops.
- .3 Fasten assembled safety cage to ladder rails and adjacent construction by welding or with stainless steel fasteners unless otherwise indicated.
- .4 Ladder Safety Cage Material: Steel.

#### 3.5.10 FLOOR TRENCH AND SUMP PIT COVERS

- .1 Fabricate from minimum 6-mm (1/4-in.) floor plate.
- .2 Provide anchors at 1200 mm on centre for embedding in concrete.
- .3 Supply trench covers in 1200 mm removable lengths.
- .4 Provide steel angle supports consisting of L 55 x 55 x 6 frame unless otherwise indicated.
- .5 Provide perimeter gasket for air tight seal at pits connected with sanitary drainage piping.

#### 3.5.11 MISCELLANEOUS STEEL TRIM

- .1 Fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- .2 Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
- .3 Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- .4 Galvanize exterior miscellaneous steel trim.
- .5 Prime paint interior miscellaneous steel trim.

- .6 Surface Applied Corner Guards (Back-of-House): Provide corner guards fabricated from angles of sizes shown, or if not shown, of minimum 114 mm x 114 mm x 6 mm (4-1/2 in x 4-1/2 in x 6 mm) thick equal leg angles. Drill and countersink legs of angles, for fastening to substrates indicated, with holes spaced maximum 600 mm (24 in) on center. Provide corner guard lengths minimum 1200 mm (48 in) above finished floor level, if not otherwise indicated.
- .7 Cast-In Pit Angles and Edge Angles: Provide edge angles, and pit angles, fabricated from angles of size as shown, or required, with welded-on stud anchors spaced 600 mm (24 in) on center. Provide pit and edge angles in as long lengths as possible. Miter and weld corners and provide splice plates for alignment between sections.

#### 3.5.12 METAL BOLLARDS

- .1 Fabricate metal bollards from Schedule 40 steel pipe with galvanized finish, with high-visibility yellow paint finish and retro-reflective banding at top.
- .2 Cap bollards with 6.4-mm- (1/4-in.-) thick, steel plate with domed top, unless indicated otherwise on Drawings.
- .3 Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
- .4 Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.
- .5 Refer to Section 03 30 00 for concrete infill requirements.

#### 3.5.13 PEDESTALS AND BOLLARDS FOR MOUNTING DEVICES AND ACTUATORS

- .1 Provide bollards designed to support the installation of push plates, control devices, or access actuators.
- .2 Bollards must be fabricated from structural-grade steel, with provisions for wiring, device mounting, complete with stainless steel cladding.
- .3 Steel:
  - .1 Pipe: ASTM A53, Grade B, standard weight (Schedule 40) steel pipe, diameter as indicated on Drawings.
  - .2 Cap: Steel plate or dome cap, welded to the top of bollard.
  - .3 Mounting Bracket: Stainless steel or galvanized steel bracket for securing push plates or control devices.
  - .4 Finish: Hot-dip galvanized to ASTM A123 with stainless steel cladding.
- .4 Stainless Steel Cladding:

- .1 Cladding Material: ASTM A240, Type 316 stainless steel, minimum 2 mm thick.
- .2 Finish: Brushed No. 4 finish unless indicated otherwise.
- .3 Cladding to be wrapped around bollard with welded or mechanically fastened seams.
- .4 Ensure stainless steel cladding covers the entire exposed surface of bollard, including the top cap.
- .5 Dimensions: Refer to Drawings.
- .6 Device Mounting Provisions:
  - .1 Provide pre-drilled holes and internal conduits for wiring of devices, push plates, or access controls. Allow for easy access to wiring connections and maintenance of electrical components.
  - .2 Provide brackets or plates for mounting devices securely fastened to bollard and to accommodate required push plate sizes.
  - .3 Wiring Path: Provide internal raceways or conduit channels for routing power and control wiring to mounted devices. Coordinate with Division 26 and Division 28.
  - .4 Device mounting brackets to be fabricated from stainless steel to match cladding.

#### 3.5.14 STEEL WELD PLATES AND ANGLES

- .1 Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

#### 3.5.15 MISCELLANEOUS FRAMING AND SUPPORTS

- .1 Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
  - .1 Fabricate units from slotted channel framing where indicated.
  - .2 Supply inserts for units installed after concrete is placed.

#### 3.5.16 PIPE RAILINGS

- .1 Steel pipe and stainless-steel pipe: to shapes and sizes as indicated.

- .2 Ergonomic design: constructed so as to be continually graspable along their entire length with no obstruction on or above them to break a handhold.
- .3 Galvanize exterior pipe railings after fabrication. Shop coat prime interior railings after fabrication.

#### **3.5.17 METAL STAIRS**

- .1 Refer to Section 05 51 00.

#### **3.5.18 METAL GRATINGS**

- .1 General: Produce metal bar gratings in accordance with the following:
  - .1 For Gratings Exposed to Non-Vehicular Loads: NAAMM MBG 531 Metal Bar Grating Manual.
  - .2 For Gratings Exposed to Vehicular Loads: NAAMM MBG 532 Heavy Duty Metal Bar Grating Manual.
- .2 Provide gratings including supplementary framing and supports to support specified loads. Provide gratings of welded type construction, rectangular pattern with plain surface bars in the same plane; accurately fabricated free from warps, twists or other defects affecting their serviceability or appearance. Fabricate gratings from ASTM A36 structural steel bars.
- .3 Fabricate cutouts in grating sections for penetrations required. Arrange layout of cutouts to permit grating removal without disturbing items penetrating gratings.
  - .1 Edge band openings in grating that interrupt 4 or more bearing bars with bars of same size and material as bearing bars.
  - .2 Do not notch bearing bars at supports to maintain elevation.
- .4 Galvanize metal bar gratings after fabrication.

#### **3.5.19 SHADE CANOPY**

- .1 Fabricate units with aluminum extrusions to sizes, shapes, and profiles indicated on Drawings and as necessary to receive adjacent construction.
- .2 Finish: Pre-painted in colour selected by Consultant at a later date.

**END OF SECTION**

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**1. GENERAL**

**1.1 Related Documents**

- 1.1.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 Summary**

- 1.2.1 Provide Work described in this Section and all ancillary components required for a complete installation. This includes but is not limited to the following: decorative metal.
- .1 Decorative mechanical grilles and screens.
  - .2 Miscellaneous decorative metal reveals and shapes including but not limited to: miscellaneous trims, fillers and closures in interior locations.

**1.3 Related Documents**

- 1.3.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.3.2 Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

**1.4 References**

- 1.4.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

**1.5 Administrative Requirements**

- 1.5.1 Preinstallation Meetings: Conduct conference at Project site to comply with requirements in 01 31 00.
- 1.5.2 Coordination:
- .1 Coordinate installation of anchorages for decorative metal items. Supply setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

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**1.6     Submittals**

- 1.6.1 Provide submittals in accordance with requirements of 01 33 00.
- 1.6.2 Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- 1.6.3 Shop Drawings: Submit Shop Drawings for decorative metal items. Include plans, elevations, component details, and attachments to other work. Indicate materials and profiles of each decorative metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.
  - .1 Provide templates for anchors and bolts specified for installation under other Sections.
- 1.6.4 Samples: Submit samples for each exposed finish and for each colour and texture required. Submit samples as follows:
  - .1 Minimum 300 mm long sections of linear shapes.

**1.7     Quality Assurance**

- 1.7.1 Fabricator Qualifications: A firm experienced in producing decorative metal similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- 1.7.2 Welding:
  - .1 Provide welding in accordance with CSA W59-M performed by a fabricator and mechanics fully approved by the Canadian Welding Bureau as specified herein.
  - .2 Ensure fabricator is fully certified by Canadian Welding Bureau for fusion welding of steel structures to CSA W47.1 and for fusion welding of aluminum to CSA W47.2.
  - .3 Conform to AWS D1.6, "Structural Welding Code--Stainless Steel."
- 1.7.3 Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  - .1 Approved mockups may become part of the completed Work if undisturbed at time of Substantial Performance of the Work.

**1.8     Delivery, Storage, And Handling**

- 1.8.1 Store decorative metal inside a well-ventilated area, away from uncured concrete and masonry, and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.
- 1.8.2 Deliver and store cast-metal products in wooden crates surrounded by sufficient packing material to ensure that products will not be cracked or otherwise damaged.

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**1.9     Project Conditions**

1.9.1 Field Measurements: Verify actual locations of walls and other construction contiguous with decorative metal by field measurements before fabrication and indicate measurements on Shop Drawings.

**1.10    Warranty**

1.10.1 Provide warranty covering the Work of this Section in accordance with Supplementary Condition SC49 / GC 12.3 WARRANTY.

**2 .     PRODUCTS**

**2.1     Description**

2.1.1 Supply architectural metals from highest architectural quality and various forms which are straight and true. Ensure there are no scratches, scars or creases, buckles, ripples or chatter marks and free from surface blemishes where exposed to view in finished unit. Provide finished surfaces suitable for polishing where required.

2.1.2 Exposed-to-view surfaces exhibiting pitting, seam marks, roller marks, oil-canning, stains, discolorations, or other imperfections on finished units are not acceptable.

**2.2     Materials**

2.2.1 Stainless Steel

- .1 Tubing: ASTM A554, Grade MT 304
- .2 Pipe: ASTM A312/A 312M, Grade TP 304
- .3 Sheet, Strip, Plate, and Flat Bar: ASTM A666, Type 304
- .4 Bars and Shapes: ASTM A276, Type 304
- .5 Unless otherwise indicated, stainless steel thickness to be minimum 1.2 mm (18 ga)
- .6 Welding Materials: CSA W59-M.

**2.3     Decorative Mechanical Grilles**

2.3.1 Fabricate decorative grilles from perforated stainless-steel sheet or plate of thickness, size, and pattern indicated on Drawings and Schedules.

2.3.2 Form perforations by punching, cutting, or drilling to produce openings of sizes and shapes indicated on Drawings and Schedules. Roll, press, and grind perforated metal to flatten and to remove burrs and deformations.



- 2.3.3 Drill and countersink grilles for mounting screws at 50 mm (2 inches) from corners and at 250 mm (10 inches) or less o.c.
- 2.3.4 Miter frame members at corners and connect with concealed splice plates welded to back of frames.
- 2.3.5 Drill and countersink frames for mounting screws at 100 mm (4 inches) from corners and at 400 mm (16 inches) or less o.c.
- 2.3.6 Finish: brushed stainless steel.

## **2.4     Auxiliary Materials**

- 2.4.1 Plywood Backing: Premium Grade, Douglas Fir plywood - CSA O121, or Western Softwood Plywood - CSA O151 or Poplar plywood - CSA O153-M in accordance with requirements of Section 06 10 00.
- 2.4.2 Fastener Materials: Unless otherwise indicated, Use fasteners of same basic metal as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.
  - .1 Provide concealed fasteners for interconnecting components and for attaching them to other work, unless otherwise indicated or unless exposed fasteners are unavoidable.
- 2.4.3 Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187.
- 2.4.4 Adhesive: Manufacturer's recommended waterproof type suitable for adhering stainless steel surfaces to wood substrates.
  - .1 Double Sided Foam Tape: "3M 4004", 3M Double Sided Urethane Tape, 25 mm (1"), suitable for indoor use, capable to sustain 220 deg F, not affected by solvent and UV exposure, urethane foam with acrylic adhesive.
- 2.4.5 Sealants: Conforming to Section 07 92 00 and as recommended by manufacturer for applications indicated

## **2.5     Fabrication**

- 2.5.1 Assemble items in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- 2.5.2 Form decorative metal to required shapes and sizes, true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.

- 2.5.3 Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- 2.5.4 Form simple and compound curves in bars and extruded shapes by bending members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces.
- 2.5.5 Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1 mm (1/32 inch), unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- 2.5.6 Mill joints to a tight, hairline fit. Cope or miter corner joints. Fabricate connections that will be exposed to weather in a manner to exclude water.
- 2.5.7 Provide weep holes where water may accumulate.
- 2.5.8 Provide necessary rebates, lugs, and brackets to assemble units and to attach to other work. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items, unless otherwise indicated.
- 2.5.9 Comply with CSA requirements for recommended practices in shop welding and brazing. Weld and braze behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed joints of flux, and dress exposed and contact surfaces.
- 2.5.10 Provide castings that are sound and free of warp, cracks, blowholes, or other defects that impair strength or appearance. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks.

## **2.6 Finishes**

- 2.6.1 Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- 2.6.2 Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- 2.6.3 Stainless-Steel Finishes
  - .1 Remove tool and die marks and stretch lines or blend into finish.
  - .2 Unless otherwise indicated, grind and polish surfaces to produce uniform finish indicated, free of cross scratches.

- .3 Run grain of directionally textured finishes with long dimension of each piece.
- .4 When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- .5 Grain direction shall be in one direction, generally, as indicated on Drawings or directed by Consultant.

### **3 . EXECUTION**

#### **3.1 Examination**

- 3.1.1 Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative metal.
  - .1 Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 Installation**

- 3.2.1 Provide anchorage devices and fasteners where needed to secure decorative metal to in-place construction.
- 3.2.2 Perform cutting, drilling, and fitting required to install decorative metal. Set products accurately in location, alignment, and elevation; measured from established lines and levels. Provide temporary bracing or anchors in formwork for items to be built into concrete, masonry, or similar construction.
- 3.2.3 Fit exposed connections accurately together to form tight, hairline joints or, where indicated, with uniform reveals and spaces for sealants and joint fillers. Where cutting, welding, and grinding are required for proper shop fitting and jointing of decorative metal, restore finishes to eliminate evidence of such corrective work.
- 3.2.4 Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.
- 3.2.5 Install concealed gaskets, joint fillers, insulation, and flashings as work progresses.
- 3.2.6 Restore protective coverings that have been damaged during shipment or installation. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at same location.
- 3.2.7 Field Welding: Comply with applicable CSA and AWS specification for procedures of manual shielded metal arc welding, for

appearance and quality of welds, and for methods used in correcting welding work. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Grind exposed welded joints smooth and restore finish to match finish of adjacent surfaces.

- 3.2.8 Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

### **3.3     Cleaning**

- 3.3.1 Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.
- 3.3.2 Clean copper alloys according to metal finisher's written instructions in a manner that leaves an undamaged and uniform finish matching approved Sample.
- 3.3.3 Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material.
- 3.3.4 Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

### **3.4     Protection**

- 3.4.1 Protect finishes of decorative metal from damage during construction period with temporary protective coverings approved by decorative metal fabricator. Remove protective covering at time of Substantial Performance of the Work.
- 3.4.2 Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

**END OF SECTION**

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**1. GENERAL**

**1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

**1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the metal stairs work specified herein. This includes, but is not necessarily limited, to:
  - .1 Steel stairs with concrete-filled pans and non-slip treads.
  - .2 Industrial stairs with steel treads.
  - .3 Steel pipe and tube guards and handrails for metal stairs.
  - .4 Steel tube handrails for walls near metal stairs.
  - .5 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

**1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

**1.4 Coordination**

- 1.4.1 Installation of anchorages for metal stairs: Supply setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

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**1.5     Preinstallation Meetings**

- 1.5.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.
- 1.5.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
  - .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.
  - .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.
  - .3 Agenda:
    - .1 Review progress of related construction activities and preparations for particular activity under consideration.
    - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
  - .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
  - .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

**1.6     Submittals**

- 1.6.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.6.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for metal stairs work specified in this Section.
- 1.6.3 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:
  - .1 Include plans, elevations, sections and details as applicable.
  - .2 Show field-measured dimensions on Shop Drawings.
  - .3 In addition to minimum requirements indicate following:
    - .1 Large scale views of members, materials, connections, attachments, reinforcing, anchorages, and exposed fastening locations.
    - .2 Jointing details.
    - .3 Setting, sealing, securing, and anchoring techniques.

**.4 Field connection methods.**

**1.6.4 Delegated Design Submittals:**

- .1 Engineering design completion of metal stairs work is delegated to Contractor based on structural design criteria indicated in Contract Documents.**
- .2 Submit Shop Drawings for work of this Section that bear the stamp of a Professional Engineer registered in Province of Ontario.**
- .3 Submit copy of structural calculations upon request by Consultant.**

**1.6.5 Embodied Carbon / Environmental Product Declarations (EPDs):** When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:

- .1 EPD Scope:** Must cover Cradle-to-Gate (A1 to A3) as a minimum.
- .2 EPD Impact Categories:** Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
- .3 Product Options:** Give preference to Products with compliant documentation when choice is at Contractor's option.

**1.6.6 Material Ingredient Disclosure:** When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:

- .1 Standard:** Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.
- .2 Product Options:** Give preference to Products with compliant documentation when choice is at Contractor's option.

**1.6.7 Samples:** Submit selection and verification samples for Products requiring colour, texture, or design selection. Submit manufacturer's list of finishes or colour swatches for Consultant's selection.

- .1 As a minimum submit samples of abrasive nosings to be used in Project.**

**1.6.8 Mill Certificates:** Submit mill certificates or data from a qualified independent testing agency with calibrated test equipment indicating steel complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and metallic-coating thickness.

**1.6.9 Welding Certificate:** Submit certification for welding firms and welders to verify compliance with welding qualifications specified in this section.

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**1.7     Closeout Submittals**

- 1.7.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.
- 1.7.2 Operating and Maintenance Data: Submit care and maintenance instructions for metal stairs to be included in building operation and maintenance manual.

**1.8     Quality Assurance**

- 1.8.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.
- 1.8.2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.
- 1.8.3 Welding Qualifications: Qualify procedures and personnel in accordance with the following:
  - .1 Steel: to CSA W47.1 and CSA W59
  - .2 Aluminum: to CSA W47.2 and CSA W59.2
  - .3 Stainless Steel: to CSA W47.1 (Annex K) and CSA W59.
- 1.8.4 Professional Engineer's Qualifications: Employ Professional Engineer licensed to practice in Province of Ontario who carries professional liability insurance and has at least five years' experience providing engineering services of similar kind, scope, and complexity.
  - .1 Professional Engineer's Responsibility:
    - .1 production and review of Shop Drawings,
    - .2 design and certification of metal stairs, including attachments for building construction, in accordance with applicable codes and regulations,
    - .3 stamping and signing of each Shop Drawing and associated calculations
- 1.8.5 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.
- 1.8.6 Mock-Ups / First Installation Review: Construct mock-ups to verify selections made under submittals, demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - .1 Location: In-situ (i.e. first installation), as directed on site by Consultant.



- .2 Purpose: To set benchmarks for installation and to judge subsequent work. Maintain Mock-ups during construction in undisturbed condition.
- .3 Reviewed mock-ups: May become part of the completed work if undisturbed at the time of Substantial Performance of The work, provided they are undisturbed, and comply with requirements outlined in Contract Documents.

**1.9 Delivery, Storage And Handling**

- 1.9.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.
- 1.9.2 Deliver, store and handle metal stairs materials in accordance with manufacturer's written instructions.
- 1.9.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.9.4 Store materials in off-ground, in clean, dry, well-ventilated area.
- 1.9.5 Replace defective or damaged materials with new.

**1.10 Warranty**

- 1.10.1 Provide warranty covering the Work of this Section in accordance with Supplementary Condition SC49 / GC 12.3 WARRANTY.

**2 . PRODUCTS**

**2.1 Regulatory Requirements**

- 2.1.1 Accessibility: Ensure the work of this Section complies with barrier-free requirements of the OBC, CAN/CSA-B651 and requirements of authorities having jurisdiction.

**2.2 Performance / Design Criteria**

- 2.2.1 Professional Engineering Design and Certification: Design metal stairs, including comprehensive engineering analysis by a Professional Engineer licensed to practice in the Province of Ontario, in accordance with requirements of Ontario Building Code, and using performance requirements and design criteria indicated on Drawings and Schedules in this Section.
- 2.2.2 Structural Performance of Stairs: Provide metal stairs capable of withstanding the effects of gravity loads and the following loads and stresses in accordance with OBC requirements (4.1.5. Live Loads Due to Use and Occupancy) within limits and under conditions indicated.

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- 2.2.3 Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
- 2.2.4 Limit deflection of treads, platforms, and framing members to L/360 or 6.4 mm (1/4 inch), whichever is less. Where stairs are intended to support tile, stone or other brittle materials, reduce deflection to L/720.
- 2.2.5 Structural Performance of Guards and Handrails: Guards and railings and guards shall withstand the effects of gravity loads according to the minimum requirements of the Ontario Building Code, CSA A500 and the following loads and stresses within limits and under conditions indicated:
- .1 Comply with requirements specified in OBC Clause 4.1.5.14. Loads on Guards and Handrails.
- 2.2.6 NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated on Drawings and Schedules.
- .1 Preassembled Stairs – Exits and Similar Locations: Commercial class.
- .2 Industrial Stairs - Service Spaces, Penthouses etc.: Industrial class.
- .3 Feature Stairs (Stair C): Architectural class.
- 2.2.7 At exposed connections, finish exposed welds of stairs, railings and guards and guards to comply with NOMMA's "Voluntary Joint Finish Standards" as follows:
- .1 Preassembled Stairs – Exits and Similar Locations: Type 2 welds; completely sanded joint, some undercutting and pinholes okay
- .2 Industrial Stairs - Service Spaces, Penthouses etc.: Type 3 welds; partially dressed weld with spatter removed.
- .3 Feature Stairs (Stair C): Architectural class; Type 1 welds: no evidence of a welded joint
- 2.2.8 Material Finish: Provide materials with smooth, flat surfaces unless otherwise indicated on Drawings and Schedules. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- 2.2.9 Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
- 2.2.10 Exterior Elements: fabricate and install to prevent buckling, opening up of joints and overstressing of welds and fasteners under the following temperature conditions:

- .1 Temperature Change: ambient temperature cycling of - 30 deg C (-22 deg F) to 82 deg C (180 deg F) over a 12 hour period.

## **2.3 Metals**

- 2.3.1 Steel Plates, Shapes, and Bars: ASTM A 36/A 36M or equivalent to CSA G40.20/G40.21.
- 2.3.2 Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- 2.3.3 Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or equivalent to CSA G40.20/G40.21 or ASTM A 283/A 283M, Grade C or D.
- 2.3.4 Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, structural steel, Grade 170 (Grade 25), unless another grade is required by design loads; exposed.
- 2.3.5 Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, structural steel, Grade 205 (Grade 30), unless another grade is required by design loads.
- 2.3.6 Galvanized-Steel Sheet: ASTM A 653/A 653M, Z275 (G90) coating, structural steel, Grade 230 (Grade 33), unless another grade is required by design loads.
- 2.3.7 Aluminum Extrusions: ASTM B 221M (ASTM B 221), Alloy 6063-T6.
- 2.3.8 Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

## **2.4 Prefilled Concrete Treads**

- 2.4.1 Concrete Materials and Properties: Comply with requirements in Section 03 30 00 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with minimum 28-day compressive strength of 20 MPa (3000 psi) and maximum aggregate size of 13 mm (1/2 inch) unless otherwise indicated.
- 2.4.2 Nonslip-Aggregate Concrete Finish: Factory-packaged abrasive aggregate made from fused, aluminum-oxide grits or crushed emery; rustproof and nonglazing; unaffected by freezing, moisture, or cleaning materials.
- .1 Plain Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, galvanized steel, 152 by 152 mm (6 by 6 inches), W1.4 by W1.4, unless otherwise indicated on Drawings.
- 2.4.3 Reinforcement Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening welded-wire reinforcement in place.

- .1 Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete.
- 2.4.4 For galvanized reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

## **2.5      Fabrication**

- 2.5.1 Provide complete stair assemblies, including metal framing, hangers, struts, railings and guards, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
  - .1 Join components by welding unless otherwise indicated on Drawings and Schedules.
  - .2 Use connections that maintain structural value of joined pieces.
  - .3 Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.
- 2.5.2 Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- 2.5.3 Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1 mm (1/32 inch) unless otherwise indicated on Drawings and Schedules. Remove sharp or rough areas on exposed surfaces.
- 2.5.4 Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- 2.5.5 Form exposed work with accurate angles and surfaces and straight edges.
- 2.5.6 Weld connections to comply with the following:
  - .1 Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - .2 Obtain fusion without undercut or overlap.
  - .3 Remove welding flux immediately.
  - .4 Weld exposed corners and seams continuously unless otherwise indicated on Drawings and Schedules.
- 2.5.7 Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated on Drawings and Schedules. Locate joints where least conspicuous.
- 2.5.8 Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

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**2.6     Fasteners**

- 2.6.1 General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941M (ASTM F 1941), Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.
- 2.6.2 Bolts and Nuts: Regular hexagon-head bolts, ASTM F 568M, Property Class 4.6 (ASTM A 307, Grade A); with hex nuts, ASTM A 563M (ASTM A 563); and, where indicated on Drawings and Schedules, flat washers.
- 2.6.3 Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated on Drawings and Schedules; with nuts, ASTM A 563M (ASTM A 563); and, where indicated on Drawings and Schedules, flat washers.
  - .1 Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for exterior stairs.

**2.7     Steel-Pan Stairs**

- 2.7.1 Fabricate stringers of steel channels, MC shapes, in sizes as required to support loadings. Provide closures for exposed ends of stringers where exposed.
- 2.7.2 Construct platforms of steel plate and miscellaneous framing members as needed to comply with performance requirements and to support loadings.
- 2.7.3 Weld stringers to headers; weld framing members to stringers and headers.
- 2.7.4 Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements but not less than 3 mm (1/8 inch) thick. Weld to stringers.
- 2.7.5 Form landings from minimum 3 mm (1/8 inch) thick steel plate, reinforced by L-shaped members spaced at minimum 400 mm (16 inches) on centre.
- 2.7.6 Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
- 2.7.7 Provide clip angles for fastening of furring channels, where applied finish indicated for underside of stairs and landings.
- 2.7.8 Extend stringers around mid landings to form steel base.
- 2.7.9 Shape metal pans to include nosing integral with riser.

**2.8     Metal Floor Plate Stairs**

- 2.8.1 Form treads and platforms to configurations shown from abrasive-surface floor plate of thickness needed to comply with performance

requirements indicated in this Section, but not less than 6 mm (1/4 inch).

- .1 Form treads with integral nosing and back edge stiffener. Form risers from steel sheet not less than 3 mm (1/8 inch) thick, welded to tread nosings and stiffeners and to platforms.
- .2 Form landings from minimum 6 mm (1/4 inch) thick steel plate, reinforced by L-shaped members spaced at minimum 400 mm (16 inches) on centre.
- .3 Weld steel supporting brackets to stringers and weld treads to brackets.
- .4 Fabricate platforms with integral nosings matching treads and weld to platform framing.

2.8.2 Metal Bar-Grating Stairs: form treads and platforms to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual."

- .1 Fabricate treads and platforms from welded steel grating with 25-by-3-mm (1-by-1/8-inch) bearing bars at 11 mm (7/16 inch) o.c. and crossbars at 100 mm (4 inches) o.c.
- .2 Fabricate treads and platforms from welded steel grating with openings in gratings no more than 12 mm (1/2 inch) in least dimension.
- .3 Surface: Serrated.
- .4 Finish: Galvanized.
- .5 Fabricate grating treads with rolled-steel floor plate nosing and with steel angle or steel plate carrier at each end for stringer connections. Secure treads to stringers with bolts.
- .6 Fabricate grating platforms with nosing matching that on grating treads. Provide toeplates at open-sided edges of grating platforms. Weld grating to platform framing.]

## **2.9 Railings And Guards (GDRL2)**

2.9.1 Steel Tube Railings and guards and Guards: Fabricate railings and guards to comply with requirements indicated on Drawings and Schedules for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand loads indicated in this Section and in Ontario Building Code.

- .1 Material: 10 mm (3/8 inch) cold rolled sheet steel, stretcher levelled and fully pickled per ASTM A1008/A1008M-11, Grade CS Type A exposed.
  - .1 Finish: Matte oiled steel
- .2 Close exposed ends of railing members with prefabricated end fittings.

- .3 Provide wall returns at ends of wall-mounted handrails unless otherwise indicated on Drawings and Schedules. Close ends of returns unless clearance between end of rail and wall is 6 mm (1/4 inch) or less.
- 2.9.2 Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work. Supply inserts and other anchorage devices for connecting to concrete or masonry work.
  - .1 Connect posts to stair framing by direct welding unless otherwise indicated on Drawings and Schedules.
  - .2 For galvanized railings and guards, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.
  - .3 For nongalvanized railings and guards, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.
- 2.9.3 Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

## **2.10 Stair Nosings**

- 2.10.1 Non-slip inserts: Aluminum units with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.
  - .1 Basis-of-Design: "Supergrit 121BF" by Wooster Products Inc. or approved equivalent by one of the following:
    - .1 American Safety Tread Co., Inc.
    - .2 Amstep Products.
    - .3 Balco Inc.
  - .2 Provide anchors for embedding units in concrete as standard with manufacturer.
  - .3 Colour: As selected by Consultant from manufacturer's full range.
  - .4 Apply di-electric separator in the form of bituminous paint or clear lacquer to concealed surfaces of units set into concrete.

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**2.11 Auxiliary Materials**

- 2.11.1 Welding Rods and Bare Electrodes: Select according to CSA specifications for metal alloy welded.
- 2.11.2 Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- 2.11.3 Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- 2.11.4 Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

**2.12 Finishes**

- 2.12.1 Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- 2.12.2 Finish metal stairs after assembly.
- 2.12.3 Galvanizing: Hot-dip galvanize items exterior components to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M or equivalent to CAN/CSA-G164 for other steel and iron products.
  - .1 Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
  - .2 Fill vent and drain holes that will be exposed in finished Work, unless indicated on Drawings and Schedules to remain as weep holes, by plugging with zinc solder and filing off smooth.
- 2.12.4 Shop Primer:
  - .1 Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - .2 Universal Shop Primer (interior components): Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
    - .1 Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
  - .3 Epoxy Zinc-Rich Primer (exterior components, not otherwise galvanized): Complying with MPI#20 and compatible with topcoat.
    - .1 Acceptable Products: "Zinc Clad IV" by Sherwin Williams or approved equivalent.



- 2.12.5 Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
- .1 Stripe paint corners, crevices, bolts, welds, and sharp edges.
  - .2 Apply one coat of shop primer except interior surfaces of pans.
  - .3 Apply two coats of primer of different colours to parts inaccessible after final assembly.

### **3 .     EXECUTION**

#### **3.1     Examination**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.

#### **3.2     Installation Of Stairs**

- 3.2.1 Installation, generally: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.
- 3.2.2 Install in accordance with NAAMM, Metal Stair Manual.
- 3.2.3 Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- 3.2.4 Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- 3.2.5 Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated on Drawings and Schedules.
- 3.2.6 Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- 3.2.7 Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip

galvanized after fabrication and are for bolted or screwed field connections.

- 3.2.8 Field Welding: Comply with requirements for welding in this Section.
- 3.2.9 Place and finish concrete fill for treads and platforms to comply with Section 03 30 00, Cast-in-Place Concrete.
  - .1 Install abrasive nosings with anchors fully embedded in concrete. Center nosings on tread width.
- 3.2.10 Install plumb and true in exact locations, using welded connections wherever possible to provide rigid structure. Provide anchor bolts, bolts and plates for connecting stairs to structure.
- 3.2.11 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- 3.2.12 Do welding work in accordance with CSA W59 unless specified otherwise.
- 3.2.13 Touch up shop primer to bolts, welds, and burned or scratched surfaces at completion of erection.

### **3.3 Installing Railings And Guards**

- 3.3.1 Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated on Drawings and Schedules or, if not indicated on Drawings and Schedules, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction by anchoring posts to steel by welding directly to steel supporting members.
- 3.3.2 Attach handrails to wall with wall brackets. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt. Provide bracket with 50-mm (2-inch) clearance from inside face of handrail and finished wall surface.
- 3.3.3 Locate brackets as indicated on Drawings and Schedules or, if not indicated on Drawings and Schedules, at spacing required to support structural loads.

### **3.4 Protection**

- 3.4.1 Protect metal stairs from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades.
- 3.4.2 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in writing by affected material's manufacturer. Do not use materials or process that can damage finishes, surfaces, or construction.

- 3.4.3 Promptly replace metal stairs work damaged during construction that cannot be satisfactorily repaired.

**3.5 Cleaning And Waste Management**

- 3.5.1 Cleaning and Waste Management, generally: in accordance with Section 01 74 00, Cleaning and Waste Management.
- 3.5.2 Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
- .1 Apply by brush or spray to provide a minimum 0.05-mm (2.0-mil) dry film thickness.
- 3.5.3 Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.
- 3.5.4 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
- 3.5.5 Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**END OF SECTION**

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the glazed decorative metal guards and handrails work specified herein. This includes, but is not necessarily limited, to:
  - .1 Interior decorative glass guards and handrails.
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

### **1.4 Coordination**

- 1.4.1 Coordinate installation of anchorages for guards and handrails. Supply setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.

### **1.5 Preinstallation Meetings**

- 1.5.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.

- 1.5.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
- .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.
  - .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.
  - .3 Agenda:
    - .1 Review progress of related construction activities and preparations for particular activity under consideration.
    - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
  - .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
  - .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

**1.6 Submittals**

- 1.6.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.6.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for glazed decorative metal guards and handrails work specified in this Section:
- .1 Metal guards and handrails.
  - .2 Glass products including glazing cement and accessories.
  - .3 Sealant and tools for structural glass guards and handrails.
- 1.6.3 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:
- .1 Include plans, elevations, sections, and attachment details.
- 1.6.4 Delegated Design Submittals:
- .1 Engineering design completion of glazed decorative metal guards and handrails work is delegated to Contractor based on structural design criteria indicated in Contract Documents.
  - .2 Submit Shop Drawings for work of this Section that bear the stamp of a Professional Engineer registered in Province of Ontario.

- .3 Submit copy of structural calculations upon request by Consultant.
- 1.6.5 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
  - .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
  - .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
  - .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.6.6 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:
  - .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.
  - .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.6.7 Samples: Submit selection and verification samples for Products requiring colour, texture, or design selection. Submit manufacturer's list of finishes or colour swatches for Consultant's selection.
  - .1 Submit assembled system samples using full-size parts, including top rail, post, handrail, and glass-infill panels. Illustrate finishing methods at intersections.
- 1.6.8 Welding Certificate: Submit certification for welding firms and welders to verify compliance with welding qualifications specified in this section.

## **1.7 Quality Assurance**

- 1.7.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.
- 1.7.2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.
- 1.7.3 Welding Qualifications: Qualify procedures and personnel in accordance with the following:
  - .1 Steel: to CSA W47.1 and CSA W59

- .2 Aluminum: to CSA W47.2 and CSA W59.2
- .3 Stainless Steel: to CSA W47.1 (Annex K) and CSA W59.
- 1.7.4 Professional Engineer's Qualifications: Employ Professional Engineer licensed to practice in Province of Ontario who carries professional liability insurance and has at least five years' experience providing engineering services of similar kind, scope, and complexity.
  - .1 Professional Engineer's Responsibility:
    - .1 production and review of Shop Drawings,
    - .2 design and certification of glazed decorative metal guards and handrails, including attachments for building construction, in accordance with applicable codes and regulations,
    - .3 stamping and signing of each Shop Drawing and associated calculations
- 1.7.5 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.
- 1.7.6 Mock-Ups / First Installation Review: Construct mock-ups to verify selections made under submittals, demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - .1 Location: In-situ (i.e. first installation), as directed on site by Consultant.
  - .2 Purpose: To set benchmarks for installation and to judge subsequent work. Maintain Mock-ups during construction in undisturbed condition.
  - .3 Reviewed mock-ups: May become part of the completed work if undisturbed at the time of Substantial Performance of The work, provided they are undisturbed, and comply with requirements outlined in Contract Documents.

## **1.8 Delivery, Storage And Handling**

- 1.8.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.
- 1.8.2 Deliver, store and handle glazed decorative metal guards and handrails materials in accordance with manufacturer's written instructions.
- 1.8.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.8.4 Store materials in off-ground, in clean, dry, well-ventilated area.
- 1.8.5 Replace defective or damaged materials with new.

**1.9     Field Conditions**

1.9.1 Field Measurements: Verify actual dimensions of construction contiguous with glazed decorative metal guards and handrails by field measurements before fabrication.

**1.10    Warranty**

1.10.1 Extended warranty: Submit for Owner's review and acceptance, manufacturer's extended warranty in which manufacturer commits to repair or replace components of glazed decorative metal guards and handrails that fail within specified warranty period. Manufacturer's extended warranty is in addition to, and does not supersede, any other rights that Owner may have under Contract Documents.

.1 Warranty Period: Not less than Five years from date of Substantial Performance of The work.

**2 .     PRODUCTS**

**2.1     Manufacturers**

2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:

- .1 CR Laurence
- .2 InKan Ltd.
- .3 Stella Glass Hardware
- .4 Wagner Companies

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

**2.2     Regulatory Requirements**

2.2.1 Accessibility: Ensure the work of this Section complies with barrier-free requirements of the OBC, CAN/CSA-B651 and requirements of authorities having jurisdiction.

**2.3     Performance / Design Criteria**

2.3.1 Employ a qualified professional engineer, as specified in this Section, to design elements of this section requiring structural performance based on the following:

- .1 Steel Elements: to CSA S16, unless indicated otherwise.
- .2 Cold-Formed Steel: to CSA S136.
- .3 Aluminum: to CSA S157/S157.1
- .4 Stainless Steel: to ANSI/AISC 370.



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- .5 Glass: to CAN/CGSB-12.20-M or ASTM E1300, subject to limitations indicated in Ontario Building Code.
- 2.3.2 Intended aesthetics: Drawings and Specifications provide requirements regarding system's aesthetic and performance criteria. Unless indicated otherwise, preserve intended aesthetic effects. For any proposed deviations, provide detailed explanation to Consultant for evaluation. Acceptance or rejection of proposed deviations rests solely with Consultant.
- 2.3.3 Support each section of top rail and handrail by a minimum of three glass panels or by other means so guards and railings will remain in place if any one glass panel fails. Support top rail and handrail ends such that guards and railings remains in place if end glass panel fails.
- 2.3.4 Structural Performance of Guards and Handrails: Ensure guards and railings withstand gravity load and other load combination effects specified in the Ontario Building Code, CSA A500, within conditions listed below:
- .1 Loads: comply with OBC Clause 4.1.5.14 Loads on Guards and Handrails.
- .2 Glass selection: comply with OBC Supplementary Standard SB-13.
- .3 Glass thickness: Glass thicknesses indicated in this section are minimums. Analyze Project loads and in-service conditions to determine final glass thicknesses to use to maintain or exceed performance criteria specified in this Section.
- 2.3.5 Material Compatibility:
- .1 Ensure solvents and elements in the glazing system do not affect bond properties of sealants and similar elements.
- .2 Use sealant materials compatible with other materials in glazing systems. If required, test for compatibility using methods such as ASTM C510, ASTM C794, ASTM C1087, or similar standards.
- .3 Use materials resistant to long-term UV light exposure.
- .4 Corrosion Control: Insulate metals and materials from direct contact with incompatible materials to prevent galvanic action and corrosion.
- 2.3.6 Material Finish: Provide materials with smooth, flat surfaces unless otherwise indicated on Drawings and Schedules. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

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**2.4     General Requirements For Metals**

- 2.4.1 Metal Surfaces: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- 2.4.2 Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.
- 2.4.3 Aluminum: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.
  - .1 Extruded Bars and Shapes, Including Extruded Tubing: ASTM B221M (ASTM B221), Alloy 6063-T5/T52.
  - .2 Drawn Seamless Tubing: ASTM B210M (ASTM B210), Alloy 6063-T832.
  - .3 Plate and Sheet: ASTM B209M (ASTM B209), Alloy 6061-T6.
  - .4 Die and Hand Forgings: ASTM B247M (ASTM B247), Alloy 6061-T6.
  - .5 Castings: ASTM B26/B26M, Alloy A356.0-T6.

**2.5     General Requirements For Glass And Glazing Products**

- 2.5.1 Glass Material Tag: This item is noted as "GL12" on Drawings and Schedules. Unless noted otherwise, provide low-iron glazing.
- 2.5.2 Glass used in glazed decorative metal guards and railings must comply with requirements of Ontario Building Code, "Supplementary SB-13 Glass in Guards" in accordance with requirements specified below. Final selection of glass in guards is at Contractor's option based on constraints specified in OBC SB-13, Table 2.1.1.1.
- 2.5.3 Edge Finishes:
  - .1 Exposed Glass Edges: Machine ground and polished edges.
  - .2 Butting Glass Edges: Flat ground edges.
- 2.5.4 Glazing Publications: Comply with written instructions of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  - .1 NGA/GANA Publications: "GANA Laminated Glazing Reference Manual" and "GANA Glazing Manual."
- 2.5.5 Glazing Cement and Accessories for Structural Glazing: Glazing cement, setting blocks, shims, and related accessories as recommended or supplied by manufacturer for installing structural glazing in metal subrails.

- .1 Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
  - .1 Water-Resistant Product: At exterior locations provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.
  - .2 Glazing gaskets for dry-glazing in lieu of glazing cement are acceptable provided they meet requirements of this Specification.
- 2.5.6 Sealant and Accessories for Glass Guards and Railings: Sealant, gaskets, setting blocks, shims, and related accessories as recommended or supplied by railing manufacturer for installing structural glazing in metal base channels.
- 2.5.7 Glazing Gaskets for Glass-Infill Panels: Glazing gaskets and related accessories as recommended or supplied by guards and railing manufacturer for installing glass-infill panels in guards and railings.

## **2.6 Finishes**

- 2.6.1 Metal Surfaces: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- 2.6.2 Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

## **2.7 Glazed Guard And Railings System Components (GDRL1)**

- 2.7.1 System configuration: Shoe-Supported System.
- 2.7.2 Material: Aluminum
- .1 Finish: Clear anodized
- 2.7.3 Rails, Channels, Posts and Hardware: Manufacturer's standard types for mounting as noted on reviewed Shop Drawings.
- 2.7.4 Handrail Brackets: To be selected by Consultant from manufacturer's full range.
- 2.7.5 Basis-of-Design:
- .1 Shoe: "CRL 8B" by C.R. Laurence or approved equivalent.
  - .2 Top Cap: "Aluminum Square Cap Rail - GRS20M" by C.R. Laurence or approved equivalent.

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**2.8     Fasteners**

- 2.8.1 Fastener Materials: Unless otherwise indicated, provide the following:
- .1 Aluminum Components: Type 304 (for interior locations) or Type 316 (for exterior locations) stainless steel fasteners.
  - .2 Stainless Steel Components: Type 304 (for interior locations) or Type 316 (for exterior locations) stainless steel fasteners.
  - .3 Dissimilar Metals: Type 304 (for interior locations) or Type 316 (for exterior locations) stainless steel fasteners.
- 2.8.2 Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring guards and railings to other types of construction indicated and capable of withstanding design loads.
- 2.8.3 Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless otherwise indicated.
- .1 Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.
- 2.8.4 Post-Installed Anchors: Fastener systems with working capacity greater than or equal to design load, in accordance with an evaluation report acceptable to authorities having jurisdiction.

**2.9     Fabrication Of Metal Railings**

- 2.9.1 Fabricate railings to comply with requirements indicated for design on reviewed Shop Drawings, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- 2.9.2 Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- 2.9.3 Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1 mm (1/32 inch) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- 2.9.4 Form work true to line and level with accurate angles and surfaces.
- 2.9.5 Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.
- 2.9.6 Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

- 2.9.7 Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
- .1 Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- 2.9.8 Form changes in direction as follows: As detailed on Drawings.
- 2.9.9 Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- 2.9.10 Close exposed ends of hollow railing members with prefabricated end fittings.
- 2.9.11 Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, handrail brackets, miscellaneous fittings, and anchors to interconnect railing members to other work where indicated.
- .1 At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and to prevent bracket or fitting rotation and crushing of substrate.
- 2.9.12 Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- 2.9.13 Make provisions in rails, panels and covers to allow for expansion and contraction, deflection and other movements of components and supporting structure.
- 2.9.14 Do not mark surface finishes with welds in back of exposed surfaces. Do not deform the exposed metal and finish in any way by welding. Remove all burrs.
- 2.9.15 Insulate contact surfaces to prevent electrolysis due to metal to metal contact or contact between metal and masonry or concrete.

**2.10 Fabrication Of Glass Panels**

- 2.10.1 Fabricate glass to sizes and shapes required; provide for proper edge clearance and bite on glazing panels.
- 2.10.2 Edge Finish: Grind smooth and flat polish exposed edges of glass, including those at open joints, to produce smooth, square edges with glass edge finishes.

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**2.11 Metal Finish Requirements, General**

- 2.11.1 Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.
- 2.11.2 Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of Samples reviewed by Consultant. Variations in appearance of other components are acceptable if they are within the range of Samples reviewed by Consultant and are assembled or installed to minimize contrast.
- 2.11.3 Provide exposed fasteners with finish matching appearance, including colour and texture, of guards and handrails.

**3 . EXECUTION**

**3.1 Examination**

- 3.1.1 Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.
- 3.1.2 Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

**3.2 Installation, General**

- 3.2.1 Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.
- 3.2.2 Fit exposed connections together to form tight, hairline joints.
- 3.2.3 Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
  - .1 Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  - .2 Set posts plumb within a tolerance of 2 mm in 1 m (1/16 inch in 3 feet).

- .3 Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 5 mm in 3 m (1/4 inch in 12 feet).
- 3.2.4 Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- 3.2.5 Adjust railings before anchoring to ensure matching alignment at abutting joints.
- 3.2.6 Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

### **3.3 Installing Glass Panels**

- 3.3.1 Glass-Supported Railings: Install assembly to comply with railing manufacturer's written instructions.
  - .1 Attach base channel to building structure, then insert glass into base channel and bond with glazing cement unless glass was bonded to base and top rail channels in factory.
    - .1 Support glass panels in base channel at quarter points with channel-shaped setting blocks that also act as shims to maintain uniform space for glazing cement. Fill remaining space in base channel with glazing cement for uniform support of glass.
  - .2 Adjust spacing of glass panels so gaps between panels are equal before securing in position.
  - .3 Erect glass railings under direct supervision of manufacturer's authorized technical personnel.

### **3.4 Installing Handrails**

- 3.4.1 Apply handrails complying with manufacturer's written instructions for cutting, mounting, forming, welding, cleaning, applying end caps, and finishing.
- 3.4.2 Minimize number of joints in handrails by installing in lengths as long as possible. Allow for shortening of handrails caused by welding and splicing process; butt ends together to produce hairline joint.

### **3.5 Cleaning**

- 3.5.1 Clean aluminum and stainless steel by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.
- 3.5.2 Clean and polish glass as recommended in writing by manufacturer. Wash both exposed surfaces in each area of Project not more than

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four days before date scheduled for inspections that establish date of Substantial Performance of the Work.

**3.6      Protection**

- 3.6.1 Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Performance of the Work.
- 3.6.2 Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

**3.7      Cleaning And Waste Management**

- 3.7.1 Cleaning and Waste Management, generally: in accordance with Section 01 74 00, Cleaning and Waste Management.
- 3.7.2 Clean aluminum and stainless steel by washing thoroughly with water and soap, rinsing with clean water, and wiping dry.
- 3.7.3 Clean and polish glass as recommended in writing by manufacturer. Wash both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Performance of the Work.
- 3.7.4 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
- 3.7.5 Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**END OF SECTION**



## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the rough carpentry work specified herein. This includes, but is not necessarily limited, to:
  - .1 Miscellaneous furring and blocking,
  - .2 Wood nailers, cants, curbs and fanning for roofing.
  - .3 Electrical and equipment mounting panels.
  - .4 Rough blocking in walls for support of wall-mounted items.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

### **1.4 Preinstallation Meetings**

- 1.4.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.
- 1.4.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
  - .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.

- .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.
- .3 Agenda:
  - .1 Review progress of related construction activities and preparations for particular activity under consideration.
  - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
- .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
- .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

## **1.5 Submittals**

- 1.5.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.5.2 Product Data:
  - .1 Where fire-retardant-treated carpentry is used, submit data for fire-retardant treatment from chemical treatment manufacturer, as well as certification from treating plant, that the treated materials meet requirements specified in this Section.
  - .2 Include data on physical properties of treated materials based on independent testing by a qualified testing agency.
- 1.5.3 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
  - .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
  - .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
  - .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.5.4 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:
  - .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.

- .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.

**1.6 Delivery, Storage And Handling**

- 1.6.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.
- 1.6.2 Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.
- 1.6.3 Deliver interior wood materials that are to be exposed to view only after building is enclosed and weatherproof, wet work other than painting is dry, and HVAC system is operating and maintaining temperature and humidity at occupancy levels.

**1.7 Warranty**

- 1.7.1 Provide warranty covering the Work of this Section in accordance with Supplementary Condition SC49 / GC 12.3 WARRANTY.

**2 . PRODUCTS**

**2.1 Regulatory Requirements**

- 2.1.1 Lumber identification: by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board conforming to the Standard Grading Rules for Canadian Lumber published by the National Lumber Grades Authority.
- 2.1.2 Plywood and wood-based composite panel construction identification: by grade mark in accordance with applicable CSA standards. Ensure plywood grading agency is certified by APA The Engineered Wood Association; <http://www.apawood.org>
- 2.1.3 Preservative Pressure-Treated and Fire-Retardant-Treated Wood and Plywood identification: by grade mark in accordance with the Canadian Wood Preservers Bureau and applicable ULC standards acceptable to authorities having jurisdiction.
- 2.1.4 Identify lumber by grade stamp of an agency certified by Canadian Lumber Standards Administration Board

**2.2 Performance / Design Criteria**

- 2.2.1 Visual Characteristics: Measure knots, checks, shakes and slope of grain in visually graded lumber in accordance with ASTM D245 with exceptions as noted under NLGA 120d.
- 2.2.2 Use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes

when preservative or fire-retardant treatment is required for exposed items designated to receive a stained or natural finish.

- 2.2.3 Maximum moisture content for materials specified in this Section: 19%.
- 2.2.4 Do not use materials that are warped or do not comply with requirements specified herein.
- 2.2.5 VOC Content and Emissions:
  - .1 Composite Wood: must be ULEF or NAF type per CARB ATCM. Do not adhesives that contain urea-formaldehyde.

## **2.3 Lumber Materials**

- 2.3.1 Standard Lumber: to CSA O141, No. 2 White Pine, No. 2 Red Pine, or No. 1 Construction S-P-F, lumber with moisture content of 19% or less, kiln-dried, free from sap, shakes, splits, knots and other defects for furring, blocking, nailing strips, grounds, rough bucks, cants, backing and sleepers as applicable.
- 2.3.2 Surfacing: minimum S2S (surfaced 2 sides) in concealed locations; minimum S4S (surfaced 4 sides) in exposed locations.
- 2.3.3 Board sizes: "Standard" or better grade.
- 2.3.4 Dimension sizes: "Standard" light framing or better grade.
- 2.3.5 Consultant reserves the right to select species and appearance grades to suit design requirements.

## **2.4 Panel Materials**

- 2.4.1 Plywood: Following types are acceptable unless indicated otherwise:
  - .1 Douglas Fir Plywood (DFP): to CSA-O121, G2S, standard construction, minimum 19 mm (3/4 inch) thickness unless indicated otherwise on Drawings.
  - .2 Canadian Softwood Plywood (CSP): to CSA-O151 G2S, standard construction, minimum 19 mm (3/4 inch) thickness unless indicated otherwise on Drawings.
- 2.4.2 Exterior Locations: DFP or CSP as specified herein, exterior-grade construction, kiln-dried to a moisture content of 15% or less, minimum 19 mm (3/4 inch) thickness unless indicated otherwise on Drawings.

## **2.5 Preservative Wood Treatment**

- 2.5.1 Preservative Pressure-Treated Wood and Plywood: in accordance with CSA O80.1
  - .1 UC2: exterior wood elements unless indicated otherwise.
  - .2 UC4.1: exterior wood elements in contact with ground.

- 2.5.2 Provide chemical treatment acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- 2.5.3 Application: Pressure treat following wood elements and other items indicated on Drawings to receive preservative wood treatments:
  - .1 Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, air barriers, vapour barriers, and waterproofing.
  - .2 Wood sleepers, blocking, and similar concealed members in contact with masonry or concrete.
  - .3 Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
  - .4 Wood sleepers supporting wood subflooring over concrete slabs in contact with ground or fill.
  - .5 Wood in direct contact with earth or concrete.
  - .6 At the junction of miscellaneous concrete elements and wood elements below grade.

## **2.6 Fire-Retardant-Treated Wood And Plywood**

- 2.6.1 Treatment: Provide chemical treatment acceptable to authorities having jurisdiction and containing no arsenic or chromium from one of the following manufacturers:
  - .1 Dircon; [www.dricon.com](http://www.dricon.com)
  - .2 FireFree; [www.firefree.com](http://www.firefree.com)
  - .3 Approved equivalent.
- 2.6.2 Surface Burning Characteristics: flame spread rating of 25 or less in accordance with CAN/ULC-S102.
  - .1 Do not damage or otherwise affect ULC Label.
- 2.6.3 Application: Provide fire-retardant-treatment for following wood elements and other items indicated on Drawings to receive treatment:
  - .1 Concealed blocking.
  - .2 Roof construction.
  - .3 Plywood backing panels.

## **2.7 Accessories**

- 2.7.1 Supply rough hardware to frame and fix rough carpentry including but not limited to bolts, anchors, nails, expansion shields and other fastenings required.
- 2.7.2 Wire Nails, Spikes and Staples: Conforming to CSA B111.

- 2.7.3 Exterior locations and treated lumber: Stainless steel nails, type 316. Nails that are plain-galvanized, electroplated, or made of aluminum are unacceptable.
- 2.7.4 Provide spiral thread nails except as indicated otherwise.
- 2.7.5 Bolts: ASTM A307, minimum 12 mm (½") complete with nuts and washers.
- 2.7.6 Proprietary fasteners (toggle bolts, expansion shields, screws, organic fibre plugs etc.): recommended for purpose by manufacturers.

### **3 .     EXECUTION**

#### **3.1     Examination**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.

#### **3.2     Preparation**

- 3.2.1 Treat surfaces with wood preservative or fire retardant treatments before installation.
- 3.2.2 Use dust collectors and high quality respirator masks when cutting or sanding wood panels.
- 3.2.3 Apply preservative by dipping or by brush to completely saturate and maintain wet film on surface for minimum 3-minute soak on lumber and 1-minute soak for plywood.
- 3.2.4 After cutting, drilling and fitting of fire-retardant treated or preservative-treated wood and plywood but before installation, apply 1 full coat of wood preservative to exposed surfaces, including ends of blocking, furring, nailers and rough carpentry. Retreat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative or fire retardant before application.
- 3.2.5 Coordinate with other Sections providing blocking, nailing strips and trims as required for installation of The Work.

#### **3.3     Installation**

- 3.3.1 Comply with requirements indicated in OBC, Section 9.23 as supplemented by requirements specified in this Section.
- 3.3.2 Properly frame together parts of the work with members accurately cut to size, closely fitted, well spiked, and erected in a substantial manner, plumb, level, square and true to dimension.
- 3.3.3 Locate joints over bearing or supporting surfaces.

- 3.3.4 Provide running members full length wherever possible.
- 3.3.5 Design for expansion and contraction of the materials.
- 3.3.6 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
- 3.3.7 Provide fasteners and rough hardware for a rigid and secure installation. In addition to mechanical fasteners, place continuous adhesive bead where appropriate in accordance with manufacturer's instructions.
- 3.3.8 Countersink bolts where necessary to provide clearance for other work.
- 3.3.9 Select exposed framing for appearance. Install lumber and panel materials so that grade-marks and other defacing marks are concealed or are removed by sanding where materials are left exposed.
- 3.3.10 Provide plywood, blocking, furring, nailers, rough carpentry, grounds and nailing strips, as required for proper installation and to support miscellaneous work indicated on Drawings to meet design requirements.

### **3.4 Plywood Backing Panels**

- 3.4.1 Install wood panels required for mechanical, electrical and communication trades for mounting of items including but not limited to control boards, panel boards, pull boxes, splitters, switches, wall-mounted switch gear, junction boxes, electrical cabinets, data control equipment, disconnect switches, fire alarm control equipment, lighting control equipment, sound/communication equipment and other similar devices.
- 3.4.2 Provide plywood backboard panels in one piece screw-fastened and securely mounted to wall surfaces by use of fire-retardant-treated wood strapping.
- 3.4.3 Ensure panel size and mounting height suit mechanical and electrical requirements and are acceptable to respective Consultants. Apply to all surfaces and edges of plywood panels 1 coat of fire-retardant wood preservative to surfaces and edges of plywood panels.

### **3.5 Roof Carpentry**

- 3.5.1 Install continuous wood nailers along roof control joints, building and roof expansion joints and around roof perimeters, curbs and roof openings at edges of insulation as shown on Drawings.
- 3.5.2 Install cut cant strips and continuous nailers on copings and curbs as detailed.
- 3.5.3 Secure using fasteners as specified herein.

- 3.5.4 Install roof walkways in coordination with roofing Section. Set sleepers and cleats on roof during roofing application and before installation of flood coat of asphalt and gravel surfacing.

**3.6     Protection**

- 3.6.1 Protect installed products and components from damage during construction.
- 3.6.2 Repair damage to adjacent materials caused by rough carpentry installation.

**3.7     Protection**

- 3.7.1 Protect rough carpentry from weather. If, despite protection, rough carpentry becomes sufficiently wet that moisture content exceeds that specified, apply borate treatment complying with requirements of authorities having jurisdiction in regards to toxicity.

**3.8     Cleaning And Waste Management**

- 3.8.1 Cleaning and Waste Management, generally: in accordance with Section 01 74 00, Cleaning and Waste Management.
- 3.8.2 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
- 3.8.3 Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**END OF SECTION**



## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Design-Build Contract and Subcontracts, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the sheathing work specified herein. This includes, but is not necessarily limited, to:
  - .1 Wall sheathing.
  - .2 Sheathing joint and penetration treatment.
  - .3 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

### **1.4 Preinstallation Meetings**

- 1.4.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.
- 1.4.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
  - .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.

- .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.
- .3 Agenda:
  - .1 Review progress of related construction activities and preparations for particular activity under consideration.
  - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
- .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
- .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

## **1.5 Submittals**

- 1.5.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.5.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for sheathing work specified in this Section.
- 1.5.3 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
  - .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
  - .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
  - .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.5.4 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:
  - .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.
  - .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.

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**1.6      Closeout Submittals**

- 1.6.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.
- 1.6.2 Operating and Maintenance Data: Submit care and maintenance instructions for sheathing to be included in building operation and maintenance manual.
- 1.6.3 Warranty Documentation: Submit copy of extended warranties specified in this Section.

**1.7      Quality Assurance**

- 1.7.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.
- 1.7.2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.
- 1.7.3 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.

**1.8      Delivery, Storage And Handling**

- 1.8.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.
- 1.8.2 Deliver, store and handle sheathing materials in accordance with manufacturer's written instructions.
- 1.8.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.8.4 Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

**1.9      Warranty**

- 1.9.1 Provide warranty covering the Work of this Section in accordance with Supplementary Condition SC49 / GC 12.3 WARRANTY.

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## **2 . PRODUCTS**

### **2.1 Manufacturers**

2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:

- .1 CertainTeed Corporation
- .2 Georgia Pacific Gypsum Corporation
- .3 USG/CGC

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

### **2.2 Performance / Design Criteria**

2.2.1 Fire Rated Assemblies: For assemblies shown on Drawings that require with fire-ratings, use materials and construction methods validated through CAN/ULC-S101 testing by a testing and inspecting agency acceptable to authorities having jurisdiction.

- .1 Demonstration of compliance: Fire-rated assemblies must be either listed in ULC Certification Directories or bear cUL label "BXUV7 – Fire Resistance Ratings – CAN/ULC-S101 Certified for Canada".

### **2.3 Glass-Mat Gypsum Wall Sheathing**

2.3.1 Material Standards: ASTM C1177/1177M.

- .1 Do not use products with paper or organic facing materials.

2.3.2 Type and Thickness: Type X, 15.9 mm (5/8 inch) thick, or as indicated on Drawings.

2.3.3 Acceptable Products:

- .1 "DensGlass Sheathing" by Georgia Pacific Gypsum Corporation
- .2 "GlasRoc" by CertainTeed Corporation
- .3 "Securock" by CGC Inc.

### **2.4 Auxiliary Materials**

2.4.1 Fasteners: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

- .1 Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: steel drill screws with appropriate length as recommended by sheathing manufacturer and with protective coating having salt-spray resistance exceeding 800 hours in accordance with ASTM B117.

- .2 For steel framing < 0.835 mm (0.0329 inch): Use screws complying with ASTM C1002.
- .3 For steel framing between 0.84 and 2.84 mm (0.033 and 0.112 inch) thick: Use screws complying with ASTM C954.
- 2.4.2 Sealant for Sheathing: silicone emulsion sealant as recommended by manufacturer and complying with ASTM C834, compatible with sheathing tape and sheathing.

### **3 . EXECUTION**

#### **3.1 Examination**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.

#### **3.2 Installation**

- 3.2.1 Compliance: Comply with ASTM C1280, GA-253 and with manufacturer's written instructions.
- 3.2.2 Installation, generally: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.
- 3.2.3 Material Quality: Do not use defective materials or small pieces that might compromise joint arrangements. Ensure panels do not span fewer than three support members.
- 3.2.4 Cutting: Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated on Drawings and Schedules.
- 3.2.5 Attachment: Securely attach to substrate by fastening as indicated; comply with manufacturer's instructions.
- 3.2.6 Coordination: Align wall sheathing installation with flashing and joint-sealant installation to prevent moisture penetration in wall assemblies. Do not bridge building expansion joints; match sheathing edges to structural support spaces. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.
- 3.2.7 Fastener Application: Ensure fastener heads sit tight against sheathing face without cutting into sheathing.

- 3.2.8 Sealant: Seal penetrations in sheathing in accordance with manufacturer's written instructions.

**3.3 Protection**

- 3.3.1 Protect sheathing from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades.
- 3.3.2 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in writing by affected material's manufacturer. Do not use materials or process that can damage finishes, surfaces, or construction.
- 3.3.3 Promptly replace sheathing work damaged during construction that cannot be satisfactorily repaired.

**3.4 Cleaning And Waste Management**

- 3.4.1 Cleaning and Waste Management, generally: in accordance with Section 01 74 00, Cleaning and Waste Management.
- 3.4.2 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
- 3.4.3 Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**END OF SECTION**

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the architectural woodwork work specified herein. This includes, but is not necessarily limited, to:
  - .1 Casework and associated hardware.
  - .2 Wood wall paneling
  - .3 Closet and utility shelving.
  - .4 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

### **1.4 Preinstallation Meetings**

- 1.4.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.
- 1.4.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
  - .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.

- .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.
- .3 Agenda:
  - .1 Review progress of related construction activities and preparations for particular activity under consideration.
  - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
- .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
- .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

## **1.5 Administrative Requirements**

### **1.5.1 Coordination:**

- .1 Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that architectural woodwork and related items can be supported and installed as indicated.
- .2 Perform pre-wiring and partial mounting of electrical and audio/visual equipment and concealed wiring required. Finalize location of outlets and similar items with Consultant prior to installation.
- .3 Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.
- .4 Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- .5 Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.

## **1.6 Submittals**

- 1.6.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.6.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for architectural woodwork work specified in this Section.
- 1.6.3 Safety Data Sheets (SDS): Submit SDS for inclusion in Operation and Maintenance Manual specified in Section 01 78 00, for



adhesives, sealants and any other material designated by Consultant.

- 1.6.4 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:
- .1 Include plans, elevations, sections and details as applicable.
  - .2 Indicate field-measured dimensions on Shop Drawings.
  - .3 material characteristics, details of construction, connections and relationship with adjacent construction.
  - .4 locations and sizes of cutouts and holes for plumbing and electrical fixtures, lavatories and similar items required in architectural woodwork; coordinate with appropriate trades.
  - .5 show connections, attachments, reinforcing, anchorage and location of exposed fastenings in accordance with NAAWS Section 1.
- 1.6.5 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
- .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
  - .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
  - .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.6.6 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:
- .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.
  - .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.6.7 Samples: Submit selection and verification samples for Products requiring colour, texture, or design selection. Submit manufacturer's list of finishes or colour swatches for Consultant's selection.
- .1 As a minimum submit samples of the following:
    - .1 For each colour of plastic laminate or wood veneer species selected (as applicable), submit manufacturer's standard 300 mm x 460 mm (12" x 18") chips.
    - .2 For each type of hardware.

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**1.7     Closeout Submittals**

- 1.7.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.
- 1.7.2 Operating and Maintenance Data: Submit care and maintenance instructions for architectural woodwork to be included in building operation and maintenance manual.
- 1.7.3 Warranty Documentation: Submit copy of extended warranties specified in this Section.

**1.8     Quality Assurance**

- 1.8.1 Fabricator Qualifications: Provide Products for Work of this Section by casework fabricator with minimum 10 years' experience in the manufacture of such materials, and who has been a member of AWMAC in good standing for the previous 2 years.
- 1.8.2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance, and who have been members of AWMAC in good standing for the previous 2 years.
- 1.8.3 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.
- 1.8.4 Mock-Ups / First Installation Review: Construct mock-ups to verify selections made under submittals, demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - .1 Location: In-situ (i.e. first installation), as directed on site by Consultant.
  - .2 Purpose: To set benchmarks for installation and to judge subsequent work. Maintain Mock-ups during construction in undisturbed condition.
  - .3 Reviewed mock-ups: May become part of the completed work if undisturbed at the time of Substantial Performance of The work, provided they are undisturbed, and comply with requirements outlined in Contract Documents.

**1.9     Delivery, Storage And Handling**

- 1.9.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.
- 1.9.2 Deliver, store and handle architectural woodwork materials in accordance with manufacturer's written instructions.

- .1 Cover and protect finished surfaces with heavy kraft paper and method acceptable to Consultant. Do not remove protective covers until immediately prior to final cleaning.
- .2 Where applicable, handle, store, and install fire-retardant-treated wood to comply with manufacturer's written instructions, including requirements for adhesives used to install woodwork.
- 1.9.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.9.4 Store materials in off-ground, in clean, dry, well-ventilated area.
- 1.9.5 Replace defective or damaged materials with new.

**1.10 Field Conditions**

- 1.10.1 Environmental Restrictions: Do not deliver or install architectural woodwork until building is enclosed, wet work is complete, and HVAC system is operational and will maintain temperature and relative humidity levels equal to occupancy levels for remainder of construction period.
- 1.10.2 Field Measurements: Verify actual dimensions of construction contiguous with architectural woodwork by field measurements before fabrication.

**1.11 Site Conditions**

- 1.11.1 Ambient Conditions: Ensure products are stored in climate-controlled areas with functional HVAC system and relative humidity and moisture content values that fall within the following range:
  - .1 Unless indicated otherwise:
    - .1 Moisture Content: 5-10%, Relative Humidity: 25-55%

**1.12 Warranty**

- 1.12.1 Extended warranty: Submit for Owner's review and acceptance, manufacturer's extended warranty in which manufacturer commits to repair or replace components of architectural woodwork that fail within specified warranty period. Manufacturer's extended warranty is in addition to, and does not supersede, any other rights that Owner may have under Contract Documents.
  - .1 Warranty Period: Not less than 3 years from date of Substantial Performance of The work.

**2 . PRODUCTS**

**2.1 Performance / Design Criteria**

- 2.1.1 Regulatory Requirements:

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- .1 Provide work in accordance with North American Architectural Woodwork Standards (NAAWS), latest edition, as published by the Architectural Woodwork Association of Canada (AWMAC), unless otherwise specified herein.
  - .2 All references to grades and terminology in this Section refer to grades defined in NAAWS and are incorporated into this Section by reference. Requirements specified in this Section govern and modify NAAWS.
  - .3 Unless indicated otherwise, Provide work of this Section in accordance with following NAAWS grades:
    - .1 Where plastic laminate facing is used: Custom.
    - .2 Where wood veneer or solid wood is used: Premium.
- 2.1.2 VOC Content and Emissions:
- .1 Composite Wood: must be ULEF or NAF type per CARB ATCM. Do not adhesives that contain urea-formaldehyde.
- 2.1.3 Design and Performance Requirements:
- .1 Architectural Drawings and details are diagrammatic and are only intended to show design concept, aesthetics, interfacing requirements, configuration, components and arrangements. They are not intended to identify or solve completely problems of thermal and structural movements, assembly framing, engineering design, fixings and anchorages.
  - .2 Seismic Performance: Provide products and systems specified in this Section to withstand the effects of earthquake motions in accordance with OBC 4.1.8.18 and CAN/CSA S832.
    - .1 Professional engineer specified in Division 01 and referenced in this Section shall be responsible for designing systems and submitting signed and sealed analysis data and Shop Drawings illustrating seismic-resistant systems.
    - .2 Refer to Structural Drawings for seismic sensitivity values.
  - .3 Ensure architectural woodwork (e.g. wall cabinets, cabinet drawers and similar items) are capable of supporting structural loads without deflection in accordance with Casework Integrity Tests indicated in Appendix A of NAAWS.
    - .1 Minimum nominal thickness and material for cabinet components and shelf deflection, type of materials, thicknesses, span width, and total load distribution must conform to NAAWS "Section 10 - Casework" and be suitable for "schools, hospitals, and library" grades.
  - .4 Seal wood surfaces and edges unless indicated otherwise. Exposed wood cores are not permitted.

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- .5 Provide cabinets with flush overlay construction.
  - .6 Provide architectural woodwork such that no sharp edges are exposed.
  - .7 Incorporate required mechanical, electrical and communication services into architectural woodwork so that wires and pipes are hidden from view. Provide access panels to services to allow for future adjustment.
  - .8 Provide built-in valance lighting underneath all upper cupboards over countertops as indicated on Drawings;
  - .9 Doors, drawers, and other exposed architectural woodwork edges must be fitted with heat-applied, appropriately-sized ABS or other durable PVC-free edge strips. Plastic laminate-to-plastic laminate edges are not permitted.
  - .10 Provide locks for of doors and drawers as indicated on Drawings. Final lock locations will be established in consultation with Owner prior to occupancy. Provide locks keyed in accordance with Owner's keying requirements.
  - .11 Cores for architectural woodwork must be MDF unless indicated otherwise. At locations subject to moisture, provide veneer core plywood cores and substrates. Do not use veneer core plywood at cabinet door or drawer front components and wall or ceiling panels.
  - .12 Provide veneer core plywood with water-resistant adhesives to bottoms of sink cabinet boxes and other areas that may come into contact with water.
  - .13 Fire Retardant Treated Materials:
    - .1 Where fire-retardant-treated materials are indicated or required by authorities having jurisdiction, use materials impregnated with fire-retardant chemicals by pressure process or other means acceptable to Consultant to produce Products with flame-spread ratings of less than 25 when tested in accordance to CAN/ULC-S102.
    - .2 Use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes when preservative or fire-retardant treatment is required for exposed items designated to receive a stained or natural finish.

## **2.2 Framing Lumber**

2.2.1 As specified in Section 06 10 00, Rough Carpentry.

2.2.2 Comply with requirements of "Section 03 – Lumber" of NAAWS.

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**2.3 Panel Products**

- 2.3.1 Comply with requirements of "Section 04 – Sheet Products" of NAAWS.
- 2.3.2 Medium Density Fibreboard Core (MDF): to ANSI A208.2, Grade 155 unless indicated otherwise.
  - .1 Acceptable Products: "NU Green MR50 NAF MDF" by Uniboard or approved equivalent by one of the following:
    - .1 Sierra Pine Ltd; [www.sierrapine.com](http://www.sierrapine.com)
    - .2 Flakeboard Company Limited.; [www.flakeboard.com](http://www.flakeboard.com),
    - .3 Tafisa Canada and Company, Ltd.; [www.tafisa.ca](http://www.tafisa.ca).
- 2.3.3 Veneer Core Plywood:
  - .1 Softwood plywood: Premium Grade, Douglas Fir plywood - CSA O121, or Western Softwood Plywood - CSA O151 or Poplar plywood - CSA O153-M.
  - .2 Hardwood Plywood (wood cores): Conforming to ANSI/HPVA HP-1.
  - .3 Provide exterior grade, veneer core plywood with moisture-resistant adhesives at locations where sinks are scheduled to be installed and at other locations indicated on Drawings
  - .4 Provide veneer core (plywood) at following locations:
    - .1 architectural wood casework cores subject to moisture (where sinks are indicated),
    - .2 cabinet bases in contact with floor,
    - .3 other locations indicated on Drawings and Schedules

**2.4 Wood Face Veneer**

- 2.4.1 Material Tag: This item is noted as "WDVN-1" on Drawings and Schedules.
- 2.4.2 Comply with requirements of "Section 04 – Sheet Products" of NAAWS.
- 2.4.3 Face Grade: Minimum 0.8 mm (0.03") thick, Grade A in accordance with requirements of AWMAC NAAWS Section 4 to match approved samples and containing no open joints, face depression, glue stain, patches, plastic repair or other manufacturing irregularities or defects
- 2.4.4 Species, Slicing and Matching: Refer to Finish Schedule on Drawings.
- 2.4.5 Facing Adhesive: non-toxic adhesive complying with NAAWS "Adhesive Usage Guide" Appendix, as recommended by manufacturer for substrates encountered, containing no added

urea-formaldehyde, and meeting VOC content and emissions criteria specified in this Section.

- .1 Provide water-resistant adhesive in areas subject to moisture.
- .2 Provide fully waterproof where casework is installed in non-climate-controlled areas.
- .3 Contact cement is not permitted for application of wood veneers.

## **2.5 Plastic Laminate**

- 2.5.1 Material Tag: This item is noted as “WD-1” on Drawings and Schedules.
- 2.5.2 Comply with requirements of “Section 04 – Sheet Products” of NAAWS.
- 2.5.3 Provide high-pressure laminates (HPL) complying with requirements of ANSI/NEMA LD3 or ISO 4526 consisting of multiple layers of thermosetting resin-saturated Kraft paper in combination with a layer of decorative melamine-saturated paper, fused together under heat and pressure.
- 2.5.4 Colours and Finishes: Refer to Finish Schedule on Drawings.

## **2.6 Plastic-Laminate-Clad Casework**

- 2.6.1 Comply with requirements of “Section 10 – Casework” of NAAWS.
- 2.6.2 Casework Construction Type: Frameless construction with edge banded front edges
- 2.6.3 Interface Style: Flush Overlay unless otherwise indicated.
- 2.6.4 Core for Exposed Surfaces, Semi-Exposed Surfaces and Concealed Surfaces: Douglas Fir Plywood (DFP), refer to Section 06 10 00 – Rough Carpentry.
- 2.6.5 Cladding: high-pressure laminate as follows:
  - .1 Exposed Surfaces:
    - .1 Horizontal Surfaces Other Than Tops: HGP
    - .2 Vertical Surfaces: VGP.
    - .3 Finish: WD-2 as specified in this Section.
  - .2 Semi-Exposed Surfaces:
    - .1 Surfaces Other Than Drawer Bodies: VGP.
    - .2 Drawer Sides and Backs: VGP.
    - .3 Drawer Bottoms: HGP
    - .4 Finish: solid colour to match exposed surfaces
  - .3 Concealed Surfaces: BKL

2.6.6 Edgebanding: ABS or other durable PVC-free edgebanding colour-matched to plastic-laminate in colour, pattern, and finish with following minimum thicknesses:

- .1 Case bodies: minimum 0.5 mm (0.0197") thick,
- .2 Doors, drawer fronts, and false fronts: minimum 3 mm (1/8") thick.
- .3 Acceptable Manufacturers: Richelieu Hardware or Wilsonart or approved equivalent.

## **2.7 Wood Wall Panels**

2.7.1 Grade: Premium.

2.7.2 Panel Core Construction: Minimum 25 mm thick, fireretardant medium-density fiberboard (MDF). Panels shall have a flame-spread index of 25 or less and a smoke-developed index of 150 or less per CAN/ULC-S102/S102.2.

2.7.3 Exposed Faces:

- .1 WD-01 as specified in this Section

2.7.4 Fastener visibility: concealed fasteners assembly.

2.7.5 Exposed Panel Edges: to match exposed faces

2.7.6 Mounting System: Aluminum J-channel extrusions or Galvanized steel Z-clips.

## **2.8 Countertops And Backsplashes**

2.8.1 Comply with requirements of "Section 11 – Countertops and Horizontal Surfaces" of NAAWS.

2.8.2 Solid Surface Countertops: Refer to Section 06 61 16, Solid Polymer Fabrications.

## **2.9 Architectural Wood Casework Hardware And Accessories**

2.9.1 Provide stainless steel wood casework hardware meeting or exceeding applicable requirements indicated in ANSI/BHMA A156 Standards for Grade 1 hardware.

2.9.2 Slides

- .1 Light Duty Drawer Slides – 610 mm (24") wide or less, Capacity: 34.02 kg (75 lbs.):
  - .1 Side Mounted Telescoping Ball Bearing drawer slide, 3/4 extension (length as required to suit drawer size); Following products are acceptable: :
    - .1 Model No. Accuride – 2132 by Hafele; [www.hafele.com](http://www.hafele.com)
    - .2 Model No. KA 3432 – by Hettich; [www.hettich.com](http://www.hettich.com)



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- .3 Approved equivalent by Knap & Vogt;  
[www.knapandvogt.com](http://www.knapandvogt.com)
  - .2 Light Duty Drawer Slides – 610 mm (24") wide or less, Capacity:  
30 kg (66 lbs.):
    - .1 Under Mounted Telescoping Ball Bearing drawer slide,  
full extension (length as required to suit drawer size);  
Following products are acceptable: :
      - .1 "Model No. Tandem slide #560H Series" by  
Richelieu Hardware; [www.richelieu.com](http://www.richelieu.com)
      - .2 Model No. Quadro V6 by Hettich; [www.hettich.com](http://www.hettich.com)
      - .3 Approved equivalent by Knap & Vogt;  
[www.knapandvogt.com](http://www.knapandvogt.com) or by Hafele;  
[www.hafele.com](http://www.hafele.com)
  - .3 Medium Duty Drawer Slides – 610 mm (24") wide or less,  
Capacity: 40.82 kg (90 lbs.):
    - .1 Side Mounted Telescoping Ball Bearing drawer slide with  
full extension and 25 mm (1") over travel (length as  
required to suit drawer size); Following products are  
acceptable: :
      - .1 Model No. Accuride – 3834 by Hafele;  
[www.hafele.com](http://www.hafele.com)
      - .2 Model No. 8455 by Knap & Vogt;  
[www.knapandvogt.com](http://www.knapandvogt.com)
      - .3 Model No. KA 5632/1" OT by Hettich;  
[www.hettich.com](http://www.hettich.com)
  - .4 Medium Duty Drawer Slides – more than 610 mm (24") wide,  
Capacity 45.36 kg (100 lbs.)
    - .1 Side Mounted Telescoping Ball Bearing drawer slide with  
full extension (length as required to suit drawer size);  
Following products are acceptable: :
      - .1 Model No. Accuride – 3832 by Hafele;  
[www.hafele.com](http://www.hafele.com)
      - .2 Model No. 1375 by Knap & Vogt;  
[www.knapandvogt.com](http://www.knapandvogt.com)
      - .3 Model No. KA 5632 by Hettich; [www.hettich.com](http://www.hettich.com)
  - .5 Heavy Duty Drawer Slides – more than 610 mm (24") wide,  
Capacity: 68.04 kg (150 lbs.)
    - .1 Side Mounted Telescoping Ball Bearing drawer slide with  
full extension and 25 mm (1") over travel (length as  
required to suit drawer size); Following products are  
acceptable:
      - .1 Model No. Accuride – 3640 by Hafele;  
[www.hafele.com](http://www.hafele.com)

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- .2 Model No. 8505 by Knappe & Vogt;  
[www.knappeandvogt.com](http://www.knappeandvogt.com)
  - .3 Model No. KA 555 by Hettich; [www.hettich.com](http://www.hettich.com)
  - .6 Trash Bin Slides: Soft closing, manual, ball bearing full extension slides with over travel complete with powder-coated steel frame, plastic cover and plastic rails. Following products are acceptable: :
    - .1 Provide "EZ-Cargo Recycling Center, #366840100" by Richelieu Hardware; [www.richelieu.com](http://www.richelieu.com)
    - .2 "Side-Mount Trash Can" by Hafele; [www.hafele.com](http://www.hafele.com)
    - .3 "Bin.It DuoII 0049474" by Hettich; [www.hettich.com](http://www.hettich.com)
  - .7 Flipper Door Slides: Mount as shown on Drawings. Following products are acceptable:
    - .1 "Easy-down Flipper Door Slide for wood applications - Accuride 1155;
    - .2 "Model No. 408.22 Series" by Hafele; [www.hafele.com](http://www.hafele.com)
    - .3 Approved equivalent by Richelieu Hardware; [www.richelieu.com](http://www.richelieu.com).
  - .8 Lid Stays:
    - .1 "Duo Swing-up Fittings" by Hafele; [www.hafele.com](http://www.hafele.com)
    - .2 "Top box stay KLS 30/250" by Hettich; [www.hettich.com](http://www.hettich.com)
    - .3 Approved equivalent complete with lid/flap stay arm, side mounting cabinet bracket and door mounting bracket.
- 2.9.3 Cabinet Door Hinges and Stays:
- .1 Wood Door Hinges:
    - .1 Frameless Concealed Hinges (European Type): Self-closing concealed hinges with integrated soft close. Manufacturer's recommended number of hinges to suit door size and thickness.
    - .2 Opening angle: Minimum 160°, except Provide 110° at locations adjacent to walls to prevent wall damage.
    - .3 Acceptable Products: "Salice Concealed Hinges 200 and 300 Series" by Hafele; [www.hafele.com](http://www.hafele.com) or "Blum Concealed - Clip-Top Hinge" by Richelieu Hardware; [www.richelieu.com](http://www.richelieu.com) or "Intermat 9943" or "Intermat 9956" by Hettich; [www.hettich.com](http://www.hettich.com)
- 2.9.4 Door and Drawer Locks:
- .1 Cylinder Locks: Provide adjustable locking system with lock throw, orientation and size to suit cabinet size. Following products are acceptable: :

- .1 "Cylinder Module System; Model No. 232 Series" by Hafele; [www.hafele.com](http://www.hafele.com) complete with cam locks or deadbolt locks and cores as required to suit applications indicated.
  - .2 "Disc Tumbler Furniture Locks - Removacore" by CompX National complete with cam locks or deadbolt locks and cores as required to suit applications indicated
- 2.9.5 Handles (Doors and Drawers):
- .1 D-Pulls: Following products are acceptable:
    - .1 "Modern Steel Pull – 305" by Richelieu
- 2.9.6 Recessed Shelf Pilasters, Standards and Clips: Provide required accessories to mount wood or glass shelves. Following products are acceptable: :
- .1 "KV255" pilaster and "KV256" adjustable clip supports by Knappe & Vogt; [www.knappeandvogt.com](http://www.knappeandvogt.com)
  - .2 "120-10 Series" pilasters and "1903-2G" clip supports by Richelieu Hardware; [www.richelieu.com](http://www.richelieu.com)
- 2.9.7 Drawer and Hinged Door Bumpers: Provide 2 clear resilient, press-fit bumpers per door or drawer.
- 2.9.8 Closet Coat Rods: "KV660" by Knappe and Vogt Manufacturing Company, 27 mm (1-1/16") od stainless steel rod complete with "KV734 – Full Circle" polished chrome flanges. Size rods to suit closet widths.

## **2.10 Finishes**

- 2.10.1 Comply with requirements of "Section 05 – Finishing" of NAAWS.
- 2.10.2 Factory Finishing: As far as practical, ensure casework is factory finished unless otherwise indicated or unavoidable.
- .1 Defer only final touch-up, cleaning, and polishing until after installation.
  - .2 Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.
- 2.10.3 Provide NAAWS System – 5, Varnish, Conversion or System – 7, Vinyl, Catalyzed finish unless indicated otherwise.
- 2.10.4 If staining is required or specified, match Consultant's control sample.
- 2.10.5 Prime unexposed surfaces including backs of casework elements that are against walls and their underside.

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**2.11     Fabrication**

- 2.11.1 Fabricate joints accurately fitted, coped where possible, and well glued up. Fabricate joints mitered to proper fit and with alignments carefully matched.
- 2.11.2 Fabricate finished woodwork in single pieces where possible. Fabricate running members in longest practicable lengths.
- 2.11.3 Conceal fastenings. Set nails and countersink screws and apply matching wood filler to indentations. Sand smooth and leave ready to receive finish.
- 2.11.4 Fabricate exposed gables to match adjacent exposed finishes. Ensure adjacent parts of continuous facing work match in colour and pattern.
- 2.11.5 Install cabinet hardware for doors, shelves and drawers in shop. Recess shelf standards unless noted otherwise.
- 2.11.6 Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes and other fixtures. Coordinate with other Divisions.
- 2.11.7 Shop-assemble work for delivery to site in size that can be easily handled and to ensure passage through building openings.
- 2.11.8 Apply plastic-laminate or wood veneer (as applicable) to core materials in accordance with adhesive manufacturer's instructions. Ensure core and laminate profiles coincide to provide continuous support and bond over entire surface.
- 2.11.9 Provide balanced construction. Apply backing sheet to reverse side of cores.
- 2.11.10 Replace, rework and refinish components that do not meet NAAWS requirements for grades specified herein at no additional cost to Owner.

**3 .     EXECUTION**

**3.1     Examination**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.
- 3.1.2 Verify that shop-fabricated work is ready for installation. Complete additional work as required, such as packing removal and back priming, before installing architectural woodwork.
- 3.1.3 Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

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**3.2     Preparation**

- 3.2.1 Before installation, condition woodwork to average prevailing humidity conditions in installation areas.

**3.3     Installation**

- 3.3.1 Installation, generally: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.
- 3.3.2 Comply with requirements of "Section 14 – Installation" of NAAWS and other applicable requirements in corresponding product sections of NAAWS.
- 3.3.3 Assemble woodwork and complete fabrication at site to comply with fabrication requirements specified herein.
- 3.3.4 Scribe and cut woodwork to fit adjoining work. Refinish cut surfaces, and repair damaged finish at cuts. Mitre exposed corners and butt joints.
- 3.3.5 Anchor wood casework to built-in anchors or blocking or directly to substrates in order to thoroughly fix and anchor Work of this Section into position.
- 3.3.6 Secure wood casework with countersunk, concealed fasteners and blind nailing as required for complete installation. Provide heavy duty fixture attachments for wall mounted cabinets.
- 3.3.7 Use fine finishing nails or finishing screws, countersunk and filled flush with woodwork, for exposed fastening (where permitted), and matching final finish if transparent finishes are specified.
- 3.3.8 Scribe and cut as required to fit abutting walls and to fit properly into recesses and to accommodate piping, columns, fixtures, outlets or other projecting, intersecting or penetrating objects.
- 3.3.9 Cabinetry:
- .1 Install cabinets without distortion to ensure doors and drawers fit openings properly, and are accurately aligned.
  - .2 Adjust hardware to center doors and drawers in openings and to provide unencumbered operation.
  - .3 Install cabinets with no more than 3 mm in 2400 mm (1/8" in 8'-0") sag, bow, or other variation from straight line
  - .4 Maintain sequence matching of cabinets for plastic-laminate or wood veneer facings, and in accordance with NAAWS grade specified.

- .5 Fasten wall cabinets with toggle bolts through metal backing or metal framing behind wall finishes through their back, near top and bottom, at ends, and at no more than 400 mm (16") o.c.

3.3.10 Hardware and Accessories:

- .1 Install architectural wood casework hardware in accordance with NAAWS requirements and manufacturer's templates.
- .2 Fit hardware accurately and securely in accordance with manufacturer's written instructions.
- .3 Adjust architectural wood casework hardware to provide smooth operation and ensure clearances are maintained.
- .4 Provide lubricants required and use in manner to ensure smooth function of hardware consistent with manufacturer's recommendations.

3.3.11 Mechanical and Electrical Fittings:

- .1 Provide openings required to accommodate mechanical and electrical fittings as part of the Work of this Section.
- .2 Locate and Install lenses where indicated.
- .3 Mount lenses perfectly level or plumb.
- .4 Ensure lenses fit tightly without showing space or light leak between frame and lenses.
- .5 Refer to Divisions 21, 22 23, 26, 27 and 28 for additional requirements.

**3.4 Tolerances**

- 3.4.1 Comply with requirements of "Section 15 – Tolerances" of NAAWS.

**3.5 Protection**

- 3.5.1 Protect architectural woodwork from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades.
- 3.5.2 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in writing by affected material's manufacturer. Do not use materials or process that can damage finishes, surfaces, or construction.
- 3.5.3 Promptly replace architectural woodwork work damaged during construction that cannot be satisfactorily repaired.

**3.6 Adjusting, Cleaning And Waste Management**

- 3.6.1 Cleaning and Waste Management, generally: in accordance with Section 01 74 00, Cleaning and Waste Management.

- 3.6.2 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
- 3.6.3 Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.
- 3.6.4 Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects.
- 3.6.5 Where repair is not possible or practical, replace woodwork to satisfaction of Consultant and at no cost to Owner.
- 3.6.6 Adjust joinery for uniform appearance.
- 3.6.7 Clean, lubricate, and adjust moving and operating parts to function smoothly and correctly.
- 3.6.8 Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**END OF SECTION**

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Solid Surfacing Fabrications work specified herein. This includes, but is not necessarily limited, to:
- .1 Solid polymer surface countertops.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.
- .1 Related requirements provided below are for convenience purposes only.
    - .1 Section 06 40 00 – Architectural Woodwork

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Preinstallation Meetings**

- 1.4.1 Pre-installation Meetings: Schedule, and conduct pre-installation meeting at Project Site, in order to coordinate work of this Section, with work of related Subcontractors.
- .1 Ensure attendance of Subcontractor performing work of this Section and representatives of manufacturers and fabricators involved in, or affected by, installation and coordination with other materials and installations that have preceded or will follow. Advise Consultant and Owner in advance of scheduled meeting dates.
  - .2 Agenda: Review progress of other construction activities and preparations for the particular activity under consideration.
  - .3 Record significant discussions, agreements, and disagreements, including required corrective measures and actions.



- .4 Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.

## **1.5 Action Submittals**

- 1.5.1 Product Data: Submit product data in accordance with Division 01 for the following:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for the Solid Surfacing Fabrications work and include product characteristics, performance criteria, physical size, finish and limitations.
- 1.5.2 Shop Drawings: Submit shop drawings in accordance with Division 01, for solid surfacing fabrications. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
  - .1 Show locations and details of joints.
  - .2 Show direction of directional pattern, if any.
  - .3 Include elevations, section details, and large scale details.
- 1.5.3 Samples: Submit samples in accordance with Division 01, selection and verification samples for each colour, pattern, and finish required.
  - .1 Submit a minimum 300 mm (12 inch) wide by 150 mm (6 inch) deep, full size sample for each type of countertop shown on Drawings. Sample must include at least one seam, edge profile and backsplash as detailed on Drawings.

## **1.6 Closeout Submittals**

- 1.6.1 Maintenance Data: Submit maintenance data in accordance with Division 01, for solid polymer surface fabrications to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

## **1.7 Quality Assurance**

- 1.7.1 Fabricator Qualifications: Shop that is certified by the solid surfacing material manufacturer, with minimum 5 years experience, and that employs skilled workers who custom-fabricate fabrications similar to that required for this Project, and whose products have a record of successful in-service performance.
  - .1 Upon request, submit solid polymer manufacturer's certification attesting to fabricator qualification approval.
- 1.7.2 Mock-ups: Build mock-ups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.

- .1 Build mockup of typical fabrication where directed by Consultant.
- .2 Subject to compliance with requirements, reviewed mock-ups may become part of the completed Work if undisturbed at time of Substantial Performance of the Work.

**1.8 Delivery, Storage, And Handling**

- 1.8.1 Do not deliver materials to project site until areas are ready for installation. Do not deliver or install solid surfacing fabrications until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at design levels during the remainder of the construction period
- 1.8.2 Deliver components and materials to the site undamaged, in containers clearly marked and labeled with manufacturer's name.
- 1.8.3 Store materials indoors with adequate precautions taken to prevent damage to finished surfaces.
- 1.8.4 Provide protective coverings to prevent physical damage or staining following installation, for duration of project.

**1.9 Field Conditions**

- 1.9.1 Field Measurements: Verify dimensions of fabrications by field measurements after base cabinets are installed but before fabrication is complete. Show recorded measurements on Shop Drawings.
- 1.9.2 Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays
- 1.9.3 Adhesive: Acclimatize adhesives to occupancy room temperatures with maximum temperature not to exceed 24 deg C (75 deg F).

**1.10 Coordination**

- 1.10.1 Coordinate sizes and locations of plumbing, cut-outs, and other related work specified in other sections to ensure that solid surfacing fabrications can be supported and installed as indicated

**1.11 Warranty**

- 1.11.1 Manufacturer's Warranty: Manufacturer's standard materials-only warranty in which manufacturer agrees to Supply replacement materials that does not comply with requirements of this Section within specified warranty period.
  - .1 Warranty Period: 10 years from date of Substantial Performance of the Work.

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## **2 . PRODUCTS**

### **2.1 Manufacturers**

2.1.1 Products from the following manufacturer may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents:

- .1 Corian® by Dupont;
- .2 Formica
- .3 LG Hausys
- .4 Wilsonart LLC

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

### **2.2 Regulatory Requirements**

2.2.1 Accessibility Requirements: Comply with requirements of CSA B651, the Ontario Building Code and AODA.

2.2.2 Food Equipment Material Compliance: to NSF/ANSI 51.

2.2.3 Fire testing results: Provide solid surfacing fabrications meeting the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

- .1 Surface-Burning Characteristics: As determined by testing per CAN/ULC-S102/S102.2 or equivalent to ASTM E84 subject to approval of authorities having jurisdiction.
  - .1 Flame-Spread Index: 25 or less.
  - .2 Smoke-Developed Index: 25 or less.

### **2.3 Design And Performance Requirements**

2.3.1 Only solid polymer sheets in 100 percent acrylic formulations complying with ICPA SS-1 are acceptable. Solid polymer sheets containing blends with polyester-based materials are not acceptable.

- .1 Exceptions: Solid polymer precast sinks are permitted to be of acrylic-polyester blends.

2.3.2 Materials must not be of coated, laminated, or of composite construction.

2.3.3 Veneered products consisting of a thin top layer of solid surfacing material with a structural substrate of plywood or particleboard are not acceptable.

2.3.4 Ensure superficial damage to a depth of 0.25 mm (0.010") is repairable by sanding and polishing.

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**2.4     Solid Polymer Surface Sheet Material**

2.4.1 Material Tag: This item is noted as "SSM-01" on Drawings and Schedules.

2.4.2 Provide cast, nonporous, filled, homogeneous sheets composed of minimum 30% acrylic resin (Polymethyl Methacrylate) and +/- 70% blend of natural minerals with through-body colours, complying with ICPA SS-1 and having following physical and performance properties:

- .1 Tensile Strength: 6800 psi; ASTM D638.
- .2 Tensile Modulus:  $1.5 \times 10^6$  psi; ASTM D638.
- .3 Tensile Elongation: 0.4 percent minimum; ASTM D638.
- .4 Flexural Strength: 10,000 psi; ASTM D790.
- .5 Flexural Modulus:  $1.2 \times 10^6$  psi; ASTM D790.
- .6 Thermal Expansion Coefficient:  $1.37 \times 10^{-5}$  in./in. deg F; ASTM D696.
- .7 Hardness (Barcol Impressor): 60; ASTM D2583.
- .8 Impact Resistance: 144 in. drop with no fracture; NEMA LD-3, Method 3.8.
- .9 Izod Impact: 0.28 (ft-lb.)/in.; ASTM D256, Method A.
- .10 Light Resistance - Xenon: No effect; NEMA LD-3, Method 3.3.
- .11 Stain Resistance: Pass; ANSI Z124.3.
- .12 Wear and Cleanability: Pass; ANSI Z 124.3.
- .13 Fungi Resistance: Pass; ASTM G21.
- .14 Bacterial Resistance: Pass; ASTM G22.
- .15 Boiling Water Resistance: No effect; NEMA LD-3, Method 3.5.
- .16 High Temperature Resistance: No effect; NEMA LD-3, Method 3.6.
- .17 Weatherability: Delta E less than 5; ASTM G155.
- .18 Moisture Absorption: Less than 0.5 percent; ASTM D570, long term.
- .19 Specific Gravity: 1.7 gram/cm<sup>3</sup>; ASTM D792.

2.4.3 Thickness: Unless otherwise indicated, provide material in following thicknesses:

- .1 Horizontal applications: Not less than 12 mm (1/2 inch)
- .2 Vertical applications: Not less than 6 mm (1/4 inch)

2.4.4 Basis-of-Design: Refer to Finish Schedule on Drawings.

**2.5     Supports**

2.5.1 Provide structurally adequate, continuous perimeter support frames to ensure flatness and levelness of solid polymer fabrications.

Ensure materials are capable of providing support to inside corners and across spans. Following substrates are acceptable:

- .1 Plywood: Minimum 19 mm (3/4 inch) exterior softwood plywood complying with CSA O121 or CSA O151.
- .2 Provide supports spaced at minimum 457 mm (18 inches) on centre. Do not use a full wood underlayment as a support for horizontal sheets.
- .3 Restrict unsupported overhangs to 150 mm (6 inches) maximum.

## **2.6      Components**

2.6.1 Countertops and Work Surfaces: Components manufactured from solid polymer surfaces as specified herein and with following characteristics:

- .1 Thickness: 12 mm (1/2 inch) for horizontal surfaces, 6 mm (1/4 inch) for vertical surfaces.
- .2 Edge Detail: As selected by Consultant from manufacturer's full range.
- .3 Colours and Patterns: "Stonique" by Corian
  - .1 Provide minimum 50 mm (2 inch) wide reinforcing strip of polymer material under each horizontal countertop seam.
- .4 Backsplash: Radius coved with integral, inconspicuous seams

## **2.7      Accessory Materials**

2.7.1 Provide accessory products, as specified in this Section, manufactured by solid polymer manufacturer or products approved by the solid polymer manufacturer for use with the solid polymer materials being specified.

2.7.2 Joint Adhesive: Methacrylate-based, two-part adhesive kit to create permanent, inconspicuous, non-porous, hard seams and joints by chemical bond between solid polymer materials and components.

- .1 Colour: complementary to solid surfacing sheet material.
- .2 Acceptable Product: Manufacturer's standard type.

2.7.3 Elastomeric Sealant: ASTM C920, Type S (single component), Grade NS (nonsag), Mildew-resistant silicone sealant for filling gaps between countertops and terminating substrates in wet environment applications.

- .1 Colour: complementary to solid surfacing sheet material.
- .2 Acceptable Product: Manufacturer's standard type.

2.7.4 Mounting Hardware: Provide mounting hardware, including sink/bowl clips, inserts and fasteners for attachment of undermount sinks and lavatories.

**2.8     Fabrication**

- 2.8.1 Fabricate fabrications according to solid polymer surface manufacturer's written instructions and to the AWMAC "North American Architectural Woodwork Standards."
- 2.8.2 Fabricate components in shop, to greatest extent practicable, in sizes and shapes indicated according to approved shop drawings and manufacturer published fabrication requirements.
- 2.8.3 Form joint seams between solid surfacing components with specified seam adhesive. Completed joints inconspicuous in appearance and without voids. Provide joint reinforced if required by manufacturer for particular installation conditions.
- 2.8.4 Thermoform corners and edges to shapes and sizes indicated on Drawings, prior to seaming and joining. Cut components larger than finished dimensions and sand edges to remove nicks and scratches. Ensure no blistering, whitening and cracking of components during forming.
- 2.8.5 Provide holes and cutouts indicated on reviewed shop drawings. Rout cutouts and complete by sanding all edges smooth.
  - .1 Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
  - .2 Counter-Mounted Plumbing Fixtures: Prepare fabrications in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
  - .3 Fittings: Drill fabrications in shop for plumbing fittings, undercounter soap dispensers, and similar items.

**3 .     EXECUTION**

**3.1     Examination**

- 3.1.1 Examine substrates to receive solid polymer surface fabrications and conditions under which fabrications will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fabrications.
- 3.1.2 Verify actual site dimensions and location of adjacent materials prior to commencing work.
- 3.1.3 Notify Consultant in writing of any conditions which would be detrimental to installation.
- 3.1.4 Proceed with installation only after unsatisfactory conditions have been corrected.

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**3.2     Countertop Installation**

- 3.2.1 Install components plumb, level, rigid, scribed to adjacent finishes in accordance with reviewed Shop Drawings and Product installation details.
- 3.2.2 Install countertops deflections limited to L/360 or 3 mm (1/8") sag, bow or other variation from a straight line; whichever is less.
- 3.2.3 Form joint seams with specified seam adhesive. Seams to be inconspicuous in completed work. Seams in locations shown on reviewed shop drawings and acceptable to manufacturer. Promptly remove excess adhesive.
- 3.2.4 Mount plumbing fixtures to countertops using manufacturer's recommended adhesive, mounting hardware or colour-matched silicone sealant as applicable. Secure seam mounted bowls and sinks to countertops using colour matched joint adhesive.
  - .1 Coordinate connections of plumbing fixtures with Division 22 and ensure fittings and accessories are provided by Division 22.
- 3.2.5 Complete cutouts not finished in shop. Mask areas of fabrications adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
  - .1 Seal edges of cutouts in plywood substrates by saturating with clear sealers.
  - .2 Seal exposed plywood edges and faces by saturating with clear sealers.
- 3.2.6 Apply sealant to gaps at walls; at expansion joints between solid polymer components and joints between solid polymer components and other adjacent surfaces such as walls, floors, ceiling, and plumbing fixtures. Comply with Section 07 92 00.
  - .1 Sealant bead must be smooth and uniform in appearance and use the minimum size necessary to bridge any gaps between the solid surfacing material and the adjacent surface.
  - .2 Install continuous bead that runs the entire length of the joint being sealed.

**3.3     Tolerances**

- 3.3.1 Install fabrications level to a tolerance of 3 mm in 2.4 m (1/8 inch in 8 feet), 6 mm (1/4 inch) maximum. Do not exceed 0.4-mm (1/64-inch) difference between planes of adjacent units.
  - .1 Maximum Variation From True Dimension: 3 mm (1/8 inch).
  - .2 Maximum Offset From True Position: 3 mm (1/8 inch).

**3.4     Repair**

- 3.4.1   Repair minor imperfections and cracked seams and replace areas of severely damaged surfaces in accordance with manufacturer's recommendations.

**3.5     Cleaning**

- 3.5.1   Remove excess adhesive and sealant from visible surfaces.
- 3.5.2   Clean surfaces in accordance with manufacturer's care and maintenance instructions.

**3.6     Protection**

- 3.6.1   Provide protective coverings to prevent physical damage or staining following installation for duration of Project.
- 3.6.2   Protect surfaces from damage until date of Substantial Performance of the Work.

END OF SECTION



## **1 . GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the self-adhering sheet waterproofing work specified herein. This includes, but is not necessarily limited, to:
  - .1 Modified bituminous sheet waterproofing at foundation walls.
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

### **1.4 Preinstallation Meetings**

- 1.4.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.
- 1.4.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
  - .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.
  - .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.

- .3 Agenda:
  - .1 Review progress of related construction activities and preparations for particular activity under consideration.
  - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
- .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
- .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

## **1.5 Submittals**

- 1.5.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.5.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for self-adhering sheet waterproofing work specified in this Section.
- 1.5.3 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:
  - .1 Include plans, elevations, sections and details as applicable.
  - .2 Indicate field-measured dimensions on Shop Drawings.
  - .3 Show locations and extent of waterproofing and details of substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
- 1.5.4 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
  - .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
  - .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
  - .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.5.5 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:

- .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.
  - .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.5.6 Low-Emitting Materials: For applicable Products specified or used for activities of this Section (i.e., site-applied coatings, adhesives, and sealants), submit certifications from third-party organizations indicating compliance with following:
- .1 VOC Emissions: California Department of Public Health (CDPH) Standard Method v1.2–2017, using applicable exposure scenario.
  - .2 VOC Content: SCAQMD Rule 1113 (for paints and coatings) and SCAQMD Rule 1168 (for adhesives and sealants).
- 1.5.7 Submit for Consultants review, QA checklist used as part of installation process. Make modifications to QA checklist based on Consultant feedback

**1.6 Closeout Submittals**

- 1.6.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.
- 1.6.2 Warranty Documentation: Submit copy of extended warranties specified in this Section.

**1.7 Quality Assurance**

- 1.7.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.
- 1.7.2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and employs installers and supervisors who are trained and approved by waterproofing manufacturer.
- 1.7.3 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.
- 1.7.4 Mock-Ups / First Installation Review: Construct mock-ups to verify selections made under submittals, demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

- .1 Location: In-situ (i.e. first installation), as directed on site by Consultant.
- .2 Size: 9.3 sq. m (100 sq. ft.) in area.
- .3 Purpose: To set benchmarks for installation and to judge subsequent work. Maintain Mock-ups during construction in undisturbed condition.
- .4 Reviewed mock-ups: May become part of the completed work if undisturbed at the time of Substantial Performance of The work, provided they are undisturbed, and comply with requirements outlined in Contract Documents.

**1.8 Delivery, Storage And Handling**

- 1.8.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.
- 1.8.2 Deliver, store and handle self-adhering sheet waterproofing materials in accordance with manufacturer's written instructions.
- 1.8.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.8.4 Store materials in off-ground, in clean, dry, well-ventilated area.
- 1.8.5 Replace defective or damaged materials with new.

**1.9 Field Conditions**

- 1.9.1 Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.
  - .1 Do not apply waterproofing in snow, rain, fog, or mist.
- 1.9.2 Maintain adequate ventilation during preparation and application of waterproofing materials.

**1.10 Warranty**

- 1.10.1 Extended warranty: Submit for Owner's review and acceptance, manufacturer's extended warranty in which manufacturer commits to repair or replace components of self-adhering sheet waterproofing that fail within specified warranty period. Manufacturer's extended warranty is in addition to, and does not supersede, any other rights that Owner may have under Contract Documents.
  - .1 Warranty Period: Not less than 10 years from date of Substantial Performance of The work.

- 1.10.2 Installer's Extended Warranty: Specified form, signed by Installer, covering Work of this Section, for warranty period of two years.
- .1 Warranty includes removing and reinstalling protection board, drainage boards, insulation, as required to perform repairs.

## **2 . PRODUCTS**

### **2.1 Manufacturers**

- 2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:
- .1 Carlisle Coatings & Waterproofing Inc.;
- .2 CETCO Building Materials Group,
- .3 GCP Applied Technologies Inc.;
- .4 Henry Company Canada;
- .5 IKO Industries Ltd.;
- .6 Soprema Inc.
- .7 W.R. Meadows Inc., Canada;
- 2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

### **2.2 Performance / Design Criteria**

- 2.2.1 Waterproofing System Integrity: Ensure compatibility between waterproofing system components. Do not allow waterproofing materials to touch chemically incompatible substances.
- 2.2.2 Waterproofing Application:
- .1 General Coverage: Apply waterproofing to below-grade elements subject to hydrostatic pressure that separate interior areas from ground in order to prevent water from entering into occupied or unoccupied building spaces. Waterproof entire width of footings and vertical surfaces adjacent to such spaces.
- .2 Protrusions and Penetrations: Ensure that pipes, drains, or other elements extending through substrates are waterproofed.
- .3 Footing Interfaces with Slab-on-Grade: Apply waterproofing atop footings where slabs-on-grade abuts them. Apply waterproofing in angle between toe footing and exterior face of below-ground walls receiving waterproofing.
- .4 Other locations: Apply waterproofing to other areas indicated on Drawings.
- 2.2.3 VOC Content and Emissions:

- .1 VOC Emissions: For applicable items in this Section, comply with CDPH Standard Method v1.2–2017 (CA Spec 01350) and ensure products are certified per UL 2818, SCS Global Gold, or equivalent.
- .2 VOC Content Requirements: Wet-applied materials used in scope of this Section must conform to the following:
  - .1 Paints and Coatings: SCAQMD Rule 1113 or CARB SCM.
  - .2 Adhesives and Sealants: SCAQMD Rule 1168.
  - .3 Methylene chloride and perchloroethylene must not be intentionally added in paints, coatings, adhesives, or sealants.

## **2.3 Modified Bituminous Sheet Waterproofing**

- 2.3.1 Material Tag: This item is noted as “WPM-1” on Drawings and Schedules.
- 2.3.2 Modified Bituminous Sheet: self-adhering sheet with minimum 1.5-mm (60-mil) nominal thickness consisting of rubberized asphalt laminated to polyethylene-film reinforcement. Provide with release liner on adhesive side.
- 2.3.3 General Performance Requirements:
  - .1 Tensile Strength (Membrane): Minimum: 1.7 MPa (250 psi); ASTM D412, Die C (modified).
  - .2 Ultimate Elongation: Minimum: 300%; D412, Die C (modified).
  - .3 Low-Temperature Flexibility: Pass at -25°C (-13°F); ASTM D1970 or equivalent to CAN/CGSB-51.33.
  - .4 Crack Cycling: Remains unaffected after 100 cycles of 3 mm (1/8-inch) movement; ASTM C836.
  - .5 Puncture Resistance: Minimum: 180 N (40 lbf); ASTM E154.
  - .6 Water Absorption: Maximum: 0.2% weight gain after 48 hours of immersion at 21°C (70°F); ASTM D570.
  - .7 Water Vapour Permeance: Maximum: 2.9 ng/Pa x s x sq. m (0.05 perms); ASTM E96/E 96M (Water Method).
  - .8 Hydrostatic-Head Resistance: Minimum: 60 m (200 feet); ASTM D5385.
  - .9 Lap Peel Strength at 5°C (41°F): Minimum: 580 N/m (3.3 lbf/in).
  - .10 Acceptable Products:
    - .1 “Blueskin WP 200” by Henry Company Canada.
    - .2 “Colphene 3000” by Soprema Inc.
    - .3 “Mel-Rol” by W.R. Meadows Inc., Canada.

- .4 "AquaBarrier™ FP" by IKO Industries Ltd.
- .11 Formulation must be suitable for application with primer or surface conditioner, complying with VOC limits set by authorities having jurisdiction.

## **2.4 Auxiliary Materials**

- 2.4.1 Ensure auxiliary materials are specifically recommended by waterproofing manufacturer for intended use and are fully compatible with primary waterproofing system. Supply auxiliary materials required for a complete installation.
- 2.4.2 Surface Conditioner / Primer: liquid waterborne primer or surface conditioner, recommended for specified substrate by sheet-waterproofing material manufacturer. System must be suitable for prevailing weather conditions as recommended by waterproofing manufacturer.
- 2.4.3 Substrate Patching Membrane: low-viscosity, two-component modified asphalt coating.
- 2.4.4 Termination Sealant: manufacturer's recommended solvent-based rubberized bitumen or elastomeric mastic sealant designed for sealing top surface and edges of waterproofing membrane. Ensure compatibility with waterproofing membrane, substrate, insulation materials and components in contact with waterproofing membrane.
- 2.4.5 Protection Board: ASTM D6506; semirigid fiberglass or mineral-reinforced-asphaltic core board.
  - .1 Thickness: Nominal 3 mm (1/8 inch).
  - .2 Adhesive: rubber-based solvent type recommended by waterproofing manufacturer suitable for protection board type.
  - .3 Basis-of-Design: "Protectoboard" by IKO Industries Ltd. or approved equivalent.
- 2.4.6 Drainage Board: composite drainage board consisting of studded, non-biodegradable, molded-plastic-sheet drainage core with nonwoven, needle-punched geotextile facing laminated to one side of the core and polymeric film on other side.
  - .1 Acceptable Products:
    - .1 "DB 6200" by Henry Canada
    - .2 "Mel-Drain" by W.R Meadows
    - .3 "Sopradrain 10G" by Soprema Inc.
    - .4 "Delta-drain 6000" by Cosella-Dorken Products Inc
    - .5 "Aquadrain 15 XP" by CETCO Building Materials Group
- 2.4.7 Termination Bar: 25 mm (1 inch) stainless steel or aluminum.

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2.4.8 Waterstop: Non-swelling/non-bentonite preformed sealant.

### **3 . EXECUTION**

#### **3.1 Examination**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.
- .1 Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
  - .2 Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D4263.

#### **3.2 Surface Preparation**

- 3.2.1 Manufacturer's instructions: Comply with ASTM D4258 and with manufacturer's written instructions with regard to cleaning, treatment, and preparation of substrates. Ensure substrates are free of dust and are dry before applying waterproofing.
- 3.2.2 Masking: Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- 3.2.3 Contaminant Removal: Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- 3.2.4 Irregularities: Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- 3.2.5 Joints and Cracks Treatment:
- .1 Comply with ASTM D4258 unless indicated otherwise.
  - .2 For construction and contraction joints and cracks wider than 1.6 mm (1/16 inch), place sheet strips centered over cracks. Ensure width aligns with manufacturer's written instructions.
- 3.2.6 Bridging Joints:
- .1 Overlap sheet strips to bridge and cover isolation joints, expansion joints, deck-to-wall junctions, and deck-to-deck joints. Ensure width aligns with manufacturer's written instructions.
- 3.2.7 Corners, Flashings and Protrusions:
- .1 Comply with ASTM D6135 for preparation, priming, and treatment of inside and outside corners.



- .2 At intersections between footings and walls, extend membrane from corner in each direction or center membrane strip over corner.
  - .3 Use strips that are at least 900 mm (36 inches) wide; stagger seams between flashing and membrane.
  - .4 Apply flashing to protrusions, expansion joints, control joints, drains, and similar areas; extend flashing at least 150 mm (6 inches) onto membrane.
  - .5 Use termination mastic to seal flashing seams.
- 3.2.8 Termination and Penetrations Treatment:
- .1 Comply with ASTM D6135 for treatment and sealing of waterproofing terminations and penetrations.
  - .2 Prepare, fill, prime, and treat joints and cracks in substrates as specified in this Section.

### **3.3 Installation**

- 3.3.1 Installation, generally: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.

### **3.4 Modified Bituminous Sheet-Waterproofing Application**

- 3.4.1 Install modified bituminous sheets according to waterproofing manufacturer's written instructions and recommendations in ASTM D6135.
- 3.4.2 Priming: Apply primer to substrate at rate specified by manufacturer and allow to dry. Ensure priming is limited to areas that will have sheet waterproofing applied on the same day. Areas exposed for more than 24 hours must be reprimed.
- 3.4.3 Sheet Placement:
- .1 Position and adhere sheets firmly over waterproofing area.
  - .2 Align sheets correctly, maintaining minimum lap width of 64-mm (2-1/2 inches). Provide 150-mm (6 inches) end laps. Install sheets in a shingle fashion as required to shed water.
  - .3 Overlap, seal seams, and stagger end laps as required to ensure a watertight installation.
  - .4 Use 75 mm (3 inches) wide hand roller for rolling membrane.
  - .5 On concrete substrates, ensure membrane terminates in reglet or use termination bars. Coordinate with concrete trades to confirm final reglet locations so as to prevent unnecessary saw-cutting.

- .6 Ensure termination edges of sheet waterproofing are sealed with mastic as specified in this Section.
- 3.4.4 Transition to Adjacent Materials: Transition sheet waterproofing and auxiliary materials with adjacent waterproofing materials to ensure a watertight installation. At tie-in points, clean surfaces 300 mm (12 inches) back from transition and re-prime if necessary.
- 3.4.5 Repairs: Immediately repair tears, voids, and improperly lapped seams. Flatten and slit blisters or fishmouths. Use sheet waterproofing materials for patching purposes. Extend patches minimum 150 mm (6 inches) in all directions beyond the repair area.
- 3.4.6 Drainage Board: Waterproofing must be protected prior to backfilling using drainage boards.
  - .1 Ensure geotextile side of drainage board is facing away from substrate.
  - .2 Use non-penetrative methods such as adhesives to secure drainage boards.
  - .3 Overlap geotextile edges and ends for continuity.
  - .4 Mechanically fasten drainage board to foundation wall at 450 mm (18 inches) o.c. horizontally. Use minimum of two staggered rows.
  - .5 Take precautions to ensure waterproofing membrane is not punctured.
  - .6 Protect installed molded-sheet drainage boards during subsequent construction.

### **3.5 Field Quality Control**

- 3.5.1 Engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to Supply reports to Consultant.

### **3.6 Protection**

- 3.6.1 Protect self-adhering sheet waterproofing from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades.
- 3.6.2 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in writing by affected material's manufacturer. Do not use materials or process that can damage finishes, surfaces, or construction.
- 3.6.3 Promptly replace self-adhering sheet waterproofing work damaged during construction that cannot be satisfactorily repaired.

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**3.7     Cleaning And Waste Management**

- 3.7.1    Cleaning and Waste Management, generally: in accordance with Section 01 74 00, Cleaning and Waste Management.
- 3.7.2    Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
- 3.7.3    Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**END OF SECTION**

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the bonded blindside sheet waterproofing work specified herein. This includes, but is not necessarily limited, to:
  - .1 Bonded blindside waterproofing for application to prepared substrates.
  - .2 Drainage boards and composites.
  - .3 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only:
  - .1 Section 03 30 00 - Cast-in-Place Concrete for forms, water stops, and concrete placement.
  - .2 Division 31, for excavating and backfilling and excavation support and protection for permanent below-grade support systems that require blind-side waterproofing.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply.
- 1.3.2 ASTM International (ASTM)
  - .1 ASTM C578: Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
  - .2 ASTM D412: Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension

- .3 ASTM D570: Standard Test Method for Water Absorption of Plastics
  - .4 ASTM D903: Standard Test Method for Peel or Stripping Strength of Adhesive Bonds
  - .5 ASTM D1876: Standard Test Method for Peel Resistance of Adhesives (T-Peel Test)
  - .6 ASTM D1970: Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
  - .7 ASTM D5147: Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material
  - .8 ASTM D5385: Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes
  - .9 ASTM D6506: Standard Specification for Asphalt Based Protection Board for Below-Grade Waterproofing
  - .10 ASTM E96: Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials
  - .11 ASTM E154: Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
- 1.3.3 International Organization for Standardization (ISO)
- .1 ISO 14025: Environmental labels and declarations — Type III environmental declarations — Principles and procedures

## **1.4 Administrative Requirements**

- 1.4.1 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site before beginning work on this Section to coordinate activities with related Subcontractors.
- .1 Notification: Where Consultant attendance is required; minimum 72 hour notice is required.
  - .2 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
  - .3 Agenda:
    - .1 Review progress of related construction activities and preparations for particular activity under consideration.
    - .2 Review all project drawings to determine if the proposed details can be constructed as intended by the designer/specifier. Consider requiring a performance mock-up to validate the performance of the system. Read more about performance mock-ups [here](#).
    - .3 Examine system specifications.

**CONSTRUCTION OF THE  
DOCKSTEADER PRPS  
REPORTING STATION**

**07 13 33  
Bonded Blindside Sheet  
Waterproofing**

- .4 Verify each material selection and confirm product compatibility.
- .5 Inspect construction details; focus on tie-in areas.
- .6 Determine sequence for installation for various materials including concrete pour, insulation, blindside waterproofing and drainage boards.
- .7 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
- .4 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

**1.5 Submittals**

- 1.5.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.5.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for bonded blindside sheet waterproofing work specified in this Section.
- 1.5.3 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:
  - .1 Show locations and extent of waterproofing and details of substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
- 1.5.4 Environmental and Material Transparency:
  - .1 Embodied Carbon / EPDs: When available, Submit EPDs conforming to ISO 14025 or equivalent standard; prioritize products with such documentation when choices are at Contractor's option.
  - .2 Material Ingredient Disclosure: When available, submit documentation identifying chemical inventories of materials to at least 0.1% (1000ppm) in accordance with HPD Open Standard, Cradle to Cradle (Basic v2/Bronze v3), ILFI Declare, or equivalent standard; products with such documentation when choices are at Contractor's option.
- 1.5.5 Certification Letter: Submit certification letter from waterproofing manufacturer confirming waterproofing materials supplied under this Section comply with requirements outlined in geotechnical report. Manufacturer must demonstrate acknowledgment of requirements set out in geotechnical and hydrogeological reports.

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**1.6     Closeout Submittals**

- 1.6.1 Warranty Documentation: Submit copy of extended warranties specified in this Section.

**1.7     Quality Assurance**

- 1.7.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.
- 1.7.2 Installer Qualifications: Engage an entity with sufficient experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.
- .1 Installer must be trained and certified by waterproofing manufacturer. Submit proof of certification upon request.
- 1.7.3 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.
- 1.7.4 First Installation Review: Construct sample installations to verify selections made under submittals, demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
- .1 Location: In-situ (i.e. first installation), as directed on site by Consultant.
- .2 Size: 9.3 sq. m (100 sq. ft.) in area.
- .3 Purpose: To set benchmarks for installation and to judge subsequent work. Maintain such sample installations during construction in undisturbed condition.
- .4 Reviewed Sample Installations: may become part of the completed work if undisturbed at the time of Substantial Performance of The work, provided they comply with requirements outlined in Contract Documents.

**1.8     Delivery, Storage And Handling**

- 1.8.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.
- 1.8.2 Deliver, store and handle bonded blindside sheet waterproofing materials in accordance with manufacturer's written instructions. deliver materials to site in original factory packaging, labelled with manufacturer's name and address. Store materials in off-ground, in clean, dry, well-ventilated area. Replace defective or damaged materials with new.

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**1.9     Field Conditions**

1.9.1 Environmental Restrictions: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.

.1 Do not apply waterproofing in snow, rain, fog, or mist.

1.9.2 Maintain adequate ventilation during preparation and application of waterproofing materials.

**1.10    Warranty**

1.10.1 Extended warranty: Submit for Owner's review and acceptance, manufacturer's extended warranty in which manufacturer commits to repair or replace components of bonded blindside sheet waterproofing that fail within specified warranty period. Manufacturer's extended warranty is in addition to, and does not supersede, any other rights that Owner may have under Contract Documents.

.1 Warranty Period: Not less than 10 years from date of Substantial Performance of The work.

**2 .    PRODUCTS**

**2.1     Manufacturers**

2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:

- .1 Carlisle Coatings and Waterproofing
- .2 GCP Applied Technologies
- .3 Henry Company Canada
- .4 Soprema Canada
- .5 Tremco Inc.
- .6 W.R Meadows

**2.2     Performance / Design Criteria**

2.2.1 Description: waterproofing membrane designed to form permanent mechanical or adhesive bond with fresh concrete.

2.2.2 Compatibility between components of waterproofing system is essential. Do not allow waterproofing materials to come in contact with chemically incompatible materials.

2.2.3 Acceptable Technologies: SBS sheet membrane or HDPE membrane or HDPE / Bentonite membrane. Final product selection and technology to be based on requirements outlined in



geotechnical and hydrogeological report. Supply required accessories, tapes, preformed shapes and auxiliary materials required for a complete waterproofing assembly.

**2.3      Bonded Blind-Side Waterproofing – Vertical Applications**

**2.3.1    Material Tag: This item is indicated as “WPM-2” on Drawings and Schedules.**

**2.3.2    General Performance Requirements:**

- .1 Low-Temperature Flexibility: Pass at -25°C (-13°F); ASTM D1970 or equivalent to CAN/CGSB-51.33.
- .2 Peel Adhesion to Concrete: 880 N/m (5 lbf/in.) minimum; ASTM D903; modified.
- .3 Lap Adhesion: Minimum: 880 N/m (5 lbf/in); ASTM D1876, modified.
- .4 Hydrostatic-Head Resistance: Minimum: 70 m (230 feet); ASTM D5385.
- .5 Lateral Water Migration Resistance: Pass at 70 m (230 feet) hydrostatic pressure; ASTM D5385, modified.
- .6 Puncture Resistance: 445 N (100 lbf) minimum; ASTM E154.
- .7 Water Vapour Permeance: Maximum: 5.1 ng/Pa x s x sq. m (0.09 perms); ASTM E96/E 96M (Water Method).
- .8 Water Absorption: Maximum: 0.2% weight gain after 48 hours of immersion at 21°C (70°F); ASTM D570.
- .9 Ultimate Elongation: Minimum: 300%.; D412, Die C (modified).
- .10 Thickness: Manufacturer's standard thicknesses required to meet performance criteria outlined in this Section. Generally, provide thicker membranes in horizontal applications.

**2.3.3    Acceptable Products – Vertical Applications:**

- .1 “Preprufe 160R” by GCP Applied Technologies
- .2 "Pre-Applied Waterproofing Membrane – HYDRASTOP " by W.R Meadows
- .3 "Colphene BSW Plus V" and “Colphene Flam 180” by Soprema Canada Inc.
- .4 “MIRAPLY-V” by Carlisle Coatings and Waterproofing
- .5 “Blueskin Preseal 320” and “Blueskin Preseal 435” by Henry Company Canada

**2.3.4    Alternative Bentonite System will also be considered acceptable as follows:**

- .1 Basis-of-design Products: “Voltex DS” by CETCO Building Materials Group.

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**2.4     Bonded Blind-Side Waterproofing – Horizontal Applications**

**2.4.1     Material Tag: This item is indicated as “WPM-2” on Drawings and Schedules.**

**2.4.2     General Performance Requirements:**

- .1 Low-Temperature Flexibility: Pass at -25°C (-13°F); ASTM D1970 or equivalent to CAN/CGSB-51.33.
- .2 Peel Adhesion to Concrete: 880 N/m (5 lbf/in.) minimum; ASTM D903; modified.
- .3 Lap Adhesion: Minimum: 880 N/m (5 lbf/in); ASTM D1876, modified.
- .4 Hydrostatic-Head Resistance: Minimum: 70 m (230 feet); ASTM D5385.
- .5 Lateral Water Migration Resistance: Pass at 70 m (230 feet) hydrostatic pressure; ASTM D5385, modified.
- .6 Puncture Resistance: 445 N (100 lbf) minimum; ASTM E154.
- .7 Water Vapour Permeance: Maximum: 5.1 ng/Pa x s x sq. m (0.09 perms); ASTM E96/E 96M (Water Method).
- .8 Water Absorption: Maximum: 0.2% weight gain after 48 hours of immersion at 21°C (70°F); ASTM D570.
- .9 Ultimate Elongation: Minimum: 300%; D412, Die C (modified).
- .10 Thickness: Manufacturer's standard thicknesses required to meet performance criteria outlined in this Section. Generally, provide thicker membranes in horizontal applications.

**2.4.3     Acceptable Products – Horizontal Applications:**

- .1 "Preprufe 300R Plus Membrane" by GCP Applied Technologies
- .2 "Underslab Waterproofing Membrane - PRECON" by W.R Meadows
- .3 "Colphene BSW Plus H" and "Colphene Flam 180" as required for hydrostatic conditions and water table location by Soprema Canada Inc.
- .4 "MIRAPLY-H" by Carlisle Coatings and Waterproofing
- .5 "Blueskin Preseal 320" (mud slab required) or Blueskin Preseal 435" by Henry Company Canada

**2.4.4     Alternative Bentonite System will also be considered acceptable as follows:**

- .1 Basis-of-design Products: "Voltex DS" by CETCO Building Materials Group.

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**2.5     Auxiliary Materials**

- 2.5.1 Supply auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
- .1 Supply liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
- 2.5.2 Primer: Liquid primer recommended for substrate by sheet-waterproofing material manufacturer.
- 2.5.3 Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet-waterproofing material manufacturer.
- 2.5.4 Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.
- 2.5.5 Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.
- 2.5.6 Metal Termination Bars: Aluminum bars, approximately 25 by 3 mm (1 by 1/8 inch) thick, predrilled at 229-mm (9-inch) centers.
- 2.5.7 Protection board: ASTM D6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:
- .1 Thickness: 3 mm (1/8 inch), nominal, for vertical applications; 6 mm (1/4 inch), nominal, elsewhere.
- .2 Adhesive: Rubber-based solvent type recommended by waterproofing manufacturer for protection board type.
- 2.5.8 Mastic, Adhesives, and Detail Tape: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer for covering cut edges, roll ends, penetrations and detailing.
- 2.5.9 Waterstop: Manufacturer's recommended hydrophilic waterstop for non-moving concrete construction joints. Coordinate with Division 03.
- 2.5.10 Preformed soil retention wall tieback cover: Manufacturer's recommended prefabricated detail for soil retention wall tiebacks.
- 2.5.11 Drainage Board: composite drainage board consisting of studded, non-biodegradable, molded-plastic-sheet drainage core with nonwoven, needle-punched geotextile facing laminated to one side of the core and polymeric film on other side.
- .1 Acceptable Products – Vertical Applications:
- .1 "DB 6200" by Henry Canada
- .2 "CCW MiraDRAIN 6000" by Carlisle Coatings & Waterproofing Inc.;
- .3 "Hydroduct 220" by GCP Applied Technologies Inc.

- .4 "Mel-Drain" by W.R Meadows
- .5 "Sopradrain 10G" by Soprema Inc.,
- .6 "Delta-drain 6000" by Cosella-Dorken Products Inc
- .2 Acceptable Products – Horizontal Applications:
  - .1 "CCW MiraDRAIN 9000" or "CCW MiraDRAIN 9900" by Carlisle Coatings & Waterproofing Inc..
  - .2 "Hydrodrain 700" by Hydrotech Membrane Corp.
  - .3 "DB 9000" by Henry Company.
  - .4 "Sopradrain 18-G" by Soprema Canada
  - .5 Approved equivalent.

### **3 . EXECUTION**

#### **3.1 Examination**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.
  - .1 Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
  - .2 Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D4263.
  - .3 For horizontal applications, verify that compacted subgrade is dry, smooth, sound, and ready to receive waterproofing sheet.
  - .4 For vertical applications, use concrete, plywood, insulation or other approved facing to sheet piling to provide support to membrane. Ensure board systems such as timber lagging are close butted to provide support and not more than 12 mm (1/2 inch) out of alignment.

#### **3.2 Surface Preparation**

- 3.2.1 Manufacturer's instructions: Comply with ASTM D4258 and with manufacturer's written instructions with regard to cleaning, treatment, and preparation of substrates. Ensure substrates are free of dust and are dry before applying waterproofing.
- 3.2.2 Ensure substrate is smooth, firm, and devoid of substances like mud, loose mortar, wires, fins, metal projections, or any obstructions that hinder membrane placement.

- 3.2.3 Contaminant Removal: Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- 3.2.4 Irregularities:
  - .1 Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
  - .2 Use manufacturer's recommended products and accessories to bridge gaps or misalignments before applying waterproofing membranes.
  - .3 On wood lagging walls, maintain gaps no larger than 13 mm (1/2 inch) unless otherwise specified by manufacturer's instructions.
- 3.2.5 Install drainage boards as required by Drawings or manufacturer's instructions.

### **3.3 Installation**

- 3.3.1 Installation, generally: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.
- 3.3.2 Horizontal Substrates: Apply waterproofing membrane on prepared concrete mud slabs, or compacted earth or crushed stone. Where required to tie in to vertical waterproofing systems, turn membrane up inside face of slab formwork to attain a fully bonded system and allow tie-in to vertical waterproofing systems after removal of formwork.
- 3.3.3 Vertical Substrates: Apply waterproofing membrane to permanent formwork or lagging. Use appropriate mechanical fasteners at top of membrane at maximum 460 mm (18") on center or other method recommended by manufacturer to secure membrane.
- 3.3.4 Overlap and Sealing: Where sheet membranes are used, provide minimum 75 mm (3 inches) overlap between sheets. Stagger end laps as required by manufacturer's instructions. For roll ends and cut edges provide consistent 75 mm (3 inch) overlap.
- 3.3.5 Corners and Penetrations: Comply with ASTM D6135 and manufacturer's instructions.
- 3.3.6 Membrane Repair: Inspect membrane prior to commencing other construction processes. Clean contaminated areas and repair punctures or other damages with manufacturer's recommended tapes or membrane patches. Provide minimum 75 mm (3 inch) overlap.

- 3.3.7 Concrete Pour and Formwork Removal: Comply with manufacturer's recommended timelines for pouring concrete and protecting membranes.
- 3.3.8 Remove and replace applications of materials where inspection indicates that it does not comply with specified requirements.

### **3.4      Field Quality Control**

- 3.4.1 Engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to supply reports to Consultant.
- 3.4.2 At minimum, ensure site representative is present on site at start of activities, 50% completion, and 90% completion.
- 3.4.3 Independent Inspection Company: Owner may engage an independent inspection service to ensure waterproofing materials installation complies with contract documents, manufacturer's guidelines, and site-specific requirements. Inspection Company to produce and provide reports and digital photographs from each inspection to Contractor, waterproofing installer, material manufacturer, and Consultant.
  - .1 Scope of inspections: must cover substrate examination, start of waterproofing installation, regular verifications, and final assessment before concrete or backfill is applied.
- 3.4.4 Correction: Correct deficient applications not passing tests and inspections, make necessary repairs, and retest as required to demonstrate compliance with requirements.
- 3.4.5 Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

### **3.5      Protection**

- 3.5.1 Protect bonded blindside sheet waterproofing from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades.
- 3.5.2 Do not permit foot or vehicular traffic on unprotected membrane.
- 3.5.3 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in writing by affected material's manufacturer. Do not use materials or process that can damage finishes, surfaces, or construction.
- 3.5.4 Promptly replace bonded blindside sheet waterproofing work damaged during construction that cannot be satisfactorily repaired.

**3.6     Cleaning And Waste Management**

- 3.6.1    Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
- 3.6.2    Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**END OF SECTION**

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the polymer modified cement waterproofing work specified herein. This includes, but is not necessarily limited, to:
  - .1 Flexible polymer-modified cement waterproofing for application to cisterns and similar water-retention structures.
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

### **1.4 Preinstallation Meetings**

- 1.4.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.
- 1.4.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
  - .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.
  - .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.



- .3 Agenda:
  - .1 Review progress of related construction activities and preparations for particular activity under consideration.
  - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
- .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
- .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

## **1.5 Submittals**

- 1.5.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.5.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for polymer modified cement waterproofing work specified in this Section.
- 1.5.3 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
  - .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
  - .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
  - .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.5.4 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:
  - .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.
  - .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.5.5 Low-Emitting Materials: For applicable Products specified or used for activities of this Section (i.e., site-applied coatings, adhesives, and sealants), submit certifications from third-party organizations indicating compliance with following:

- .1 VOC Emissions: California Department of Public Health (CDPH) Standard Method v1.2–2017, using applicable exposure scenario.
- .2 VOC Content: SCAQMD Rule 1113 (for paints and coatings) and SCAQMD Rule 1168 (for adhesives and sealants).

**1.6      Closeout Submittals**

- 1.6.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.
- 1.6.2 Warranty Documentation: Submit copy of extended warranties specified in this Section.

**1.7      Quality Assurance**

- 1.7.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.
- 1.7.2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.
- 1.7.3 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.
- 1.7.4 Mock-Ups / First Installation Review: Construct mock-ups to verify selections made under submittals, demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - .1 Location: In-situ (i.e. first installation), as directed on site by Consultant.
  - .2 Size: 9.3 sq. m (100 sq. ft.) in area.
  - .3 Purpose: To set benchmarks for installation and to judge subsequent work. Maintain Mock-ups during construction in undisturbed condition.
  - .4 Reviewed mock-ups: May become part of the completed work if undisturbed at the time of Substantial Performance of The work, provided they are undisturbed, and comply with requirements outlined in Contract Documents.

**1.8      Delivery, Storage And Handling**

- 1.8.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.

- 1.8.2 Deliver, store and handle polymer modified cement waterproofing materials in accordance with manufacturer's written instructions.
- 1.8.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.8.4 Store materials in off-ground, in clean, dry, well-ventilated area.
- 1.8.5 Replace defective or damaged materials with new.

**1.9 Project Conditions**

- 1.9.1 Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit polymer-modified cement waterproofing to be performed according to manufacturer's written instructions.
  - .1 Do not apply waterproofing in snow, rain, fog, or mist.
- 1.9.2 Maintain adequate ventilation during preparation and application of waterproofing materials.
- 1.9.3 Ambient Conditions: Proceed with waterproofing work only when temperature is at least 5 deg C (40°F) and rising during work and curing periods. Ensure spaces are well-ventilated and free of water.

**1.10 Warranty**

- 1.10.1 Extended warranty: Submit for Owner's review and acceptance, manufacturer's extended warranty in which manufacturer commits to repair or replace components of bonded blindside sheet waterproofing that fail within specified warranty period. Manufacturer's extended warranty is in addition to, and does not supersede, any other rights that Owner may have under Contract Documents.
  - .1 Warranty Period: Not less than 5 years from date of Substantial Performance of The work.

**2 . PRODUCTS**

**2.1 Manufacturers**

- 2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:
  - .1 Durex
  - .2 Sika Canada Inc.
  - .3 W.R. Meadows Inc., Canada
- 2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

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**2.2     Performance / Design Criteria**

- 2.2.1 Waterproofing System Integrity: Ensure compatibility between waterproofing system components. Do not allow waterproofing materials to touch chemically incompatible substances.
- 2.2.2 VOC Content and Emissions:
- .1 VOC Emissions: For applicable items in this Section, comply with CDPH Standard Method v1.2–2017 (CA Spec 01350) and ensure products are certified per UL 2818, SCS Global Gold, or equivalent.
  - .2 VOC Content Requirements: Wet-applied materials used in scope of this Section must conform to the following:
    - .1 Paints and Coatings: SCAQMD Rule 1113 or CARB SCM.
    - .2 Adhesives and Sealants: SCAQMD Rule 1168.
    - .3 Methylene chloride and perchloroethylene must not be intentionally added in paints, coatings, adhesives, or sealants.

**2.3     Flexible Cementitious Waterproofing**

- 2.3.1 Material Tag: This item is noted as “WPM-3” on Drawings and Schedules.
- 2.3.2 Two-component fiber-reinforced, highly flexible, breathable cementitious slurry designed for positive and negative waterproofing of concrete structures such as water-containing tanks, reservoirs, cisterns and similar elements. System must be vapour permeable.
- 2.3.3 General Performance Requirements:
- .1 Water Permeability: No leakage at 30 m (98.4 feet) hydraulic head; TTP 1411 or CE CRD-C 48.
  - .2 Water Vapour Permeance (ASTM E96): Minimum 697 ng/Pa.s.m<sup>2</sup> (12.8 perms); water method.
  - .3 Elongation: Not less than 20% per ASTM C190 or ASTM D412.
  - .4 Crack Spanning: Must be capable of spanning 1.6 mm (63 mils) cracks.
  - .5 Potable Water Containment: NSF/ANSI Standard 61 for potable water use.
- 2.3.4 Basis-of-Design Product: “Cem-Kote Flex ST” by W.R. Meadows Inc., Canada.
- .1 Acceptable Equivalents:
    - .1 “ECTOFLEX” by Durex.
    - .2 “SikaTop Seal-107” by Sika Canada

## **2.4     Accessory Materials**

### **2.4.1   Mesh and Fabrics:**

- .1   Reinforcing Mesh: Manufacturer's standard polymeric reinforcing fabric specifically designed for reinforcing cementitious coatings.
- .2   Crack Treatment Mesh: Manufacturer's standard polymeric reinforcing fabric specifically designed for treating and detailing cracks.

### **2.4.2   Mortars:**

- .1   Bonding Mortar: Manufacturer's standard cementitious bonding mortar suitable for improving bond at coves, protrusions and other locations recommended by manufacturer.
- .2   Patching Mortar: Manufacturer's standard cementitious repair mortar suitable for filling tie holes, honeycombs, reveals, and imperfections.
- .3   Plugging Mortar: Manufacturer's standard hydrophobic cementitious mortar. System must be vapour permeable while demonstrating resistance to liquid water. Do not use on surfaces exposed to vehicular traffic.
- .4   Finishing Mortar: Manufacturer's standard cementitious finish mortar recommended by manufacturer.

### **2.4.3   Portland Cement: CAN/CSA-A3001, Type GU.**

### **2.4.4   Sand: ASTM C144, ASTM C33 or CAN/CSA A3000 as recommended by manufacturer.**

### **2.4.5   Water: Potable.**

## **3 .     EXECUTION**

### **3.1     Examination**

- #### **3.1.1   Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.**
- .1   Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
  - .2   Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D4263.

### **3.2     Surface Preparation**

- #### **3.2.1   Manufacturer's instructions: Comply with ASTM D4258 and with manufacturer's written instructions regarding cleaning, treatment,**

and preparation of substrates. Ensure substrates are free of dust and are dry before applying waterproofing.

- 3.2.2 Ensure substrate is smooth, firm, and devoid of substances like mud, loose mortar, wires, fins, metal projections, or any obstructions that hinder membrane placement.
- 3.2.3 Contaminant Removal: Remove grease, oil, bitumen, form-release agents, paints, curing mortars, and other penetrating contaminants or film-forming coatings from concrete.
- 3.2.4 Do not allow waterproofing, patching, and plugging materials to enter reveals or annular spaces intended for resilient sealants or gaskets, such as joint spaces between pipes and pipe sleeves.
- 3.2.5 Stop active water leaks with plugging mortar according to waterproofing manufacturer's written instructions.
- 3.2.6 Repair damaged or unsatisfactory substrate with patching mortar according to manufacturer's written instructions.
- 3.2.7 Conduct bond test in accordance with manufacturer's according to manufacturer's written instructions.
- 3.2.8 Wash substrates with water before applying cementitious coating. Allow surfaces to reach saturated surface dry (SSD) state after washing.

### **3.3     Application**

- 3.3.1 Installation, generally: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.
- 3.3.2 Treatment of Joints and Cracks:
  - .1 Comply with ASTM D4258 unless indicated otherwise.
  - .2 Treat joints and cracks using reinforced flexible cementitious coating in accordance with manufacturer's instructions.
- 3.3.3 Corners, Flashings, and Protrusions Treatment: Comply with manufacturer's instructions for corners and protrusions treatment. Provide reinforcing as required.
- 3.3.4 Mixing: Mix two-component waterproofing system with water using mechanical mixer or manual mixing and as directed by manufacturer's instructions.
  - .1 Consistency: Ensure mixture reaches lump-free, homogeneous consistency. Comply with manufacturer's specified water-to-powder ratio. Do not overmix or add excessive water.
- 3.3.5 Apply in two coats as follows:

- .1 First coat: Use brush or roller to eliminate pinholes. Apply to thickness of 0.8 mm (1/32 in).
  - .2 Second coat: Use brush, roller, or spray. Apply to thickness of 0.8 mm (1/32 in).
  - .3 Achieve total application thickness of 1.6 mm (1/16 inch).
  - .4 Wait minimum of 30 minutes between coats or as recommended by manufacturer.
  - .5 Dampen surface between coats to protect against surface water evaporation.
  - .6 Final finish: smooth troweled.
- 3.3.6 Curing: Air-cure cementitious coating for minimum of 72 hours at 20 deg C (68 deg F) and 70-80% relative humidity before filling with water, or follow manufacturer's recommendations.
- 3.3.7 Extensions of Waterproofing Treatment:
- .1 Where columns are integral with walls scheduled to be waterproofed: extend for full height of column.
  - .2 For intersections of non-waterproofed interior walls and exterior walls receiving waterproofing: extend minimum of 600 mm (24 inches) onto interior walls.
  - .3 For locations where only horizontal surfaces are to be waterproofed: extend upward for minimum of 300 mm (12 inches) onto adjacent walls and columns.
  - .4 Water all surfaces within designated waterproofing areas, including trenches, chases, pits, and similar elements.

### **3.4 Field Quality Control**

- 3.4.1 Engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to supply reports to Consultant.

### **3.5 Protection**

- 3.5.1 Protect polymer-modified cement waterproofing from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades.
- 3.5.2 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in writing by affected material's manufacturer. Do not use materials or processes that can damage finishes, surfaces, or construction.
- 3.5.3 Promptly replace polymer-modified cement waterproofing work damaged during construction that cannot be satisfactorily repaired.

**3.6     Cleaning And Waste Management**

- 3.6.1 Cleaning and Waste Management, generally: in accordance with Section 01 74 00, Cleaning and Waste Management.
- 3.6.2 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
- 3.6.3 Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**END OF SECTION**



## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the Crystalline waterproofing admixture work specified herein. This includes, but is not necessarily limited, to:
  - .1 Crystalline waterproofing admixture for application to elevator pits, sump pits and other locations noted on Drawings.
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

### **1.4 Preinstallation Meetings**

- 1.4.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.
- 1.4.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
  - .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.
  - .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.

- .3 Agenda:
  - .1 Review progress of related construction activities and preparations for particular activity under consideration.
  - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
- .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
- .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

## **1.5 Submittals**

- 1.5.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.5.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for Crystalline waterproofing admixture work specified in this Section.
- 1.5.3 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:
  - .1 Include manufacturer's standard details for treating substrate joints and cracks, flashings, penetrations, and other termination conditions.
- 1.5.4 Test Reports: Submit test reports from accredited independent laboratories confirming that the waterproofing system meets the performance requirements specified.
- 1.5.5 Mix Designs: Obtain mix designs from Section 03 30 00 and comply with administrative and submittal procedures referenced therein to ensure proper coordination of crystalline waterproofing admixture with concrete pour.
- 1.5.6 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
  - .1 EPD Scope: must cover Cradle-to-Gate (A1 to A3) as a minimum.
  - .2 EPD Impact Categories: must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
  - .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.

1.5.7 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:

- .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.
- .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.

## **1.6 Closeout Submittals**

- 1.6.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.
- 1.6.2 Warranty Documentation: Submit copy of extended warranties specified in this Section.

## **1.7 Quality Assurance**

- 1.7.1 Manufacturer Qualifications: Manufacturer must be ISO 9001 certified and have a minimum of 10 years' experience in producing crystalline waterproofing additives. Manufacturer must provide field service representation during construction. Manufacturers unable to provide field support or performance test data as specified will not be considered.
- 1.7.2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.
- 1.7.3 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.

## **1.8 Delivery, Storage And Handling**

- 1.8.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.
- 1.8.2 Deliver, store and handle Crystalline waterproofing admixture materials in accordance with manufacturer's written instructions.
- 1.8.3 deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.8.4 Store materials in off-ground, in clean, dry, well-ventilated area.
- 1.8.5 Replace defective or damaged materials with new.

**1.9 Project Conditions**

1.9.1 Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit Crystalline waterproofing admixture to be performed according to manufacturer's written instructions.

.1 Do not apply waterproofing in snow, rain, fog, or mist.

1.9.2 Maintain adequate ventilation during preparation and application of waterproofing materials.

1.9.3 Ambient Conditions: Proceed with waterproofing work only when temperature is at least 5 deg C (40°F) and rising during work and curing periods. Ensure spaces are well-ventilated and free of water.

**1.10 Warranty**

1.10.1 Extended warranty: Submit for Owner's review and acceptance, manufacturer's extended warranty in which manufacturer commits to repair or replace components of bonded blindside sheet waterproofing that fail within specified warranty period. Manufacturer's extended warranty is in addition to, and does not supersede, any other rights that Owner may have under Contract Documents.

.1 Warranty Period: Not less than 5 years from date of Substantial Performance of The work.

.2 Warranty scope: Materials and workmanship.

**2 . PRODUCTS**

**2.1 Manufacturers**

2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:

.1 Euclid Canada.

.2 Kryton International

.3 Xypex Chemical Corporation.

.4 Penetron International Ltd.

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

**2.2 Performance / Design Criteria**

2.2.1 Waterproofing System Integrity: Ensure compatibility between waterproofing system components. Do not allow waterproofing materials to touch chemically incompatible substances.

- 2.2.2 Compatibility: It is the responsibility of Contractor to verify compatibility of the crystalline additive with other admixtures or additives used in concrete mix. Coordinate with Section 03 30 00.

## **2.3 Crystalline Waterproofing Admixture**

- 2.3.1 Description: crystalline waterproofing and protection system that chemically forms a non-soluble crystalline structure within the concrete pores and capillaries. This system must seal concrete against liquid penetration from any direction and protect against environmental deterioration. The additive must include a Visual Detection System (VDS) to confirm its presence in hardened concrete.
- 2.3.2 Permeability Testing:
- .1 CRD-C48 Mod: Treated concrete samples must exhibit no measurable leakage when pressure tested to 1.05 MPa (150 psi) after 5 days.
  - .2 EN 12390-8: Treated samples must demonstrate an 80% reduction in permeability coefficient when exposed to 0.5 MPa of water pressure for 72 hours.
- 2.3.3 Sulfuric Acid Resistance: Independent testing must confirm that treated samples exhibit significantly lower mass loss compared to control samples when exposed to 7% sulfuric acid until the control sample reaches a 50% mass loss.
- 2.3.4 Sulfate Resistance: Independent testing must confirm that treated samples exhibit significantly lower mass loss compared to control samples after immersion in a concentrated sulfate solution for a minimum of 4 months.
- 2.3.5 Compressive Strength: At 28 days, treated concrete samples must exhibit equal or increased compressive strength compared to untreated control samples.
- 2.3.6 Potable Water Approval: The waterproofing material must have current, valid certification from NSF (NSF 61), DWI, or another recognized agency.
- 2.3.7 Visual Detection System (VDS): The additive must include a non-soluble Visual Detection System, detectable in hardened concrete for at least 6 months after casting.
- 2.3.8 Basis-of-Design Product: "C-500 Series" by Xypex

## **2.4 Mixing**

- 2.4.1 Add crystalline waterproofing additive to concrete at the time of batching. Comply with the manufacturer's instructions for dosage rate.

- 2.4.2 Adjust dosage based on project-specific conditions, such as enhanced chemical protection, or when using high percentages of supplementary cementitious materials. Consult with manufacturer for required dosage recommendations.

## **2.5 Accessory Materials**

### **2.5.1 Mortars:**

- .1 Patching Mortar: Manufacturer's standard cementitious repair mortar suitable for filling tie holes, honeycombs, reveals, and imperfections.
- .2 Plugging Mortar: Manufacturer's standard cementitious mortar.
- .3 Waterstops: Manufacturer's recommended PVC or expandable types. Coordinate with Division 03.

### **2.5.2 Portland Cement: CAN/CSA-A3001, Type GU.**

### **2.5.3 Sand: ASTM C144, ASTM C33 or CAN/CSA A3000 as recommended by manufacturer.**

### **2.5.4 Water: Potable.**

## **3 . EXECUTION**

### **3.1 Examination**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.

### **3.2 Application**

- 3.2.1 Installation, generally: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.
- 3.2.2 Add crystalline waterproofing additive to the concrete at the time of batching. Ensure thorough mixing for a homogeneous distribution. Do not add dry powder directly to wet mixed concrete.
- 3.2.3 Construction and Cold Joints: Apply a slurry coat of crystalline concentrate to joint surfaces between concrete pours. Moisten surfaces prior to application and keep moist for 12 hours.
- 3.2.4 Sealing Strips: Apply sealing strips at construction joints where hydrostatic conditions exist. Follow manufacturer's instructions for groove preparation and application.

3.2.5 Form Tie Holes: Waterproof form tie holes in accordance with manufacturer's technical literature. Prepare and profile the area around the tie hole and fill with appropriate materials.

3.2.6 Repair of Defects: Repair cracks, construction joints, rock pockets, and other defects using manufacturer's recommended methods.

**3.3 Placing Concrete**

3.3.1 Comply with requirements of Section 03 30 00.

**3.4 Protection**

3.4.1 Protect installed product and finished surfaces from damage during construction.

3.4.2 Ensure compatibility of treated concrete with subsequently applied materials.

**3.5 Field Quality Control**

3.5.1 Conduct VDS examination within 28 days of placement. Alternatively, perform VDS evaluation on test specimens in a laboratory setting.

3.5.2 Examination for Defects: Inspect treated concrete for defects before covering. Repair identified defects in accordance with manufacturer's procedures.

3.5.3 Testing Procedure for Tanks and Foundation Work:

- .1 Testing: Fill tanks or expose foundation works to service conditions as soon as possible to monitor for leaks.
- .2 Monitoring: Monitor for self-healing of cracks and joints. Repair joints and cracks that do not self-heal using appropriate methods.
- .3 Repair: Repair static cracks or joints that fail to self-heal using manufacturer's recommended methods.

**END OF SECTION**

## **1 . GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the interior pedestrian traffic coatings work specified herein. This includes, but is not necessarily limited, to:
  - .1 Traffic coatings consisting of waterproofing membrane and top coats for interior pedestrian traffic for application in mechanical rooms, service rooms and similar locations.
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

### **1.4 Preinstallation Meetings**

- 1.4.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.
- 1.4.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
  - .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.



- .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.
- .3 Agenda:
  - .1 Review progress of related construction activities and preparations for particular activity under consideration.
  - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
- .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
- .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

## **1.5 Submittals**

- 1.5.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.5.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for pedestrian traffic coatings work specified in this Section.
- 1.5.3 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:
  - .1 Include manufacturer's standard details for treating substrate joints and cracks, flashings, penetrations, and other termination conditions.
- 1.5.4 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
  - .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
  - .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
  - .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.5.5 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:

- .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.
  - .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.5.6 Low-Emitting Materials: For applicable Products specified or used for activities of this Section (i.e., site-applied coatings, adhesives, and sealants), submit certifications from third-party organizations indicating compliance with following:
- .1 VOC Emissions: California Department of Public Health (CDPH) Standard Method v1.2–2017, using applicable exposure scenario.
  - .2 VOC Content: SCAQMD Rule 1113 (for paints and coatings) and SCAQMD Rule 1168 (for adhesives and sealants).
- 1.5.7 Samples: Submit selection and verification samples for Products requiring colour, texture, or design selection. Submit manufacturer's list of finishes or colour swatches for Consultant's selection.
- .1 As a minimum submit samples of the following: Provide stepped samples on backing large enough to illustrate buildup of pedestrian traffic coatings.

## **1.6 Closeout Submittals**

- 1.6.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.
- 1.6.2 Maintenance Data: Submit maintenance data for pedestrian traffic coatings to include in maintenance manuals.
- 1.6.3 Warranty Documentation: Submit copy of extended warranties specified in this Section.

## **1.7 Quality Assurance**

- 1.7.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.
- 1.7.2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.
- 1.7.3 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and

secondary materials from sources recommended by manufacturers of primary materials.

- 1.7.4 Mock-Ups / First Installation Review: Construct mock-ups to verify selections made under submittals, demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
- .1 Location: In-situ (i.e. first installation), as directed on site by Consultant.
  - .2 Apply each coating to at least 10 sq. m (100 sq. ft.) of each substrate to demonstrate surface preparation, joint and crack treatment, thickness, texture, colour, and standard of workmanship.
  - .3 Purpose: To set benchmarks for installation and to judge subsequent work. Maintain Mock-ups during construction in undisturbed condition.
  - .4 Reviewed mock-ups: May become part of the completed work if undisturbed at the time of Substantial Performance of The work, provided they are undisturbed, and comply with requirements outlined in Contract Documents.

**1.8 Delivery, Storage And Handling**

- 1.8.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.
- 1.8.2 Deliver, store and handle pedestrian traffic coatings materials in accordance with manufacturer's written instructions.
- 1.8.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.8.4 Store materials in off-ground, in clean, dry, well-ventilated area.
- 1.8.5 Replace defective or damaged materials with new.

**1.9 Project Conditions**

- 1.9.1 Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit traffic coating to be performed according to manufacturer's written instructions.
  - .1 Do not apply traffic coating in snow, rain, fog, or mist.
- 1.9.2 Ambient Conditions: Proceed with traffic coating work only when temperature is at least 5 deg C (40°F) and rising during work and curing periods. Maintain adequate ventilation during preparation and application of traffic coating materials.
- 1.9.3 Do not install pedestrian traffic coating until items that will penetrate membrane have been installed.

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**1.10 Warranty**

1.10.1 Extended warranty: Submit for Owner's review and acceptance, manufacturer's extended warranty in which manufacturer commits to repair or replace components of pedestrian traffic coatings that fail within specified warranty period. Manufacturer's extended warranty is in addition to, and does not supersede, any other rights that Owner may have under Contract Documents.

- .1 Warranty Period: Not less than 2 years from date of Substantial Performance of The work.
- .2 Warranty scope: Materials and workmanship.

**2 . PRODUCTS**

**2.1 Manufacturers**

2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:

- .1 Sika Canada Inc.
- .2 Soprema Canada
- .3 Tremco Inc.

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

**2.2 Performance / Design Criteria**

2.2.1 Waterproofing System Integrity: Ensure compatibility between waterproofing system components. Do not allow waterproofing materials to touch chemically incompatible substances.

2.2.2 Membrane Performance: ASTM C957, elastomeric traffic-bearing waterproofing membrane designed to withstand pedestrian traffic and stop water penetration under pressure.

2.2.3 Minimum crack bridging capabilities: 1.5 mm (1/16").

2.2.4 Diesel Fuel Resistance: For areas where traffic coating membrane will be exposed to diesel fuel, apply additional chemical-resistant protective coated to resist diesel fuel-induced damage.

2.2.5 Dynamic Coefficient of Friction (DCOF): system must exhibit minimum DCOF of 0.42 (wet), in accordance with ANSI A137.1 when tested with BOT 3000 Digital Tribometer.

2.2.6 Static Coefficient of Friction (SCOF): system must exhibit minimum SCOF of 0.6 in accordance with ASTM D2047.

- 2.2.7 Fire testing results: Minimum Flame-Spread Value of 25 or less and Smoke-Developed Value of 450 or less when tested in accordance with CAN/ULC S102.2.
- 2.2.8 Material Compatibility: Provide primers; base, intermediate, and topcoats; and miscellaneous materials that are compatible with one another and with substrate under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- 2.2.9 VOC Content and Emissions:
  - .1 VOC Content Requirements: Wet-applied materials used in scope of this Section must conform to the following:
    - .1 Paints and Coatings: SCAQMD Rule 1113 or CARB SCM.
    - .2 Adhesives and Sealants: SCAQMD Rule 1168.
    - .3 Methylene chloride and perchloroethylene must not be intentionally added in paints, coatings, adhesives, or sealants.

## **2.3 Interior Pedestrian Traffic Coatings**

- 2.3.1 Material Tag: This item is noted as "SRTC" on Drawings and Schedules.
- 2.3.2 Primer: Manufacturer's standard polyurethane factory-formulated primer recommended for substrate and conditions indicated on Drawings and Schedules.
- 2.3.3 Waterproofing Membrane: two-component, solvent-free, elastomeric and crack bridging polyurethane waterproofing membrane.
  - .1 Thickness: As recommended by manufacturer for substrate and service conditions indicated on Drawings and Schedules, but not less than those indicated (measured excluding aggregate).
- 2.3.4 Topcoat: two-component, water-based epoxy coating suitable for application onto floors, walls, ceilings, machinery and equipment.
  - .1 Thickness: As recommended by manufacturer for substrate and service conditions indicated on Drawings and Schedules, but not less than those indicated (measured excluding aggregate).
  - .2 Colour: As selected at a later from manufacturer's full range.
- 2.3.5 Finish Coat (Chemical-Resistant): Sealing or finish coats. Test specimens of cured pedestrian traffic coating system are unaffected when tested according to ASTM D1308 for 50 percent immersion or

ASTM D543, Procedure A, for immersion or ASTM C267 for immersion.

2.3.6 Aggregate: Manufacturer's recommended Uniformly graded, washed silica sand or Walnut shell granules of particle sizes, shape, and minimum hardness recommended in writing by pedestrian traffic coating manufacturer.

.1 Spreading Rate: As recommended by manufacturer for substrate and service conditions indicated on Drawings and Schedules, but not less than the following:

2.3.7 Basis-of-Design System: "Vulkem 360NF/950NF" by Tremco Canada

.1 Acceptable Equivalents:

.1 "Alsan Trafik" by Soprema

.2 "Epo-Flex Mer II" by Sherwin Williams.

.3 "Kelmar® MERDEK LD" by Kelmar.

.4 "Mapefloor Parking Deck System" by MAPEI Corp.

.5 "Peda-Gard M Pedestrian Traffic Coatings" by Neogard

.6 "Sikafloor® Resoclad MRW Type II" by Sika Canada

## **2.4 Auxiliary Materials**

2.4.1 Joint Sealants: As recommended by traffic coating manufacturer and complying with requirements specified in Section 07 92 00, Joint Sealants.

2.4.2 Adhesive: Contact adhesive recommended in writing by pedestrian traffic coating manufacturer.

2.4.3 Reinforcing Strip: Fiberglass mesh recommended in writing by pedestrian traffic coating manufacturer.

2.4.4 Moisture Vapour Control System: Fluid-applied, two-component epoxy-resin system complying with ASTM F3010 designed to reduce moisture vapour emissions in concrete substrates.

.1 Performance: Capable of suppressing up to 100% RH when tested according to ASTM F2170.

.2 Substrate Primer: Use manufacturer's recommended primer as needed.

.3 Acceptable Products: Approved proprietary moisture control system recommended in writing by floor covering manufacturer and acceptable to Consultant in order to authenticate floor covering warranties.

.4 Alternative: Manufacturer's recommended moisture-tolerant primers may be used in lieu of moisture vapour control system

provided manufacturer approves such use for specific conditions in writing.

### **3 . EXECUTION**

#### **3.1 Examination**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.
- 3.1.2 Begin coating application only after the following:
  - .1 minimum concrete curing and drying period recommended by pedestrian traffic coating manufacturer has passed,
  - .2 unsatisfactory conditions have been corrected, and
  - .3 surfaces are dry. Verify that substrates are visibly dry and free of moisture.

#### **3.2 Preparation**

- 3.2.1 Manufacturer's instructions: Comply with ASTM C1127 and with manufacturer's written instructions with regards to cleaning, treatment, and preparation of substrates. Ensure substrates are free of dust and are dry before applying traffic coating.
- 3.2.2 Masking: Mask off adjoining surfaces not receiving traffic coating to prevent spillage and overspray affecting other construction. Use patching materials to address substrate imperfections.
- 3.2.3 Irregularities: Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- 3.2.4 Contaminant Removal: Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete. Do not acid etch.
- 3.2.5 Surface Profile: Roughen concrete using shot-blasting and provide ICRI CSP of 2 or greater as required by manufacturer's written instructions.
- 3.2.6 Concrete Repair: Repair damaged and deteriorated concrete according to pedestrian traffic coating manufacturer's written instructions.
- 3.2.7 Moisture Testing: Perform moisture testing in accordance with ASTM F2170. Verify that concrete substrates are dry and moisture-vapour emissions are within acceptable levels according to manufacturer's written instructions.

- .1 Maximum Permitted Relative Humidity: 75 percent; or as recommended by manufacturer.
- 3.2.8 Joints and Cracks Treatment: Comply with ASTM C1127 unless indicated otherwise. Provide manufacturer's recommended sealant materials.
- 3.2.9 Termination and Penetrations Treatment: Comply with ASTM C1127 for treatment and sealing of traffic coating terminations and penetrations.
  - .1 Apply sealant cants at floor-to-wall joints and penetrations.
  - .2 At movement joints, terminate with a manufacturer's recommended strips.
- 3.2.10 Prepare, fill, prime, and treat joints and cracks in substrates as specified in this Section

### **3.3 Pedestrian Traffic Coating Application**

- 3.3.1 Installation, generally: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.
- 3.3.2 Apply pedestrian traffic coating material according to ASTM C1127 and manufacturer's written instructions.
- 3.3.3 Primer Application: Prime substrate if required by manufacturer. Apply primer according to manufacturer's instructions.
- 3.3.4 Membrane Preparation: Mix multi-component systems in accordance with manufacturer's instructions. Ensure homogeneous mix free of air bubbles.
- 3.3.5 Membrane Application: Apply membrane to deck by spray gun, notched squeegee, or roller as recommended by manufacturer. Comply with manufacturer's instructions on application method, rate, number and thickness of coats, cure intervals, aggregate application, and cure time.
  - .1 Measure wet film thickness every 9 m<sup>2</sup> (100 ft<sup>2</sup>). Maintain thickness above minimum requirements specified in this Section.
- 3.3.6 Where work stoppage is required and may exceed 1 to 2 hours, terminate membranes in straight line. Prior to resuming, clean and prime (as needed) existing membrane minimum 150 mm (6 in.) from edge. Overlap new membrane 150 mm (6 in.) with existing membrane prior to continuing application.



- 3.3.7 Apply pedestrian traffic coatings to prepared wall terminations and vertical surfaces to height of not less than 100 mm (4 inches). Do not provide aggregate on vertical surfaces. Apply membrane over housekeeping pads as required to ensure continuity of system.
- 3.3.8 Cove Bases: Provide 13mm x 13mm (1/2 in x 1/2 in) cant to internal coves and angles with manufacturer's recommended sealant.
- 3.3.9 Cure pedestrian traffic coatings according to manufacturer's written recommendations. Prevent contamination and damage during application and curing stages.
- 3.3.10 Finish with a top coat and silica aggregate to as required to provide slip resistance.

### **3.4 Field Quality Control**

- 3.4.1 Engage site representative qualified by traffic coating membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to supply reports to Consultant upon completion of installation.
- 3.4.2 Notify Consultant or Owner 48 hours in advance of date and time of inspection.

### **3.5 Protection**

- 3.5.1 Protect pedestrian traffic coatings from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades.
- 3.5.2 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in writing by affected material's manufacturer. Do not use materials or process that can damage finishes, surfaces, or construction.
- 3.5.3 Promptly replace pedestrian traffic coatings work damaged during construction that cannot be satisfactorily repaired.

### **3.6 Cleaning And Waste Management**

- 3.6.1 Cleaning and Waste Management, generally: in accordance with Section 01 74 00, Cleaning and Waste Management.
- 3.6.2 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
- 3.6.3 Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**Regional Municipality  
of Peel  
Procurement Division**

**Document 2024-346P  
CONSTRUCTION OF THE  
DOCKSTEADER PRPS  
REPORTING STATION**

**Division 07  
07 18 13  
Pedestrian Traffic  
Coatings (Mechanical  
Room Waterproofing)**

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**END OF SECTION**

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the vehicular traffic coatings work specified herein. This includes, but is not necessarily limited, to:
  - .1 Vehicular traffic coatings where noted on Drawings.
  - .2 Pavement markings associated with traffic coatings.
  - .3 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

### **1.4 Preinstallation Meetings**

- 1.4.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.
- 1.4.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
  - .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.

- .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.
- .3 Agenda:
  - .1 Review progress of related construction activities and preparations for particular activity under consideration.
  - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
- .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
- .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

## **1.5 Submittals**

- 1.5.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.5.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for vehicular traffic coatings work specified in this Section.
- 1.5.3 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:
  - .1 Include manufacturer's standard details for treating substrate joints and cracks, flashings, penetrations, and other termination conditions.
  - .2 Provide layout of pavement markings.
- 1.5.4 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
  - .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
  - .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
  - .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.5.5 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:

- .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.
- .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.5.6 Low-Emitting Materials: For applicable Products specified or used for activities of this Section (i.e., site-applied coatings, adhesives, and sealants), submit certifications from third-party organizations indicating compliance with following:
  - .1 VOC Emissions: California Department of Public Health (CDPH) Standard Method v1.2–2017, using applicable exposure scenario.
  - .2 VOC Content: SCAQMD Rule 1113 (for paints and coatings) and SCAQMD Rule 1168 (for adhesives and sealants).
- 1.5.7 Samples: Submit selection and verification samples for Products requiring colour, texture, or design selection. Submit manufacturer's list of finishes or colour swatches for Consultant's selection.
  - .1 As a minimum submit samples of the following: Provide stepped samples on backing large enough to illustrate buildup of pedestrian traffic coatings.

## **1.6 Closeout Submittals**

- 1.6.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.
- 1.6.2 Maintenance Data: Submit maintenance data for pedestrian traffic coatings to include in maintenance manuals.
- 1.6.3 Warranty Documentation: Submit copy of extended warranties specified in this Section.

## **1.7 Quality Assurance**

- 1.7.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.
- 1.7.2 Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of traffic coatings required for this Project.
- 1.7.3 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.

- 1.7.4 Mock-Ups / First Installation Review: Construct mock-ups to verify selections made under submittals, demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
- .1 Location: In-situ (i.e. first installation), as directed on site by Consultant.
  - .2 Apply each coating to at least 10 sq. m (100 sq. ft.) of each substrate to demonstrate surface preparation, joint and crack treatment, thickness, texture, colour, and standard of workmanship.
  - .3 Purpose: To set benchmarks for installation and to judge subsequent work. Maintain Mock-ups during construction in undisturbed condition.
  - .4 Reviewed mock-ups: May become part of the completed work if undisturbed at the time of Substantial Performance of The work, provided they are undisturbed, and comply with requirements outlined in Contract Documents.

**1.8 Delivery, Storage And Handling**

- 1.8.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.
- 1.8.2 Deliver, store and handle pedestrian traffic coatings materials in accordance with manufacturer's written instructions.
- 1.8.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.8.4 Store materials in off-ground, in clean, dry, well-ventilated area.
- 1.8.5 Replace defective or damaged materials with new.

**1.9 Project Conditions**

- 1.9.1 Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit traffic coating to be performed according to manufacturer's written instructions.
- .1 Do not apply traffic coating in snow, rain, fog, or mist.
- 1.9.2 Ambient Conditions: Proceed with traffic coating work only when temperature is at least 5 deg C (40°F) and rising during work and curing periods. Maintain adequate ventilation during preparation and application of traffic coating materials.
- 1.9.3 Do not install vehicular traffic coating until items that will penetrate membrane have been installed.

**1.10 Warranty**

- 1.10.1 Extended warranty: Submit for Owner's review and acceptance, manufacturer's extended warranty in which manufacturer commits

to repair or replace components of vehicular traffic coatings that fail within specified warranty period. Manufacturer's extended warranty is in addition to, and does not supersede, any other rights that Owner may have under Contract Documents.

- .1 Warranty Period: Not less than 5 years from date of Substantial Performance of The work.

## **2 . PRODUCTS**

### **2.1 Manufacturers**

2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:

- .1 Sika Canada Inc.
- .2 Soprema Canada
- .3 Tremco Inc.

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

### **2.2 Performance / Design Criteria**

2.2.1 Waterproofing System Integrity: Ensure compatibility between waterproofing system components. Do not allow waterproofing materials to touch chemically incompatible substances.

2.2.2 Membrane Performance: ASTM C957 and CSA S413, elastomeric traffic-bearing waterproofing membrane designed to withstand pedestrian traffic and stop water penetration under pressure.

2.2.3 Minimum crack bridging capabilities: 1.5 mm (1/16").

2.2.4 Ensure traffic topping accommodates normal substrate movement and seal expansion and control joints, construction material transitions, opening transitions, penetrations, and perimeter conditions without resultant moisture deterioration.

2.2.5 Diesel Fuel and Cleaning Chemical Resistance: For areas where traffic coating membrane will be exposed to diesel fuel or cleaning chemicals (Vehicle Bay, Pit Stop, Wash Bay, Bypass Bay, Wet Area, etc.), apply additional chemical-resistant protective coated to resist fuel and chemical induced damage.

2.2.6 Snow Plow Resistance: Where membranes are installed on top of parking structure or at any areas where they may be subject to snow plow blades, provide materials complying with CSA S413 and capable of resisting such abrasion.

2.2.7 Fire testing results: Minimum Flame-Spread Value of 25 or less and Smoke-Developed Value of 450 or less when tested in accordance with CAN/ULC S102.2.

- .1 Where membranes are installed on top of parking structure, provide materials complying with Class A ratings in accordance with CAN/ULC-S107.

2.2.8 VOC Content and Emissions:

- .1 VOC Content Requirements: Wet-applied materials used in scope of this Section must conform to the following:
  - .1 Paints and Coatings: SCAQMD Rule 1113 or CARB SCM.
  - .2 Adhesives and Sealants: SCAQMD Rule 1168.
  - .3 Methylene chloride and perchloroethylene must not be intentionally added in paints, coatings, adhesives, or sealants.

**2.3 Traffic Coating – Type 1**

- 2.3.1 Material Tag: This item is noted as “EP-1” on Drawings and Schedules.
- 2.3.2 Primer: Manufacturer's standard factory-formulated primer recommended for substrate and conditions required. Provide moisture-tolerant primers in conditions where slab moisture content is above manufacturer's recommendations after performing testing.
- 2.3.3 Preparatory and Base Coats: Chemical-curing polyurethane-methacrylate (PUMA) modified coating
  - .1 Minimum thickness: As recommended by manufacturer; if not recommended, not less than 80 mils w.f.t. (measured excluding aggregate)
- 2.3.4 Wear Coat: Chemical-curing polyurethane-methacrylate (PUMA) modified coating
  - .1 Minimum thickness: As recommended by manufacturer; if not recommended, not less than 100 mils w.f.t. (measured excluding aggregate)
- 2.3.5 Top Coat: Chemical-curing polyurethane-methacrylate (PUMA) modified coating with UV inhibitors where used in exterior applications.
  - .1 Minimum thickness: As recommended by manufacturer; if not recommended, not less than 30 mils w.f.t. (measured excluding aggregate)
- 2.3.6 Aggregate: Aluminum-oxide grit of particle sizes, shape, and minimum hardness recommended in writing by traffic coating manufacturer.
  - .1 Spreading Rate: As recommended by manufacturer for substrate and service conditions required, but not less than the following: to refusal.



2.3.7 Basis-of-Design: "Vulkem PUMA EWS" by Tremco Canada or approved equivalent as follows:

- .1 "Sikalastic Pronto RB-5700 PUMA" by Sika Canada Inc.
- .2 "Alsan Trafik RS" by Soprema

## **2.4 Fluid-Applied Flooring – Self-Leveling (Traffic Coating – Type 2)**

2.4.1 Material Tag: This item is noted as "EP-2" on Drawings and Schedules.

2.4.2 System Description: Chemical-resistant, self-leveling, resin-based, monolithic flooring system for use over properly prepared concrete substrates.

- .1 System Type: Urethane-cement based.
  - .2 System Classification (ASTM C722): Self-levelling (SL)
    - .1 Minimum compressive strength: 50 MPa (7250 psi) at 7 days; ASTM C579.
    - .2 Minimum tensile strength: 12 MPa (1740 psi) at 7 days; ASTM C307.
    - .3 Minimum flexural strength: 20 MPa (2900 psi) at 7 days; ASTM C580.
    - .4 Maximum shrinkage: 0.5%; ASTM C531.
    - .5 Maximum water absorption: 1.0%; ASTM C413.
    - .6 Minimum coefficient of friction: 0.5; ASTM D2047.
    - .7 Chemical Resistance (spot): ASTM D1308.
    - .8 Fungi Growth (ASTM G21): Minimum Class 1 Rating.
    - .9 Mould Growth (ASTM D3273): Minimum Class 10 Rating.
    - .10 Pull-off Strength: 100% substrate failure in accordance with ASTM D4541 or ACI 503R.
  - .3 Overall System Thickness: 3 mm (1/8 inch)
  - .4 Primer: as recommended by manufacturer.
  - .5 Body/Grout Coats: urethane cement resin complete with manufacturer's standard aggregates.
  - .6 Color and Pattern: As selected by Consultant from manufacturer's full range at a later date
  - .7 Sheen: semi-gloss, unless otherwise indicated.
  - .8 Wearing Surface: Manufacturer's standard wearing surface meeting slip-resistance performance specified herein.
- 2.4.3 Basis-of-Design System:
- .1 Base coat: "TREMfloor SL" by Tremco or approved equivalent.
  - .2 Topcoat: TREMfloor FC or approved equivalent.

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**2.5     Auxiliary Materials**

- 2.5.1 Joint Sealants: As recommended by traffic coating manufacturer and complying with requirements specified in Section 07 92 00, Joint Sealants.
- 2.5.2 Sheet Flashing: Nonstaining; minimum 1.5 mm (60 mils) thick sheet material recommended in writing by traffic coating manufacturer.
- 2.5.3 Adhesive: Contact adhesive recommended in writing by traffic coating manufacturer.
- 2.5.4 Reinforcing Strip: Fiberglass mesh recommended in writing by traffic coating manufacturer.

**2.6     Pavement Markings**

- 2.6.1 Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with MPI 97 with drying time of less than 45 minutes.
  - .1 Colour: As selected by Consultant at a later date. Use blue for spaces barrier-free parking areas.
  - .2 Basis-of-Design: "Pro-Park" by Sherwin-Williams or approved equivalent.

**3 .     EXECUTION**

**3.1     Examination**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.
- 3.1.2 Begin coating application only after the following:
  - .1 minimum concrete curing and drying period recommended by vehicular traffic coating manufacturer has passed,
  - .2 unsatisfactory conditions have been corrected, and
  - .3 surfaces are dry. Verify that substrates are visibly dry and free of moisture.

**3.2     Preparation**

- 3.2.1 Manufacturer's instructions: Comply with ASTM C1127 and with manufacturer's written instructions with regards to cleaning, treatment, and preparation of substrates. Ensure substrates are free of dust and are dry before applying traffic coating.

- 3.2.2 Masking: Mask off adjoining surfaces not receiving traffic coating to prevent spillage and overspray affecting other construction. Use patching materials to address substrate imperfections.
- 3.2.3 Irregularities: Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- 3.2.4 Contaminant Removal: Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete. Do not acid etch.
- 3.2.5 Surface Profile: Roughen concrete using shot-blasting and provide ICRI CSP of 2 or greater as required by manufacturer's written instructions.
- 3.2.6 Concrete Repair: Repair damaged and deteriorated concrete according to vehicular traffic coating manufacturer's written instructions.
- 3.2.7 Moisture Testing: Perform moisture testing in accordance with ASTM F2170. Verify that concrete substrates are dry and moisture-vapour emissions are within acceptable levels according to manufacturer's written instructions.
  - .1 Maximum Permitted Relative Humidity: 75 percent; or as recommended by manufacturer.
  - .2 Do not proceed with installation until moisture-related issues are resolved.
- 3.2.8 Joints and Cracks Treatment: Comply with ASTM C1127 unless indicated otherwise. Provide manufacturer's recommended sealant materials.
- 3.2.9 Termination and Penetrations Treatment: Comply with ASTM C1127 for treatment and sealing of traffic coating terminations and penetrations.
  - .1 Apply sealant cants at floor-to-wall joints and penetrations.
  - .2 At movement joints, terminate with a manufacturer's recommended strips.
- 3.2.10 Prepare, fill, prime, and treat joints and cracks in substrates as specified in this Section

### **3.3 Vehicular Traffic Coating Application**

- 3.3.1 Installation, generally: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.

- 3.3.2 Apply vehicular traffic coating material according to ASTM C1127 and manufacturer's written instructions.
- 3.3.3 Primer Application: Prime substrate if required by manufacturer. Apply primer according to manufacturer's instructions.
- 3.3.4 Membrane Preparation: Mix multi-component systems in accordance with manufacturer's instructions. Ensure homogeneous mix free of air bubbles.
- 3.3.5 Membrane Application: Apply membrane to deck by spray gun, notched squeegee, or roller as recommended by manufacturer. Comply with manufacturer's instructions on application method, rate, number and thickness of coats, cure intervals, aggregate application, and cure time.
  - .1 Measure wet film thickness every 9 m<sup>2</sup> (100 ft<sup>2</sup>). Maintain thickness above minimum requirements specified in this Section.
- 3.3.6 Where work stoppage is required and may exceed 1 to 2 hours, terminate membranes in straight line. Prior to resuming, clean and prime (as needed) existing membrane minimum 150 mm (6 in.) from edge. Overlap new membrane 150 mm (6 in.) with existing membrane prior to continuing application.
- 3.3.7 Apply pedestrian traffic coatings to prepared wall terminations and vertical surfaces to height of not less than 100 mm (4 inches). Do not provide aggregate on vertical surfaces. Apply membrane over housekeeping pads as required to ensure continuity of system.
- 3.3.8 Cure pedestrian traffic coatings according to manufacturer's written recommendations. Prevent contamination and damage during application and curing stages.
- 3.3.9 Finish with top coat and aggregate as required to provide skid resistance.

### **3.4 Pavement Markings**

- 3.4.1 Do not apply traffic paint for striping and other markings until traffic coating has cured according to manufacturer's written recommendations.
- 3.4.2 Apply traffic paint for striping and other markings with mechanical equipment to produce uniform straight edges. Apply at manufacturer's recommended rates for a 0.38-mm- (15-mil-) minimum wet film thickness.

### **3.5 Field Quality Control**

- 3.5.1 Engage site representative qualified by traffic coating membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage

components, and to supply reports to Consultant upon completion of installation.

- 3.5.2 Notify Consultant or Owner 48 hours in advance of date and time of inspection.

**3.6 Protection**

- 3.6.1 Protect vehicular traffic coatings from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades.
- 3.6.2 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in writing by affected material's manufacturer. Do not use materials or process that can damage finishes, surfaces, or construction.
- 3.6.3 Promptly replace vehicular traffic coatings work damaged during construction that cannot be satisfactorily repaired.

**3.7 Cleaning And Waste Management**

- 3.7.1 Cleaning and Waste Management, generally: in accordance with Section 01 74 00, Cleaning and Waste Management.
- 3.7.2 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
- 3.7.3 Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**END OF SECTION**

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the parking slab silane water repellents work specified herein. This includes, but is not necessarily limited, to:
  - .1 Penetrating silane water repellents for application to vehicle bays, loading dock, make ready vestibule and cylinder room.
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only:
  - .1 Refer to 07 18 16 - Vehicular Traffic Coatings for membrane coatings applied to suspended slabs.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

### **1.4 Preinstallation Meetings**

- 1.4.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.
- 1.4.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.

- .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.
- .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.
- .3 Agenda:
  - .1 Review progress of related construction activities and preparations for particular activity under consideration.
  - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
- .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
- .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

## **1.5 Submittals**

- 1.5.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.5.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for water repellents work specified in this Section.
- 1.5.3 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
  - .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
  - .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
  - .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.5.4 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:
  - .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.
  - .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.

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**1.6     Closeout Submittals**

- 1.6.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.

**1.7     Quality Assurance**

- 1.7.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.
- 1.7.2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.
- 1.7.3 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.
- 1.7.4 Mock-Ups / First Installation Review: Apply test samples -ups to verify selections made under submittals, demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
- .1 Location: In-situ (i.e. first installation), as directed on site by Consultant.
  - .2 Apply each coating to at least 1 sq. m (10 sq. ft.) of each substrate to demonstrate surface preparation, texture, colour, and standard of workmanship.
  - .3 Purpose: To set benchmarks for installation and to judge subsequent work. To ensure water repellent will not adversely affect concrete substrates.
  - .4 Reviewed mock-ups: May become part of the completed work if undisturbed at the time of Substantial Performance of The work, provided they are undisturbed, and comply with requirements outlined in Contract Documents.

**1.8     Delivery, Storage And Handling**

- 1.8.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.
- 1.8.2 Deliver, store and handle water repellents materials in accordance with manufacturer's written instructions.
- 1.8.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.8.4 Store materials in off-ground, in clean, dry, well-ventilated area.
- 1.8.5 Replace defective or damaged materials with new.



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**1.9     Project Conditions**

1.9.1 Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit traffic coating to be performed according to manufacturer's written instructions.

.1 Do not apply traffic coating in snow, rain, fog, or mist.

1.9.2 Ambient Conditions: Proceed with traffic coating work only when temperature is at least 5 deg C (40°F) and rising during work and curing periods. Maintain adequate ventilation during preparation and application of traffic coating materials.

1.9.3 Ensure concrete surfaces and mortars have cured for minimum of 28 days.

**1.10    Warranty**

1.10.1 Extended warranty: Submit for Owner's review and acceptance, manufacturer's extended warranty in which manufacturer commits to repair or replace components of water repellents that fail within specified warranty period. Manufacturer's extended warranty is in addition to, and does not supersede, any other rights that Owner may have under Contract Documents.

.1 Warranty Period: Not less than 5 years from date of Substantial Performance of The work.

**2 .     PRODUCTS**

**2.1     Manufacturers**

2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:

.1 Evonik Degussa Corporation

.2 Prosoco Inc.

.3 Sika Canada Inc.

.4 W.R. Meadows Inc., Canada

.5 Sherwin Williams

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

**2.2     Performance / Design Criteria**

2.2.1 Systems must comply with Alberta Transportation Specifications for Type 1b, or Type 1c.

2.2.2 Solids content range: 25% to 33%.

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**2.3     Silane Penetrating Water Repellent**

- 2.3.1 Material Tag: This item is noted as “WRP” on Drawings and Schedules.
- 2.3.2 Description: Alkali-resistant, silane-based, hydrophobic penetrating sealer designed to penetrate concrete pores and capillaries to enhance durability and inhibit water and salt penetration in concrete structures. System must have minimum effects on appearance.
- 2.3.3 Basis-of-Design: “SL100 Water Repellent neat” by Prosoco
  - .1 Acceptable Equivalents:
    - .1 “Pentreat 244 40” by W.R. Meadows Inc., Canada
    - .2 “Sikagard® SN-40 Lo VOC” or “Sikagard 740 W” or “Sikagard SN-100” by Sika Canada Inc.
    - .3 “Baracade Silane 100 C” by Euclid Canada
    - .4 “SW-244-100VOC” by Sherwin Williams.

**3 .     EXECUTION**

**3.1     Examination**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.
- 3.1.2 Begin coating application only after the following:
  - .1 minimum concrete curing and drying period recommended by water repellent manufacturer has passed,
  - .2 unsatisfactory conditions have been corrected, and
  - .3 surfaces are dry. Verify that substrates are visibly dry and free of moisture.

**3.2     Preparation**

- 3.2.1 Clean substrate to eliminate substances that might interfere with performance of water repellents. Conduct moisture content test in accordance with water-repellent manufacturer's written instructions.
- 3.2.2 Remove oils, curing compounds, and laitance that may hinder adhesion or penetration of water repellents.
- 3.2.3 Masking: Mask off adjoining surfaces not receiving traffic coating to prevent spillage and overspray affecting other construction.

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**3.3     Installation**

- 3.3.1 Installation, generally: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.
- 3.3.2 Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.
- 3.3.3 Number of coats: Minimum two.
  - .1 Horizontal Surfaces: Apply saturation coat to parking garage slabs at rate recommended by manufacturer use roller or low-pressure spray; ensure proper penetration into substrates. Prevent ponding; redistribute or remove excess if necessary.
  - .2 Vertical Surfaces: Apply water repellents at least 100 mm (4 inches) up vertical walls and columns intersection with garage slabs. Saturate surface in single application using spray equipment. Brush heavy runs and drips into surface until full absorption.
  - .3 Second Coat: Apply second coat perpendicular to first, as required by manufacturer. Comply with manufacturer's written instructions for drying time between coats. Do not overapply.

**3.4     Protection**

- 3.4.1 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in writing by affected material's manufacturer. Do not use materials or process that can damage finishes, surfaces, or construction.
- 3.4.2 Promptly replace water repellents work damaged during construction that cannot be satisfactorily repaired.

**3.5     Cleaning And Waste Management**

- 3.5.1 After completing water repellent application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- 3.5.2 Cleaning and Waste Management, generally: in accordance with Section 01 74 00, Cleaning and Waste Management.
- 3.5.3 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
- 3.5.4 Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses

- 3.5.5 Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**END OF SECTION**

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## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the thermal insulation work specified herein. This includes, but is not necessarily limited, to:
  - .1 Foam-plastic board insulation.
  - .2 Mineral fibre board insulation.
  - .3 Flexible batt / blanket insulation.
  - .4 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

### **1.4 Preinstallation Meetings**

- 1.4.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.
- 1.4.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
  - .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.

- .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.
- .3 Agenda:
  - .1 Review progress of related construction activities and preparations for particular activity under consideration.
  - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
- .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
- .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

## **1.5 Submittals**

- 1.5.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.5.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for thermal insulation work specified in this Section.
- 1.5.3 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:
  - .1 Include insulation manufacturer's standard insulation fastening patterns and load tables.
- 1.5.4 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
  - .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
  - .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
  - .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.5.5 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:
  - .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze

level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.

.2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.

1.5.6 Submit for Consultants review, QA checklist used as part of installation process. Make modifications to QA checklist based on Consultant feedback

#### **1.6 Closeout Submittals**

1.6.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.

1.6.2 Warranty Documentation: Submit copy of extended warranties specified in this Section.

#### **1.7 Quality Assurance**

1.7.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.

1.7.2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.

1.7.3 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.

#### **1.8 Delivery, Storage And Handling**

1.8.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.

1.8.2 Deliver, store and handle thermal insulation materials in accordance with manufacturer's written instructions.

1.8.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

1.8.4 Store materials in off-ground, in clean, dry, well-ventilated area.

1.8.5 Replace defective or damaged materials with new.

#### **1.9 Warranty**

1.9.1 Provide warranty covering the Work of this Section in accordance with Supplementary Condition SC49 / GC 12.3 WARRANTY.

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## **2 . PRODUCTS**

### **2.1 Manufacturers**

2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:

.1 Extruded-polystyrene board insulation (XPS)

.1 DuPont de Nemours Inc.

.2 Owens Corning.

.3 Soprema

.2 Glass-Fiber Insulation:

.1 Johns Manville.

.2 Knauf Insulation.

.3 Owens Corning.

.3 Mineral-Wool Insulation

.1 Rockwool Inc.

.2 Thermafiber.

.3 Johns Manville.

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

### **2.2 Performance / Design Criteria**

2.2.1 Regulatory Compliance: Provide insulation materials tested and approved by agencies recognized by authorities having jurisdiction. Provide markings to indicate certification.

2.2.2 Combustible Materials: For combustible foam-plastic insulation or flammable vapour retarders, strictly comply with OBC requirements. Generally, combustible foam-plastic insulation and flammable vapour retarders must not be left exposed and must be protected by approved non-combustible thermal barriers.

2.2.3 Insulation in contact with ground: Insulation boards specified in this Section which are in contact with ground must not be affected by the action of soil and water and must behave in such a way that their insulating properties are not substantially reduced by moisture.

2.2.4 Required Insulation Thickness and Assembly R-Values: Refer to Drawings and Schedules. Unless specified otherwise, R-values indicated in this Section are measured in accordance with ASTM C518 and tested at 24 deg C (75 deg F) mean temperature.

2.2.5 Building Enclosure Design Principle: Exterior envelope construction for this Project is based on "Rain Screen" design principle, as recommended by National Research Council of Canada. Unless



specifically indicated otherwise, face sealed assemblies are not permitted.

- .1 Continuity: Maintain integrity and continuity of building enclosure's thermal, air, and vapour control layers at all times by using appropriate insulation, air barriers, vapour retarders to tie work of this Section with adjacent construction.
- .2 Air Sealing: Supplement building enclosure's primary air barrier and vapour retarder membranes by sealing openings and penetrations using low-density polyurethane foam sealants specified in this Section.
- .3 Material Compatibility: Before installation, review and confirm compatibility of material types, including insulation, adhesives, and substrates.

## **2.3      Below Grade Board Insulation**

### **2.3.1    Foundation Perimeter Insulation - XPS:**

- .1 Material Tag: This item is noted as "INS-3" on Drawings and Schedules.
- .2 Description: Extruded polystyrene board insulation complying with CAN/ULC-S701.1 Type 4 or equivalent to ASTM C 578.
- .3 General Performance Requirements:
  - .1 Minimum compressive strength: 210 kPa (30 psi).
  - .2 Thermal Resistance per 25 mm (in.): RSI 0.87 m<sup>2</sup> •°C/W (R5 ft<sup>2</sup> •h•°F/Btu) per ASTM C518.
  - .3 Water Absorption (ASTM D2842 or ASTM C272): Max 0.3 %
- .4 Location: Foundation walls below grade.
- .5 Basis-of-Design Products: "Sopra-XPS 30" by Soprema
- .6 GWP: ≤ 1.83 kgCO<sub>2</sub>e / 1 m<sup>2</sup> RSI as reported in Building Transparency EC3 Platform.

### **2.3.2    Under Slab High-Density Insulation Panels:**

- .1 Material Tag: This item is noted as "INS-4" on Drawings and Schedules.
- .2 Description: Extruded polystyrene board insulation complying with CAN/ULC-S701.1 Type 4 or equivalent to ASTM C 578.
- .3 General Performance Requirements:
  - .1 Minimum compressive strength: 276 kPa (40 psi).
  - .2 Thermal Resistance per 25 mm (in.): RSI 0.87 m<sup>2</sup> •°C/W (R5 ft<sup>2</sup> •h•°F/Btu) per ASTM C518.
  - .3 Water Absorption (ASTM D2842 or ASTM C272): Max 0.3 %

- .4 Location: Under concrete slabs-on-grade.
- .5 Basis-of-Design: "Sopra-XPS 40" (pedestrian traffic) or "Sopra-XPS 60" (vehicular traffic) by Soprema.
- .6 GWP:  $\leq 1.83 \text{ kgCO}_2\text{e} / 1 \text{ m}^2$  RSI as reported in Building Transparency EC3 Platform.
- .7 Note: In areas subject to vehicular traffic, increase compressive strength to minimum 414 kPa (60 psi) or as required to carry stipulated loads.

## **2.4 Mineral Wool Board Insulation**

2.4.1 Material Tag: This item is noted as "INS-1" on Drawings and Schedules.

- .1 Fire Performance:
  - .1 Maximum flame spread value: 15 in accordance with CAN/ULC-S102
  - .2 Smoke-developed value: 0 in accordance with CAN/ULC-S102
  - .3 Combustion Characteristics: Non-combustible per CAN/ULC-S114.
- .2 Cladding Applications: Medium-density mineral wool insulation conforming to CAN/ULC-S702.1 Type 1 or equivalent to ASTM C612.
  - .1 Nominal density: 64 kg/cu. m (4 lb/cu. ft.)
  - .2 Thermal Resistance per 25 mm (in.): RSI 0.75 m<sup>2</sup> •°C/W (R4.3 ft<sup>2</sup> •h•°F/Btu) per ASTM C518.
  - .2 Location: Panelized cladding systems such as metal cladding, cementitious cladding, wood cladding, composite cladding etc.
  - .3 Basis-of-Design Products: "CAVITYROCK Black" by Rockwool or approved equivalent as follows:
    - .1 "Thermafiber® RainBarrier™ Dark" by Owens Corning/Thermafiber
- .3 Curtain Wall Backpan Applications: Medium-density mineral wool insulation conforming to CAN/ULC-S702.1 Type 1 or equivalent to ASTM C612.
  - .1 Nominal density: 56 kg/m<sup>3</sup> (3.5 lb/cu. ft.)
  - .2 Thermal Resistance per 25 mm (in.): RSI 0.75 m<sup>2</sup> •°C/W (R4.3 ft<sup>2</sup> •h•°F/Btu) per ASTM C518.
  - .3 Location: Panelized cladding systems such metal cladding, cementitious cladding, wood cladding, composite cladding etc.

- .1 Basis-of-Design Products: "CAVITYROCK" by Rockwool or approved equivalent as follows:
- .2 "Thermafiber® RainBarrier™" by Owens Corning/Thermafiber
- .3 "JM CladStone™ Water & Fire Block Insulation" by Johns Manville

## **2.5 Roofing Board Insulation**

2.5.1 Polyisocyanurate insulation (INS-2): As specified in 07 52 16.

## **2.6 Foamed-In-Place Air Barriers Insulating Foam Sealants**

2.6.1 General Purpose Type (for application at gaps and cracks): semi-rigid single-component polyurethane sealant, to CAN/ULC-S710 and CAN/ULC-S711; and having the following properties:

- .1 Minimum Thermal Resistance (ASTM C518): RSI 0.73 per 25 mm (R4.2 per inch)
- .2 Core Density (ASTM D1622): minimum 24.03 kg/m<sup>3</sup> (1.5 pcf).
- .3 Fire Resistance (CAN/ULC S102): Flame spread < 15, Smoke Developed < 20.
- .4 Primer: As recommended by sealant manufacturer.
- .5 Acceptable Products:
  - .1 "Handi-Foam®" by Fomo Products, Inc.; [www.fomo.com](http://www.fomo.com)
  - .2 "GREAT STUFF PRO™ Series" Foam Sealant by DuPont de Nemours Inc.
  - .3 "CF-I XTW WD Extreme-Weather Foam Sealant by Hilti Inc.

## **2.7 Insulation Fasteners**

2.7.1 Types: Provide fasteners with demonstrated capability to retain securely insulation to substrates without damaging insulation and substrates.

2.7.2 Minimum Number of Fasteners: Final number and pattern of attachment to be determined by insulation board dimensions and cladding attachment system. For board insulation, provide not less than five fasteners per board (4 along perimeter and 1 in middle).

2.7.3 Fastener Requirements for Concrete and Masonry: For permanent attachment, use mechanical fasteners equipped with minimum 50 mm (2-inch) diameter washers.

- .1 Material: Use low-conductivity fasteners unless indicated otherwise.
- .2 Attachment Criteria: Select fasteners based on substrate type and manufacturer's recommendation to ensure fasteners can:

- .1 withstand applied pullout and shear loads;
- .2 prevent insulation tear-through under normal conditions;
- .3 have sufficient durability to last lifetime of installation.
- .3 Basis-of-Design: "X-IE-G 6 Insulation Fastener" by Hilti Inc.
  - .1 Acceptable Equivalent: "Ramset T3 Insulfast System" by ITW Construction Products; [www.ramset.ca](http://www.ramset.ca)
- 2.7.4 Fastener Requirements for Metal Framing: Perforated base insulation pins with stainless steel nails and 50 mm self-locking washers.
  - .1 Adhesive: to be compatible with air/vapour barrier membrane.
  - .2 Basis-of-Design: "Insulation Hanger" by Gemco or approved equivalent.

### **3 . EXECUTION**

#### **3.1 Examination**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.

#### **3.2 Preparation**

- 3.2.1 Clean substrates of substances that are harmful to insulation or that interfere with insulation attachment.

#### **3.3 Installation**

- 3.3.1 Installation, generally: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.
- 3.3.2 Use insulation that is free from damage, moisture, and contaminants, and not previously exposed to ice, rain, snow or other harmful substances.
- 3.3.3 Extend insulation to cover entire area to be insulated. Fit tightly around obstructions. Fill voids with insulation. Remove projections that might interfere with placement.
- 3.3.4 Ensure snug fit of insulation around electrical boxes, pipes, ducts, doors, windows, and other protrusions. Comply with local building regulations and safety codes for required clearances around electrical and heat-emitting devices. Seal penetrations in insulation

with compatible sealant and in accordance with manufacturer's instructions.

- 3.3.5 Use manufacturer's standard sizes to achieve thermal resistance requirements indicated on Drawings. As far as practical, install insulation in a single layer to achieve required thermal resistance criteria. In multi-layer applications, offset joints both vertically and horizontally.
- 3.3.6 Where insulation contains a facer with printed label, ensure printed side of boards face outward.

### **3.4 Below-Grade Insulation**

- 3.4.1 Vertical Application: Extend insulation minimum of 1200 mm (48 inches) below exterior grade line unless otherwise indicated on Drawings or by local energy codes.
- 3.4.2 Horizontal Application: Loosely lay insulation units on horizontal surfaces in accordance with manufacturer's written instructions. Stagger end joints and tightly abut insulation board. Extend insulation minimum of 1200 mm (48 inches) below exterior grade line unless otherwise indicated on Drawings or by local energy codes.

### **3.5 Above-Grade Board Insulation**

- 3.5.1 Panelized Systems (Cladding)
  - .1 Where horizontal Z-girts are indicated on Drawings, provide continuous galvanized steel framing members spaced at 610 mm (24 inches) to 1220 mm (48 inches) on center based on cladding weight. Permanently secure insulation with fasteners and washers as specified in this Section.
  - .2 For thermally broken systems, provide manufacturer's proprietary clips to reduce thermal bridging effects. Attach clips to vertical or horizontal rails as specified by manufacturer. Permanently secure insulation with fasteners and washers as specified in this Section.
- 3.5.2 Masonry Ties:
  - .1 Use wedges or clips over masonry ties for securing boards to backup wall. Fit board insulation around ties and backup wall.
  - .2 Where masonry ties do not have lack an insulation retention system, attach insulation boards using fasteners and washers as specified in this Section.
- 3.5.3 Curtain-Wall Construction
  - .1 Secure insulation within curtain wall using metal clips and straps or integral pockets within window frames. Maintain

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specified cavity width between insulation and glass to prevent bowing from perimeter firestopping systems.

**3.6     Blanket / Batt Insulation**

- 3.6.1 Fitting and Placement : Provide batt insulation in dimensions that completely fill cavities formed by framing members. Secure insulation in cavities to achieve friction fit against adjacent framing members.
- 3.6.2 Clearances: Maintain minimum 76-mm (3-inch) clearance around recessed lighting fixtures not rated for insulation contact.
- 3.6.3 Support and Fastening: In metal-framed walls exceeding 2440 mm (96 inches) in height, mechanically support batt insulation. For faced batt insulation, tape flanges of insulation to metal stud flanges for support.

**3.7     Miscellaneous Voids**

- 3.7.1 Material Selection and Installation: Fill miscellaneous voids and cavity spaces where breaks occur in insulation with appropriate insulation to prevent gaps in thermal control layer continuity.
- 3.7.2 Loose-Fill Insulation: Compact insulation to density of approximately 40 kg/cu. m (2.5 lb/cu. ft.), equal to 40% of normal maximum volume.
- 3.7.3 Foamed-in-Place Air Barrier Sealants in concealed cavities: Use in accordance with manufacturer's guidelines and in conformance with CAN/ULC-S710.2.
  - .1 Use one-component foam for cracks or openings 6 mm to 50 mm wide.
  - .2 Use two-component foam sealant for gaps over 50 mm wide.
- 3.7.4 Continuity of Air Barriers and Vapour Retarders:
  - .1 Seal penetrations including vertical and horizontal penetrations through floors and walls.
  - .2 Seal roof-to-wall junctions.
  - .3 Seal roof scuppers and other mechanical equipment on roof.
  - .4 Seal window perimeters in walls, parapets, and at columns, as applicable.
  - .5 Seal exhaust vents and soffits.
  - .6 Seal interfaces in masonry, curtain wall systems, metal panels and between various cladding systems.
  - .7 Seal door heads, jambs, and thresholds.

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**3.8     Thermal Bridging Mitigation**

- 3.8.1 General Guidelines: Implement following techniques to remediate thermal bridges at miscellaneous locations and to ensure insulation continuity.
- 3.8.2 Parapet Insulation: Extend wall insulation onto exterior face of parapet. Insulate interior cavity of parapet.
- 3.8.3 Above-to-Below Grade Transition: Butt the below-grade insulation tightly against above-grade insulation.
- 3.8.4 Punched Window Transitions: Align exterior wall insulation with thermal break in window frame. Extend insulation to window frame.
- 3.8.5 Curtain Wall Transitions: Align exterior insulation with thermal break in curtain wall frame. Extend insulation to curtain wall frame.
- 3.8.6 Miscellaneous Thermal Bridges
  - .1 For plumbing stack vents above the roof deck: provide a minimum of 50 mm insulation.
  - .2 Insulate body of roof drains and drainage pipes below roof deck.
  - .3 Extend below-grade insulation onto the vertical surfaces of columns and elevator sump pit walls.

**3.9     Protection**

- 3.9.1 Protect thermal insulation from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades.
- 3.9.2 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in writing by affected material's manufacturer. Do not use materials or process that can damage finishes, surfaces, or construction.
- 3.9.3 Promptly replace thermal insulation work damaged during construction that cannot be satisfactorily repaired.
- 3.9.4 Special Measures for Foam Plastic Insulation:
  - .1 Limit exposure to UV radiation to duration needed for installation and concealment. Protect foam plastic board from UV radiation within 30 days of installation or according to manufacturer recommendations.
  - .2 Protect foam insulation against ignition risks. Do not deliver foam plastic board materials to project site before they are ready to be installed.
  - .3 Expedite installation and concealment of foam plastic board insulation in each construction area to minimize exposure.

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**3.10     Cleaning And Waste Management**

- 3.10.1 Cleaning and Waste Management, generally: in accordance with Section 01 74 00, Cleaning and Waste Management.
- 3.10.2 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
- 3.10.3 Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**END OF SECTION**



## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the spray-applied polyurethane foam insulation work specified herein. This includes, but is not necessarily limited, to:
  - .1 Closed cell, medium density spray applied polyurethane foam insulation applied to substrates indicated on Drawings.
  - .2 Self-adhering transition membranes at perimeter of rough openings, dissimilar materials, roof tie-ins, interface between structural components (beams, columns and sheathing) and control and/or expansion joints.
  - .3 Primers and sealants necessary to performance of spray-applied polyurethane foam insulation and self-adhering membrane materials.
  - .4 Formed metal insulation stops at rough openings, control and expansion joints, and at horizontal and vertical cavity wall firestopping.
  - .5 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.
  - .1 Refer to Section 07 27 14 - Self-Adhered Air Barriers And Vapour Retarders for required coordination with sheet air barrier and vapour retarder materials to ensure continuity of air control and vapour control layers of building enclosure.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference

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standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

**1.4 Preinstallation Meetings**

- 1.4.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.
- 1.4.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
  - .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.
  - .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.
  - .3 Agenda:
    - .1 Review progress of related construction activities and preparations for particular activity under consideration.
    - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
  - .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
  - .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

**1.5 Submittals**

- 1.5.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.5.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for spray-applied polyurethane foam insulation work specified in this Section.
- 1.5.3 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:
  - .1 Include plans, elevations, sections and details as applicable.
  - .2 Indicate field-measured dimensions on Shop Drawings.
  - .3 Indicate construction details, relationship with adjacent construction, and material characteristics, including joints, closures, and methods of anchorage.

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- 1.5.4 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
- .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
  - .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
  - .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.5.5 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:
- .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.
  - .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.5.6 Low-Emitting Materials: For applicable Products specified or used for activities of this Section (i.e., site-applied coatings, adhesives, and sealants), submit certifications from third-party organizations indicating compliance with following:
- .1 VOC Emissions: California Department of Public Health (CDPH) Standard Method v1.2–2017, using applicable exposure scenario.
  - .2 VOC Content: SCAQMD Rule 1113 (for paints and coatings) and SCAQMD Rule 1168 (for adhesives and sealants).
- 1.5.7 Product Test Reports: Submit product test reports based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.
- 1.5.8 Research/Evaluation Reports: For all Products specified in this Section submit CCMC or ULC evaluation reports for spray-applied polyurethane foam insulation confirming material has been evaluated and conforms to requirements of CAN/ULC S705.1.
- .1 Report must clearly indicate spray-applied polyurethane foam insulation's long-term thermal resistance (LTTR) based on testing performed in accordance with CAN/ULC S770.
- 1.5.9 Submit for Consultants review, QA checklist used as part of installation process. Make modifications to QA checklist based on Consultant feedback

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**1.6      Closeout Submittals**

- 1.6.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.
- 1.6.2 Operating and Maintenance Data: Submit care and maintenance instructions for spray-applied polyurethane foam insulation to be included in building operation and maintenance manual.
- 1.6.3 Warranty Documentation: Submit copy of extended warranties specified in this Section.

**1.7      Quality Assurance**

- 1.7.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.
- 1.7.2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.
  - .1 Employ only skilled mechanics having experience in the work specified, and having an understanding of the design principles of the thermal and vapour barriers which they are providing.
  - .2 Installers must be licensed by a certification organization complying with requirements of CAN/ULC S773.
  - .3 Installer's Photo ID substantiating certification must be available upon request.
- 1.7.3 Quality Assurance Program: Work of this Section is subject to quality assurance program conforming to requirements of CAN/ULC S705.2. Submit copy of quality assurance program upon request.
- 1.7.4 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.
- 1.7.5 Mock-Ups / First Installation Review: Construct mock-ups to verify selections made under submittals, demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - .1 Location: In-situ (i.e. first installation), as directed on site by Consultant.
  - .2 Construct full size 3 x 3 m (10 ft x 10 ft) mock-up of spray-applied polyurethane foam insulation work to coordinate with the work of other building envelope sections in order to illustrate entire assembly including substrate preparation, transitions, and quality of workmanship. Include window and frame and sill,

insulation, building corner condition, junction with roof system and methods of interface with sealants.

- .3 Mock-Up Testing: Perform tests on mock-up to assess impact of spray-applied polyurethane foam insulation materials on adjacent sheet air barriers and vapor retarder membranes.
  - .1 Spray-applied polyurethane foam insulation and self-adhering membrane mock-ups will be used to perform following tests, which must be executed daily upon acceptance of mock-up:
    - .1 Foam material core density test
    - .2 Foam material adhesion/cohesion test
    - .3 Self-adhering transition test
  - .2 Documentation and Reporting: Record test results and submit recorded results for review. Report negative outcomes to Consultant and manufacturer immediately.
- .4 Mock-up Purpose: To set benchmarks for installation and to judge subsequent work. Maintain Mock-ups during construction in undisturbed condition.
- .5 Reviewed mock-ups: May become part of the completed work if undisturbed at the time of Substantial Performance of The work, provided they are undisturbed, and comply with requirements outlined in Contract Documents.

## **1.8 Delivery, Storage And Handling**

- 1.8.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.
- 1.8.2 Deliver, store and handle spray-applied polyurethane foam insulation materials in accordance with manufacturer's written instructions. Comply with WHMIS requirements for use, handling, storage, and disposal of hazardous materials.
- 1.8.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address and label indicating compliance with CAN/ULC S705.1.
- 1.8.4 Store materials in off-ground, in clean, dry, well-ventilated area.
- 1.8.5 Replace defective or damaged materials with new.
- 1.8.6 Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources.

## **1.9 Field Conditions**

- 1.9.1 Environmental Limitations: Apply spray-applied polyurethane foam insulation within the range of ambient and substrate temperatures recommended by spray-applied polyurethane foam insulation manufacturer.

- .1 Temperature Limitations: Do not spray foam insulation in temperatures below -20°C ( 4 deg F) or above 35°C (95 deg F); consult manufacturer if there are significant temperature differences between ambient and substrate temperatures.
  - .2 Temperature Differential: Consult manufacturer if ambient temperature and substrate temperature differ by more than 17 deg, especially when spraying in heated interiors in winter.
  - .3 Relative Humidity: Do not apply foam when relative humidity exceed 80 percent.
  - .4 Wind Conditions: Do not apply spray polyurethane foam outdoors when wind speeds exceed 15 km/h (9.32 mph). Use windscreens if spraying in such conditions.
  - .5 Sun and shade: Consider substrate temperature differences between sun-exposed and shaded areas as they may affect reaction times. Follow sunpath during spray to ensure foam is sprayed on areas directly exposed to sun.
- 1.9.2 Protect surfaces, and in particular the building cladding finishes, from being marred or contaminated by the materials, by means of protective covers, boards, tapes and other approved means.
  - 1.9.3 Examine the work of other Sections where such work is closely associated with the work of this Section and report any damage done to the work of this Section.
  - 1.9.4 Protect the work of this Section from damage due to high-velocity winds until the building cladding or other permanent protection is in place.

**1.10 Warranty**

- 1.10.1 Extended warranty: Submit for Owner's review and acceptance, manufacturer's extended warranty in which manufacturer commits to repair or replace components of spray-applied polyurethane foam insulation that fail within specified warranty period. Manufacturer's extended warranty is in addition to, and does not supersede, any other rights that Owner may have under Contract Documents.
  - .1 Warranty Period: Not less than 2 years from date of Substantial Performance of The work.

**2 . PRODUCTS**

**2.1 Manufacturers**

- 2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:
  - .1 BASF Canada Inc.;

- .2 Carlisle Spray-applied polyurethane foam insulation;
- .3 Elastochem Chemicals;
- .4 Huntsman Building Solutions;
- .5 Icynene Inc.
- .6 Soprema Canada

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

## **2.2 Performance / Design Criteria**

- 2.2.1 Regulatory Compliance: Provide insulation materials tested and approved by agencies recognized by authorities having jurisdiction. Provide markings to indicate certification.
- 2.2.2 Provide spray polyurethane foam insulation conforming to CAN/ULC-S705.1-18 and having CCMC Evaluation Report substantiating use as an air barrier system.
- 2.2.3 Provide equipment required for complete installation in accordance with requirements and recommendations of CAN/ULC S705.2 and equipment manufacturer's recommendations for specific type of application.
- 2.2.4 Combustible Materials: For combustible foam-plastic insulation, strictly comply with OBC requirements. Generally, combustible foam-plastic insulation must not be left exposed and must be protected by approved non-combustible thermal barriers.
- 2.2.5 Required Insulation Thickness and Assembly R-Values: as shown on Drawings and Schedules. Unless otherwise specified, R-values indicated in Contract Documents are LTTR values tested in accordance with CAN/ULC S770-15 at mean temperature of 24±2 deg C (75±2 deg F) and temperature difference of 22±2 deg C (72±2 deg F).
- 2.2.6 Mandatory LTTR Testing Requirement: Irrespective of whether Products experience less than 3% change in thermal resistance over 180-day period, all spray-applied polyurethane foam insulation materials specified in this Section must have undergone testing in accordance with LTTR method specified in CAN/ULC S770. Evidence results by means of evaluation report performed by inspection agency acceptable to Authorities Having Jurisdiction.
- 2.2.7 Building Enclosure Design Principle: Exterior envelope construction for this Project is based on "Rain Screen" design principle, as recommended by National Research Council of Canada. Unless specifically indicated otherwise, face sealed assemblies are not permitted.
  - .1 Continuity: Maintain integrity and continuity of building enclosure's thermal, air, and vapour control layers at all times

by using appropriate insulation, air barriers, vapour retarders to tie work of this Section with adjacent construction.

- .2 Air Sealing: Supplement building enclosure's primary air barrier and vapour retarder membranes by sealing openings and penetrations using low-density polyurethane foam sealants specified in this Section.
- .3 Air Leakage Criteria (system): Spray foam insulation must act as air barrier assembly. Air leakage of air barrier assembly must not exceed 0.2 L/(s·m<sup>2</sup>) under a pressure differential of 75 Pa (0.04 cfm/ft<sup>2</sup> @ 1.57 psf) when tested in accordance with CAN/ULC S742 (Minimum A1).
- .4 Material Compatibility: Before installation, review and confirm compatibility of material types, including insulation, adhesives, and substrates.

2.2.8 VOC Content and Emissions:

- .1 VOC Emissions: For applicable items in this Section, comply with CDPH Standard Method v1.2–2017 (CA Spec 01350) and ensure products are certified per UL 2818, SCS Global Gold, or equivalent.
- .2 VOC Content Requirements: Wet-applied materials used in scope of this Section must conform to the following:
  - .1 Paints and Coatings: SCAQMD Rule 1113 or CARB SCM.
  - .2 Adhesives and Sealants: SCAQMD Rule 1168.
  - .3 Methylene chloride and perchloroethylene must not be intentionally added in paints, coatings, adhesives, or sealants.

**2.3 Spray-Applied Polyurethane Foam Insulation**

- 2.3.1 Material Tag: This item is noted as "INS-5" on Drawings and Schedules.
- 2.3.2 Material Description: closed cell, 2-component, spray-applied polyurethane foam insulation with non-ozone-depleting, hydrofluoro-olefin (HFO)-based blowing agent with global warming potential (GWP) of less than or equal to 1.
- 2.3.3 General Performance Requirements:
  - .1 Long-Term Thermal Resistance (CAN/ULC 770-09): Not less than RSI 1.8 at 50 mm thickness (R10.2 at 2 inches).
  - .2 CAN/ULC S742 Classification (air sealing characteristics): Class A1; ≤ 0.05 L/(s·m<sup>2</sup>) at 75 Pa (1.57 psf) air pressure differential (full system testing); or comparable result in accordance with CCMC 07272.



- .3 Compressive Strength: Not less than 203 kPa (29 psi)
  - .4 Apparent Core Density: Not less than 28 kg/cu. m (1.75 lbs/cu ft)
  - .5 Open cell content: Not more than 10 percent.
  - .6 Water Vapour Permeance (ASTM E96): Not more than 60 ng/Pa•s•m<sup>2</sup> (1.05 perm)
  - .7 Equipment: to CAN/ULC S705.2 and equipment manufacturer's recommendations for specific type of application.
  - .8 Surface Burning Characteristics (CAN/ULC S102 and CAN/ULC S127): <500.
- 2.3.4 Location: As shown on Drawings. Foam plastic insulation must be protected by a thermal barrier in accordance with OBC 3.1.5.12.
- 2.3.5 Basis-of-Design Products: "Walltite v.5" by BASF Canada Inc.
- .1 Acceptable Equivalents:
    - .1 "Heatlok Soya" by Huntsman Building Solutions
    - .2 "SealTite ECO" by Carlisle Spray-applied polyurethane foam insulation;
    - .3 "Sopra-SPF" by Soprema
    - .4 Approved equivalent.

## **2.4 Auxiliary Air Barrier And Vapour Retarder Products**

- 2.4.1 Material Tag: This item is noted as "AVBM-1" on Drawings and Schedules.
- 2.4.2 Use products approved by manufacturer for use in its system.
- 2.4.3 Transition Membrane: 1.0 mm thick, Self-adhering, SBS modified bitumen, sheet membrane complete with a cross-laminated polyethylene film.
- .1 Air Leakage (ASTM E283): < 0.005 L/s.m<sup>2</sup>@ 75 Pa.
  - .2 Vapour Permeance (ASTM E96): < 2.8 ng/Pa.m<sup>2</sup> (0.05 Perms).
  - .3 Low Temperature Flexibility (CGSB 37-GP-56M): -30°C.
  - .4 Elongation (ASTM D412 modified): 200%.
  - .5 Tensile Strength (ASTM D882) - 3.4 MPa @ 5000 psi
  - .6 Puncture Resistance (ASTM E154) -178N minimum
  - .7 Basis-of-Design Product: As specified by manufacturer.
- 2.4.4 Through-wall flashing: 1.0 mm thick, Self-adhering, SBS modified bitumen, sheet membrane complete with a cross-laminated polyethylene film.
- .1 Performance Requirements: Meeting or exceeding the properties of the transition membrane.
  - .2 Basis-of-Design Product: As specified by manufacturer.

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**2.5     Accessories**

- 2.5.1 Ensure compatibility of auxiliary materials with spray-applied polyurethane foam insulation and transition membrane products manufacturers. Obtain written confirmation from manufacturers.
- 2.5.2 Primers: If required, Provide type recommended by insulation manufacturer and transition membrane manufacturer for surface conditions, application, and compatible with insulation and substrate.
- 2.5.3 Metal closures: cold-formed, galvanized steel sheet compliant with ASTM C645.
  - .1 Coating: Z275 hot-dip galvanized (G90) per ASTM A653/A653M or Class AZM150 (Class AZ50) aluminum-zinc-alloy per ASTM A792/A792M.
  - .2 Minimum thickness: 1.219 mm (18 ga.).
  - .3 Locations: at rough openings where insulation terminates.
    - .1 Fasten to masonry and concrete using fasteners recommended in writing by manufacturer. Minimize thermal bridges during installation.

**2.6     Sprayed Thermal Barrier**

- 2.6.1 Provide foamed-in-place urethane foam insulation complete with thermal barrier were indicated on Drawings or as required by Authorities Having Jurisdiction.
- 2.6.2 Use systems and products bearing classification ratings and listings from qualified testing agencies based on testing according to the following as applicable:
  - .1 CAN/ULC S101
  - .2 CAN/ULC S145
  - .3 CAN/ULC S124
  - .4 CCMC Evaluation Listing
- 2.6.3 Interior Applications:
  - .1 Damage-resistant, humidity-resistant, cementitious fire-protective coating specifically formulated for application over rigid urethane and polystyrene foam plastics. Coating must be compatible with insulation material.
  - .2 Basis-of-Design: "MONOKOTE® Z-3306 – Thermal Barrier" manufactured by GCP Applied Technologies Inc. or approved equivalent.
- 2.6.4 Exterior Applications:
  - .1 Manufacturer's standard liquid intumescent coating designed to act as thermal barrier and specifically designed for application

of sprayed foam insulation. System must be capable of being installed on exterior of building.

- .2 Basis-of-Design: "DC315" by International Fireproof Technology Inc. complete with manufacturer's recommended primers and topcoats.

- 2.6.5 Accessories and Ancillaries: Provide accessories to comply with manufacturer's recommendations and to meet fire resistance design and code requirements. Such accessories include, but are not limited to, required or optional items such as primers, bonding agents, mechanical attachments, top coats and application aids such as metal lath.

## **2.7 Equipment**

- 2.7.1 Provide equipment conforming to requirements of CAN/ULC-S705.2 and approved by foam manufacturer for type of application.

## **3 . EXECUTION**

### **3.1 Examination**

- 3.1.1 Ensure surfaces are clean, dry, and compliant with CAN/ULC-S705.2.
- 3.1.2 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.
- 3.1.3 Verify that substrate, adjacent materials are free of excess moisture, frost, oil, rust, and other foreign materials that may affect adhesion of insulation products.
- 3.1.4 Verify substrate surface is flat, free of honeycomb, fins, irregularities, materials or substances that may impede installation.
- 3.1.5 Protect adjacent surfaces and equipment against damage due to spray foam overspray beyond specified limits.
- 3.1.6 Ensure following elements are complete prior to applying spray polyurethane foam insulation system:
  - .1 Confirm installation of masonry anchoring system.
  - .2 Verify installation of opening closures.
  - .3 Ensure electrical or mechanical penetrations are complete.
  - .4 Ensure roofing membranes or waterproofing materials are installed.
  - .5 Air barrier and vapor barrier transition membranes must be in place.

- .6 Sub-girt framing members for exterior cladding must be complete.
- .7 Provide adequate protection for adjacent areas.

### **3.2     Preparation**

#### **3.2.1   Transition Membrane Installation, Generally:**

- .1 Install transition membranes before applying spray polyurethane foam insulation.
- .2 Use only membranes certified for use by spray polyurethane foam insulation system manufacturer. Where ambient temperatures are below 10 deg C (50 deg F), use self-adhering membranes formulated for cold applications. Supplement adhesion by mechanical fastening if adhesion is not adequate.
- .3 Install transition membranes in accordance with manufacturer's written instructions.

#### **3.2.2   Through-Wall Flashing Membrane:**

- .1 Prime surfaces in accordance with manufacturer's instructions. Re-prime surfaces not covered the same day
- .2 Install flashing membrane onto primed surface. Provide minimum 50 mm (2 inches) lap to all substrates.
- .3 Create return and end dam flashing membrane at intersecting wall openings
- .4 Apply specified termination mastic to treat terminations and redirect water flow away from building interiors.

#### **3.2.3   Transition Membrane Application**

- .1 Apply transition membranes at control joints, wall penetrations, dissimilar material connections, beams, rough openings, and roof parapets where differential movement may occur.
- .2 Apply transition membrane only onto primed surfaces.
- .3 Ensure full contact by rolling self-adhering transition membrane with steel or polypropylene hand roller.
- .4 Mechanically fasten membrane to window, door, and parapet blocking connections using metal bars or straps. At windows, extend membrane into rough window openings to connect to window thermal break. Minimize thermal bridging.
- .5 Overlap sheet membrane by minimum of 75mm (3 inches) on each connection substrate and 50mm (2 inches) at joints.
- .6 Seal cuts and terminations of membrane and end dam with termination sealant.

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**3.3     Installation**

3.3.1 Installation, generally: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.

**3.4     Installation Of Spray-Applied Polyurethane Foam Insulation**

- 3.4.1 Install sprayed foam insulation in accordance with CAN/ULC-S705.2
- 3.4.2 Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
- 3.4.3 Spray insulation to achieve uniform, monolithic density with no voids. Spray foam insulation only to indicated surfaces; protect other surfaces with drop sheets or masking tape.
- 3.4.4 Apply insulation in lifts of minimum 13 mm (1/2") thickness and maximum of 50 mm (2") thickness in single pass, unless specified in writing by manufacturer. Maintain tolerance of +6mm/-0mm in relation to specified thickness.
- 3.4.5 Extend insulation to envelop entire area to be insulated. Spray tightly around obstructions and fill voids. Do not permit formation of sub-layer air pockets during installation.
- 3.4.6 Maintain minimum clearance of 75mm (3 inches) from heat sources such as chimneys and lighting fixtures; do not spray inside electrical junction boxes.
- 3.4.7 Do not expose foam to open flames, cutting and welding torches, electric heaters, high intensity lamps, cigars or cigarettes.
- 3.4.8 Remove masking materials and overspray from adjacent areas immediately after foam surface has hardened.
- 3.4.9 Repair damaged areas in accordance with spray polyurethane foam insulation manufacturer's application guidelines.

**3.5     Fire Protection**

- 3.5.1 Post warning signs that are clearly visible in all sprayed areas. Do not expose rigid polyurethane cellular plastic to flames or other sources of intense heat. Conform to CAN/ULC-S705.2.
- 3.5.2 Cavity Wall Firestopping: Comply with OBC 3.1.11 – Fire Blocks in Concealed Spaces and as follows:
  - .1 Use 18ga galvanized sheet steel angles complying with ASTM A525 with minimum Z275 (G90) coating.
  - .2 Install preformed metal angles where cavity wall air space exceeds 25mm (1 inch).

- .3 Ensure dimensions allow horizontal section of angle to extend 12mm (1/2 inch) beyond surface of spray-applied polyurethane foam.
  - .4 Fill remaining space between metal firestopping and the inner face of the cladding with compressed mineral fiber having minimum 50% compression.
  - .5 Spacing and Locations:
    - .1 Vertical Spacing: Install preformed metal angles at intervals not exceeding 3 meters (10 ft) vertically and at every floor level.
    - .2 Horizontal Spacing: Install preformed metal angles at intervals not exceeding 20 meters (65 ft) horizontally.
- 3.5.3 Sprayed thermal barrier: Provide sprayed thermal barrier complying with CAN/S124M (minimum Class B) or CAN/ULC S101 (for non-sprinklered high buildings) in cases where foamed-in-place urethane foam insulation is not protected by one of the following:
- .1 Minimum 12.7 mm (1/2 inch) thick gypsum board, mechanically fastened to an independent supporting assembly.
  - .2 Lath and plaster, mechanically fastened to an independent supporting assembly.
  - .3 Masonry.
  - .4 Concrete.

### **3.6 Protection**

- 3.6.1 Protect spray-applied polyurethane foam insulation from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades.
- 3.6.2 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in writing by affected material's manufacturer. Do not use materials or process that can damage finishes, surfaces, or construction.
- 3.6.3 Promptly replace spray-applied polyurethane foam insulation work damaged during construction that cannot be satisfactorily repaired.
- 3.6.4 Provide approved, non-staining means of protection for completed foam insulation work where required to protect work from mechanical, thermal, chemical and other damage by construction operations and traffic.
- 3.6.5 Maintain protection securely in place until completion of work. Remove protection when directed by Consultant.
- 3.6.6 Special Measures for Foam Plastic Insulation:
  - .1 Limit exposure to UV radiation to duration needed for installation and concealment. Protect foam plastic board from

UV radiation promptly after installation or according to manufacturer recommendations.

- .2 Protect foam insulation against ignition risks. Do not deliver foam plastic materials to project site before they are ready to be installed.
- .3 Expedite installation and concealment of foam plastic insulation in each construction area to minimize exposure.
- .4 Decontaminate and remove empty isocyanate containers from site daily.

### **3.7 Cleaning And Waste Management**

- 3.7.1 Cleaning and Waste Management, generally: in accordance with Section 01 74 00, Cleaning and Waste Management.
- 3.7.2 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
- 3.7.3 Waste Management and Disposal: Comply with CAN/ULC-S705.2 neutralization and disposal methods.

### **3.8 Field Quality Control**

- 3.8.1 Daily Site Testing Requirements: Conduct daily visual inspection, adhesion testing and density measurements as required by CAN/ULC S705.2 and manufacturer's application guidelines. Upon request submit copies of all completed forms to Consultant. As a minimum, comply with the following:
  - .1 Complete daily work record in accordance quality assurance program guidelines in order to document testing results and job site conditions. Update daily work record at beginning of each day, when changing material batches, and when changing locations within a given day.
  - .2 Density check: required daily, for every project, and for every batch.
  - .3 Adhesion/Cohesion test: required daily, for every project, and for every batch.
  - .4 Environmental tests: required daily for humidity, wind speed, substrate temperature and ambient temperature.
  - .5 Qualitative Inspections:
    - .1 Confirm proper substrate preparation.
    - .2 Ensure equipment is set to safe and proper operating parameters.
    - .3 Conduct ongoing visual and physical checks for cell size, spray pattern, foam color, and spray foam reactions.

- .4 Continuously measure installation thickness using depth gauge to meet minimum specified thicknesses.
  - .5 Ensure spray polyurethane foam achieves smooth and consistent surface.
- 3.8.2 Manufacturer's Services: Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions. Report any inconsistencies from manufacturer's recommendations immediately to Consultant.
- 3.8.3 Third Party Testing:
- .1 Permit access to site by manufacturer's third-party inspection company representative for technical assistance, verification of operator certification or confirmation of quality of polyurethane foam application.
  - .2 Arrange and pay for cost of site reviews/tests in accordance with third party testing inspection company's quality assurance program. As a minimum, schedule number of site reviews/tests in accordance with following schedule:

<b>Foam Coverage Area</b>	<b>Minimum No. of Inspections for Transition Membrane</b>	<b>Minimum No. of Inspections for Spray Foam</b>	<b>Minimum No. of Inspections for air barrier system</b>
3252 – 6503 m2 (35,000 – 70,000 sq ft)	1	1	2
6504 – 9755 m2 (70,001 – 105,000 sq ft)	2	2	4
9756 – 13,006 m2 (105,001 – 140,000 sq ft)	3	3	6
Over 13,006 m2 (140,000 sq ft)	Minimum 4. Additional may be required on a case-by basis	Minimum 4. Additional may be required on a case-by basis	Minimum 7. Additional may be required on a case-by basis

**END OF SECTION**



## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the under-slab vapour retarders work specified herein. This includes, but is not necessarily limited, to:
  - .1 Puncture-resistant vapour retarders under-slabs-on-grade.
  - .2 Miscellaneous sealing materials and tapes to connect and seal openings, joints, protrusions and junctions.
  - .3 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

### **1.4 Preinstallation Meetings**

- 1.4.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.
- 1.4.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
  - .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.

- .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.
- .3 Agenda:
  - .1 Review progress of related construction activities and preparations for particular activity under consideration.
  - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
- .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
- .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

## **1.5 Submittals**

- 1.5.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.5.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for under-slab vapour retarders work specified in this Section.
- 1.5.3 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:
  - .1 Include plans, elevations, sections and details as applicable.
- 1.5.4 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
  - .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
  - .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
  - .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.5.5 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:
  - .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.

- .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.

- 1.5.6 Submit for Consultants review, QA checklist used as part of installation process. Make modifications to QA checklist based on Consultant feedback

## **1.6 Closeout Submittals**

- 1.6.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.
- 1.6.2 Warranty Documentation: Submit copy of extended warranties specified in this Section.

## **1.7 Quality Assurance**

- 1.7.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 3 years' experience manufacturing such materials.
- 1.7.2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.
- 1.7.3 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.
- 1.7.4 Mock-Ups / First Installation Review: Construct mock-ups to verify selections made under submittals, demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - .1 Location: In-situ (i.e. first installation), as directed on site by Consultant.
  - .2 Purpose: To set benchmarks for installation and to judge subsequent work. Maintain Mock-ups during construction in undisturbed condition.
  - .3 Reviewed mock-ups: May become part of the completed work if undisturbed at the time of Substantial Performance of The work, provided they are undisturbed, and comply with requirements outlined in Contract Documents.

## **1.8 Delivery, Storage And Handling**

- 1.8.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.
- 1.8.2 Deliver, store and handle under-slab vapour retarders materials in accordance with manufacturer's written instructions.

- 1.8.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.8.4 Store materials in off-ground, in clean, dry, well-ventilated area.
- 1.8.5 Replace defective or damaged materials with new.

## **1.9 Warranty**

- 1.9.1 Extended warranty: Submit for Owner's review and acceptance, manufacturer's extended warranty in which manufacturer commits to repair or replace components of under-slab vapour retarders that fail within specified warranty period. Manufacturer's extended warranty is in addition to, and does not supersede, any other rights that Owner may have under Contract Documents.
  - .1 Warranty Period: Not less than 10 years from date of Substantial Performance of The work.

## **2 . PRODUCTS**

### **2.1 Manufacturers**

- 2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:
  - .1 GCP Applied Technologies; [www.gcpat.com](http://www.gcpat.com)
  - .2 Layfield Construction Products; [www.layfieldgroup.com](http://www.layfieldgroup.com)
  - .3 Stego Industries, LLC; [www.stegoindustries.com](http://www.stegoindustries.com)
  - .4 W.R. Meadows of Canada; [www.wrmeadows.com](http://www.wrmeadows.com)
- 2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

### **2.2 Performance / Design Criteria**

- 2.2.1 Vapour Retarder System Integrity: Ensure compatibility between under-slab vapour retarder system components. Do not allow materials to touch chemically incompatible substances.
- 2.2.2 Unless indicated otherwise, provide vapour retarders under all slabs-on-grades.
- 2.2.3 Place under-slab vapour retarders on prepared subbases prior to placement of concrete slabs.
- 2.2.4 Ensure vapour retarder can resist effects of vapour penetration from ground through building enclosure within limitations specified in this Section.
- 2.2.5 Protrusions and Penetrations: Ensure that pipes, drains, or other elements extending through vapour retarders are adequately sealed.

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**2.3     Under-Slab Plastic Vapour Retarder**

- 2.3.1 Material Tag: This item is noted as "VCM-02" on Drawings and Schedules.
- 2.3.2 Description: Resin based, sheet vapour retarder membrane conforming to ASTM E1745 (Class A) with following characteristics:
- .1 Water vapour permeance (ASTM E96 or ASTM F1249): less than 5.7 ng/s.m<sup>2</sup>.Pa (0.1 perms).
  - .2 Puncture resistance (ASTM D1709): over 2,200 grams (4.8 lbs).
  - .3 Tensile strength (ASTM E154): ≥ 8.77 kN per m (50 lbs force/inch)
  - .4 Minimum thickness: 0.25 mm (10 mils)
  - .5 Acceptable Products:
    - .1 "Perminator 15mil" by W. R. Meadows of Canada; [www.wrmeadows.com](http://www.wrmeadows.com)
    - .2 "Florprufe 120" by GCP Applied Technologies; [www.gcpat.com](http://www.gcpat.com)
    - .3 "Stego® Wrap" Vapor Barrier" by Stego Industries, LLC; [www.stegoindustries.com](http://www.stegoindustries.com)
    - .4 "VaporFlex" by Layfield Construction Products

**2.4     Auxiliary Materials**

- 2.4.1 Ensure auxiliary materials are specifically recommended by vapour retarder manufacturer for intended use and are fully compatible with under-slab vapour retarders. Supply auxiliary materials required for a complete installation.
- 2.4.2 Seam Tape: manufacturer's recommended high-density tape with pressure-sensitive adhesive; minimum 100 mm (4 inches) wide.
- 2.4.3 Pipe Collars: Construct pipe collars from vapour retarder material and pressure-sensitive tape in accordance with manufacturer's instructions.

**3 .     EXECUTION**

**3.1     Examination**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.

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**3.2     Preparation**

- 3.2.1 Prepare surfaces in accordance with manufacturer's instructions.
- 3.2.2 Level, tamp, or roll earth or granular material beneath slab to ensure proper compaction.

**3.3     Installation**

- 3.3.1 Installation, generally: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.
- 3.3.2 Installation Standard: ASTM E1643.
- 3.3.3 Unroll vapour retarder with the longest dimension parallel with direction of concrete pour.
- 3.3.4 Cover footings with vapour retarder, ensuring sealing to foundation wall, grade beam, or slab at height equal to top of slab. Seal around utility and column penetrations to provide continuous vapour barrier.
- 3.3.5 Overlap joints minimum of 152 mm (6 inch) and seal with manufacturer's tape.
- 3.3.6 Seal penetrations (including pipes) with manufacturer's pipe boot.
- 3.3.7 Penetrations in vapour retarder are not permitted except for reinforcing steel and permanent utilities.

**3.4     Protection**

- 3.4.1 Protect under-slab vapour retarders from damage during installation of reinforcing steel, utilities, and concrete. Use reinforcing bar supports with bases designed to minimize risk of puncture to vapour retarder.
- 3.4.2 Promptly replace under-slab vapour retarders work damaged during construction that cannot be satisfactorily repaired.

**3.5     Repair And Inspection**

- 3.5.1 Inspect vapour retarder for damage and improper installation before concrete placement. Mark problem areas for correction before concrete placement.
- 3.5.2 Repair damaged areas by cutting patches of vapour barrier, overlapping damaged area minimum of 152 mm (6 inches) and taping all four sides with tape.

**3.6     Cleaning And Waste Management**

- 3.6.1 Cleaning and Waste Management, generally: in accordance with Section 01 74 00, Cleaning and Waste Management.

- 3.6.2 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
- 3.6.3 Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**END OF SECTION**

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the self-adhering sheet air barriers and vapour retarders work specified herein. This includes, but is not necessarily limited, to:
  - .1 Self-adhering, sheet air barriers and vapour retarders.
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only:
  - .1 Section 03 30 00 - Cast-In-Place Concrete.
  - .2 Section 04 22 00 – Concrete Unit Masonry.
  - .3 Section 06 16 00 - Sheathing.
  - .4 Section 07 42 13 – Aluminum Composite Material Wall Panels
  - .5 Section 07 42 19 – Solid Aluminum Plate Wall Panels
  - .6 Section 07 42 46 – PER Cementitious Cladding System
  - .7 Section 07 44 36 – Glass-Faced Rainscreen Cladding Systems
  - .8 Section 07 46 18 – Aluminum Interlocking Metal System

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.



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## **1.4 Definitions**

### **1.4.1 In accordance with CAN/ULC-S741 and CAN/ULC-S742:**

- .1 Air Barrier Accessory:** products designated to maintain air tightness between air barrier materials, air barrier assemblies and air barrier components, to fasten them to the structure of the building, or both (e.g., sealants, tapes, backer rods, transition membranes, fasteners/washers, ties, clips, staples, strapping, primers).
- .2 Air Barrier Assembly:** the combination of air barrier materials and air barrier accessories that are designated and designed within the environmental separator to act as a continuous barrier to the movement of air through the environmental separator.
- .3 Air Barrier Component:** pre-manufactured elements such as windows, doors and mechanical and electrical services that are installed in the environmental separator.
- .4 Air Barrier Material:** a building material with an air leakage characteristic not greater than  $0.02 \text{ L}/(\text{s}\cdot\text{m}^2)$  at 75 Pa pressure difference that is designed and manufactured to provide the primary resistance to airflow through an air barrier assembly.
- .5 Air Barrier System:** the combination of air barrier assemblies and air barrier components, connected by air barrier accessories, designed to provide a continuous barrier to the movement of air through an environmental separator.

## **1.5 Administrative Requirements**

### **1.5.1 Site Meetings:** Schedule, and conduct pre-installation meeting at Project Site, in order to coordinate work of this Section, with work of related Subcontractors.

- .1 Ensure attendance of Subcontractor performing work of this Section and representatives of manufacturers and fabricators involved in, or affected by, installation and coordination with other materials and installations that have preceded or will follow.** Advise Consultant and Owner in advance of scheduled meeting dates.
- .2 Agenda:** As a minimum, include the following:
  - .1 sequence of construction, coordination with substrate preparation, air barrier materials approved for use, compatibility of materials, coordination with installation of adjacent and covering materials, air leakage and bond testing, protection of installed materials and details of construction.**

- .2 Review progress of other construction activities and preparations for the particular activity under consideration.
  - .3 Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
  - .4 Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
- 1.5.2 Sequencing:
- .1 Sequence work to permit installation of materials in conjunction with related materials and seals.
  - .2 Do not install air barrier material before the roof assembly has been sufficiently installed to prevent a buildup of water in the interior of the building.

## **1.6 Preinstallation Meetings**

- 1.6.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.
- 1.6.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
- .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.
  - .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.
  - .3 Agenda:
    - .1 Review progress of related construction activities and preparations for particular activity under consideration.
    - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
  - .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
  - .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

## **1.7 Submittals**

- 1.7.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.

- 
- 1.7.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for self-adhering sheet air barriers and vapour retarders work specified in this Section.
- 1.7.3 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:
- .1 Include plans, elevations, sections and details as applicable.
  - .2 Show locations and extent of air barrier assemblies, including details of typical conditions.
  - .3 Show intersections with other envelope assemblies and materials.
  - .4 Provide comprehensive details on bridging gaps in construction materials, treatments of inside and outside corners, and sealing of miscellaneous penetrations such as conduits, pipes, electric boxes, and similar elements.
  - .5 Provide details illustrating how air barrier materials interface with other materials forming part of air barrier system.
- 1.7.4 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
- .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
  - .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
  - .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.7.5 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:
- .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.
  - .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.7.6 Submit for Consultants review, QA checklist used as part of installation process. Make modifications to QA checklist based on Consultant feedback

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**1.8      Closeout Submittals**

- 1.8.1 Closeout Submittals, generally: in accordance with Section 01 77 00, Closeout Procedures.
- 1.8.2 Warranty Documentation: Submit copy of extended warranties specified in this Section.

**1.9      Quality Assurance**

- 1.9.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.
  - .1 Manufacturer must have implemented program of continuous quality management conforming to requirements of ISO 9001 or similar equivalent system.
  - .2 Submit proof of certification upon request.
- 1.9.2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.
- 1.9.3 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.
- 1.9.4 Mock-Ups / First Installation Review: Construct mock-ups to verify selections made under submittals, demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - .1 Location: In-situ (i.e. first installation), as directed on site by Consultant.
  - .2 Coordinate construction of mockups to permit inspection by Owner's testing agency of air barrier before external insulation and cladding are installed.
    - .1 Mock-Up Tests - Air Infiltration: As specified in Section 01 91 15.
  - .3 Include junction with roofing membrane, building corner condition, foundation wall intersection.
  - .4 Purpose: To set benchmarks for installation and to judge subsequent work. Maintain Mock-ups during construction in undisturbed condition.
  - .5 Reviewed mock-ups: May become part of the completed work if undisturbed at the time of Substantial Performance of The work, provided they are undisturbed, and comply with requirements outlined in Contract Documents.

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**1.10 Delivery, Storage And Handling**

- 1.10.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.
- 1.10.2 Deliver, store and handle self-adhering sheet air barriers and vapour retarders materials in accordance with manufacturer's written instructions.
- 1.10.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.10.4 Store materials in off-ground, in clean, dry, well-ventilated area.
- 1.10.5 Replace defective or damaged materials with new.

**1.11 Field Conditions**

- 1.11.1 Environmental Limitations:
  - .1 Install air barrier within range of ambient and substrate temperatures, and moisture content recommended by material manufacturer.
  - .2 Protect substrates from environmental conditions that affect air barrier performance.
  - .3 Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.
  - .4 Do not leave membrane exposed to sunlight/UV for more than 30 days, unless otherwise recommended by manufacturer.
- 1.11.2 Maintain temperature and humidity recommended by materials manufactures before, during and after installation.
- 1.11.3 Field Measurements: Verify actual dimensions of construction contiguous with self-adhering sheet air barriers and vapour retarders by field measurements before fabrication.

**1.12 Warranty**

- 1.12.1 Extended warranty (Materials): Submit for Owner's review and acceptance, manufacturer's extended warranty in which manufacturer commits to repair or replace components of self-adhering sheet air barriers and vapour retarders that fail within specified warranty period. Manufacturer's extended warranty is in addition to, and does not supersede, any other rights that Owner may have under Contract Documents.
  - .1 Warranty Period: Not less than 5 years from date of Substantial Performance of The work.
- 1.12.2 Installation Warranty: Provide installation warranty, including all materials of the air barrier assembly, against failures including loss

of airtight seal, loss of watertight seal, loss of attachment, loss of cohesion/adhesion and failure to cure properly.

- .1 Warranty Period: Not less than 2 years from date of Substantial Performance of The work.

## **2 . PRODUCTS**

### **2.1 Manufacturers**

2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:

- .1 As specified in this Section.

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

### **2.2 Performance / Design Criteria**

2.2.1 Air-Barrier Assembly: Provide air barrier assembly and seals with adjacent construction capable of functioning as an air barrier and liquid-water drainage plane. System must be able to discharge incidental condensation or water penetration to exterior.

2.2.2 Air Leakage Criteria: Assembly air leakage must not exceed 0.2 L/(s·m<sup>2</sup>) under pressure differential of 75 Pa (0.04 cfm/ft<sup>2</sup> @ 1.57 psf) in accordance with CAN/ULC S742 (Minimum A1).

2.2.3 Structural Performance: Air barrier assembly must be able to withstand combined design wind, fan, and stack pressures (positive and negative) on building envelope without damage or displacement. Assembly must be able to transfer required loads to structure effectively.

2.2.4 Movement Accommodation: Ensure assembly accommodates building material movements, and provides necessary accommodation for expansion and control joints. Include appropriate accessory materials for such joints, substrate changes, and perimeter conditions. Provide tie-ins to installed waterproofing and transitions at perimeter conditions.

2.2.5 Seismic Performance: Provide products and systems specified in this Section to withstand the effects of earthquake motions in accordance with OBC 4.1.8.18 and CAN/CSA S832.

- .1 Professional engineer specified in Division 01 and referenced in this Section shall be responsible for designing systems and submitting signed and sealed analysis data and Shop Drawings illustrating seismic-resistant systems.
- .2 Refer to Structural Drawings for seismic sensitivity values.

- 2.2.6 Joint Sealing and Tie-Ins: Install air barrier assembly in an airtight and flexible manner to air barrier materials of adjacent assemblies. Allow for relative movements due to thermal and moisture variations, creep, and anticipated seismic activity, if any.
- 2.2.7 Continuity of Seal: Unless otherwise specified, it is the responsibility of this Section to provide and maintain the continuity of air seal to adjacent and dissimilar materials. Ensure materials used provide positive support and continuity of for air barrier.
- .1 Connections to Adjacent Materials: Provide air barrier accessory materials to prevent air leakage at the following locations:
- .1 Foundation and walls, including penetrations, ties and anchors.
  - .2 Walls, windows, curtain walls, storefronts, louvers and doors.
  - .3 Different assemblies and fixed openings within those assemblies.
  - .4 Wall and roof connections.
  - .5 Floors over unconditioned space.
  - .6 Walls, floor and roof across construction, control and expansion joints.
  - .7 Walls, floors and roof to utility, pipe and duct penetrations.
  - .8 Seismic and expansion joints.
  - .9 All other potential air leakage pathways in the building envelope.
- 2.2.8 Unless otherwise noted, it is responsibility of this Section to Provide and maintain continuity of air seal to adjacent dissimilar materials. Provide materials to ensure positive support and continuity of air barrier.
- 2.2.9 Material Compatibility: Ensure compatibility between various types of air barriers and interfacing materials. Select a combination of base materials, transition, bridging and reinforcing membranes, adhesives, and accessories from specified materials. When cured, combinations of materials must be compatible with each other and offer bonding characteristics equivalent to shear strength of selected air barrier materials.

**2.3 Self-Adhering Sheet Air Barrier And Vapour Retarder**

- 2.3.1 Material Tag: This item is noted as "AVBM-1" on Drawings and Schedules.

2.3.2 Description: self-adhered membrane consisting of flexible facing material uniformly coated on one side with adhesive material and removable release liner. Use appropriate formulation — regular, high temperature, or low temperature — based on site conditions and within the temperature ranges specified by material manufacturer.

2.3.3 General Performance Requirements:

- .1 Material Air Permeance: Maximum 0.02 L/(s·m<sup>2</sup>) of surface area at 75 Pa (0.004 cfm/sq. ft. of surface area at 1.57 psf) pressure difference; CAN/ULC S741.
- .2 Vapour Permeance: Maximum 2.9 ng/Pa-s-m<sup>2</sup> (0.05 perm); ASTM E96/E 96M (Method B).
- .3 Puncture Resistance (ASTM E154): Minimum 178 N (40 lbf)
- .4 Tensile Strength (ASTM D882): 3.5 N/mm (20 lbf/in) or until substrate failure
- .5 Peel or Stripping Strength of Adhesive Bond (ASTM D903): Minimum 0.875 N/mm (5.0 lbf/in)
- .6 Lap Adhesion (ASTM D1876): Minimum 0.875 N/mm (5.0 lbf/in)
- .7 Low Temperature Flexibility (ASTM D1970 / ASTM D1970M): Pass at -20°F (-30°C)
- .8 Nail Sealability (ASTM D1970 / D1970M): Pass
- .9 Pull Adhesion (ASTM D4541): Minimum 110 kPa (16 Psi)
- .10 Tear Initiation and Propagation (ASTM D4073): Minimum 40 N (9.0 lbf)
- .11 Crack Bridging (ASTM C1305): Pass at -26°C (-15°F)
- .12 Ultimate Elongation: Minimum 200 percent; ASTM D412, Die C.
- .13 Water Absorption: Maximum 0.15 percent weight gain after 48-hour immersion at 21 deg C (70 deg F); ASTM D570.

2.3.4 Acceptable Products:

- .1 “Blueskin SA” by Henry Company
- .2 “AquaBarrier™ AVB AIR & VAPOUR BARRIER” by IKO Industries Ltd.
- .3 “Sopraseal Stick 1100T” by Soprema Inc.
- .4 “AcrlicStick SA” by IKO Industries Ltd.

**2.4 Accessory Materials**

2.4.1 Use accessory materials recommended by the air-barrier manufacturer to create a complete air-barrier assembly. Ensure compatibility with primary air-barrier membrane.



- 2.4.2 Primer: liquid waterborne or solvent-borne primer as recommended for substrate by air barrier material manufacturer. For primer-less products, submit certification from manufacturer confirming that Product can be installed without primer.
- 2.4.3 Termination Mastic: manufacturer's standard cold fluid-applied, trowel grade liquid material.
- 2.4.4 Flashing Tape: manufacturer's standard adhesive and pressure-sensitive adhesive tape.
- 2.4.5 Flashing Membrane: self-adhering, type recommended by manufacturer and compatible with air-barrier material. Provide for flashing at transitions, masonry through-wall flashings, and other locations requiring flashing.
- 2.4.6 Do not allow contact between air barrier materials and PVC, TPO, or EPDM materials such as single-ply roofing membranes, gaskets, and similar elements. Use compatible self-adhering separators such as butyl strips to avoid adverse reactions.
- 2.4.7 Sprayed Polyurethane Foam Sealant (for filling gaps, penetrations, and openings): one- or two-component, foamed-in-place, polyurethane foam sealant with density of 24 to 32 m<sup>3</sup> (1.5 to 2.0 pcf).
  - .1 Acceptable Products:
    - .1 "Zerodraft Air Sealant Foam and Insulating Sealant" by Zerodraft (Division of Canam Building Envelope Specialists Inc.).
    - .2 "Handi-Foam®" by Fomo Products, Inc.
    - .3 "GREAT STUFF PRO™ Series" Foam Sealant by DuPont de Nemours Inc.
    - .4 "Exo LEF" or "ExoAir Flex Foam" by Tremco Incorporated, an RPM company.
- 2.4.8 Joint Sealant: silicone, butyl or polyurethane sealant complying with ASTM C920 and confirmed in writing by manufacturer and demonstrated to have proper adhesion to air barrier materials.

### **3 . EXECUTION**

#### **3.1 Examination**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation.
- 3.1.2 Ensure following conditions are met prior to proceeding:

- .1 Surfaces must be smooth, sound, dry, even, and free from excess mortar or contaminants and without large voids or sharp protrusions. .
- .2 Masonry joints must be flush, filled, and free of excess mortar on ties.
- .3 Confirm substrate dryness using ASTM D4263 moisture test. Address moisture issues before proceeding.
- 3.1.3 Verify sealant compatibility with proposed membrane through field peel-adhesion tests.
- 3.1.4 Commencement of work implies acceptance of previously completed work.

### **3.2 Surface Preparation**

- 3.2.1 Manufacturer's instructions: Comply with manufacturer's written instructions with regard to cleaning, treatment, and preparation of substrates.
- 3.2.2 Masking: Mask off adjoining surfaces not receiving air barrier to prevent spillage and overspray affecting other construction.
- 3.2.3 Contaminant Removal: Prepare surfaces by brushing, scrubbing, scraping, grinding, or using compressed air to eliminate contaminants.
- 3.2.4 Irregularities: Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- 3.2.5 Gaps in substrate plane must be covered a smooth transition must be ensured from one substrate plane to another with galvanized steel sheet mechanically fastened to framing in order to provide continuous support for air barrier.
- 3.2.6 Prime substrates prior to installation of self-adhered sheet air barrier and sheet membrane transition strip flashings as recommended by manufacturer.
  - .1 Prime masonry and concrete substrates with appropriate primers.
  - .2 For glass-fiber surfaced gypsum sheathing, apply the necessary number of primer coats for adequate bond, allowing sufficient drying time between coats.
  - .3 Prime wood, metal, structural steel, sheet metal, and painted substrates.
  - .4 Prepare, treat, and seal surfaces at terminations and penetrations.

- .5 Ensure priming is limited to areas that will have sheet waterproofing applied on the same day. Areas exposed for more than 24 hours must be reprimed.

### **3.3 Installation Of Self-Adhering Sheets**

3.3.1 Installation, generally: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.

- .1 Install self-adhering sheet air barrier and accessory materials in a shingle fashion to ensure building envelope continuity.
- .2 Overlap air barrier sheets by minimum 50 mm (2 in.). Smoothly roll membrane onto substrate.
- .3 At end of each day, seal top edge of membrane to substrate.
- .4 Tie-in primary air barrier material to vertical and horizontal planes of roofs, concrete structures, windows, doors, curtain walls, storefronts, louvers, and other intersection conditions using accessory materials.

3.3.2 Seam Overlaps and Alignment:

- .1 Air Barrier Sheets:
  - .1 Apply and firmly adhere self-adhering sheets horizontally. Align accurately with uniform lap widths and end laps.
  - .2 Overlap and seal seams. Stagger end laps.
  - .3 Membrane sheets must shed water without interception. Where reverse laps occur, seal edges with termination mastic.
  - .4 Provide minimum 150 mm (6 in.) overlap at end laps and 75 mm (3 in.) at side laps.
  - .5 Roll membrane seams with roller.
- .2 Transition Materials:
  - .1 Apply transition material primer as required by the manufacturer, ensuring complete curing before application.
  - .2 Overlap transition material sheets by at least 50 mm (2 in.) or as recommended by the manufacturer. Roll all seams thoroughly.
  - .3 Overlap horizontally adjacent transition materials by at least 50 mm (2 in.), rolling all seams.

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Self-Adhering Sheet Air  
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Retarders**

- .4 At through-wall flashings, provide a 150 mm (6-in.) wide strip of membrane counterflashing.
- .5 Support movement at deflection and control joints with self-adhered membrane.
- .6 Provide transition material at building expansion and seismic joints, as applicable.

3.3.3 Bridging Gaps and Joints:

- .1 Bridge substrate cracks and joints by apply continuous self-adhering air barrier sheets over transition strips or flashing tapes in accordance with manufacturer's written instructions.
- .2 Bridge gaps over 25 mm (1 in.) with mechanically-fastened metal sheets or other transition materials approved by manufacturer in writing.
- .3 Fill perimeter frame surfaces of windows, curtain walls, storefronts, doors, and miscellaneous penetrations with foam sealant.

3.3.4 Joint Sealant Application:

- .1 Use termination mastic to seal exposed edges of air barrier sheet at seams, cuts, penetrations, and terminations not concealed by metal counter flashings or ending in reglets.
- .2 Apply joint sealants forming part of the air-barrier assembly within the manufacturer's recommended temperature ranges. Consult manufacturer when sealant cannot be applied within approved temperature ranges.

**3.4 Protection And Repairs**

- 3.4.1 Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.
- 3.4.2 Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for more than 30 days, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane according to air-barrier manufacturer's written instructions.
- 3.4.3 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in writing by affected material's manufacturer. Do not use materials or process that can damage finishes, surfaces, or construction.
- 3.4.4 Promptly replace self-adhering sheet air barriers work damaged during construction that cannot be satisfactorily repaired.

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**3.5      Field Quality Control**

- 3.5.1 Engage a site representative qualified by air-barrier membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to Supply reports to Consultant.
- 3.5.2 Inspection and Testing: As specified in Section 01 83 16 and Section 01 91 15.

**3.6      Cleaning And Waste Management**

- 3.6.1 Cleaning and Waste Management, generally: in accordance with Section 01 74 00, Cleaning.
- 3.6.2 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
- 3.6.3 Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**END OF SECTION**

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Aluminum Composite Material Wall Panels work specified herein. This includes, but is not necessarily limited, to:
- .1 Custom-fabricated aluminum composite material wall panel system.
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only.
- .1 Section 06 16 00 - Sheathing.
  - .2 Section 07 21 00 - Thermal Insulation.
  - .3 Section 07 92 00 - Joint Sealants.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Definitions**

- 1.4.1 ACM: aluminum composite material cladding formed by joining two thin metal skins to polyethylene or fire-retardant core and bonded under precise temperature, pressure, and tension.
- 1.4.2 PER: Pressure equalized rainscreen system; rainscreen system designed for no water intrusion with equal pressure between interior system cavity and outside cladding barrier.

### **1.5 Preinstallation Meetings**

- 1.5.1 Preinstallation Conference: Conduct conference at Project site.
- .1 Meet with Owner, Consultant, Owner's insurer if applicable, aluminum composite material panel Installer, aluminum

- composite material panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects aluminum composite material panels, including installers of doors, windows, and louvers.
- .2 Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - .3 Review methods and procedures related to aluminum composite material panel installation, including manufacturer's written instructions.
  - .4 Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
  - .5 Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect aluminum composite material panels.
  - .6 Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
  - .7 Review temporary protection requirements for aluminum composite material panel assembly during and after installation.
  - .8 Review procedures for repair of panels damaged after installation.
  - .9 Document proceedings, including corrective measures and actions required, and Supply copy of record to each participant.

## **1.6     Action Submittals**

- 1.6.1 Product Data: Submit product data in accordance with Division 01 for the following:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for the Aluminum Composite Material Wall Panels work and include product characteristics, performance criteria, physical size, finish and limitations.
- 1.6.2 Shop Drawings:
  - .1 Include fabrication and installation layouts of aluminum composite material panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.
  - .2 Accessories: Include details of the flashing, trim and anchorage, at a scale of not less than 1:10 (1-1/2 inches per 12 inches).

- 1.6.3 Samples : Submit samples in accordance with Division 01, for each type of exposed finish required, prepared on Samples of size indicated below.
  - .1 Aluminum composite material Panels: 305 mm (12 inches) long by actual panel width. Include fasteners, closures, and other aluminum composite material panel accessories.
- 1.6.4 Professional Engineer's Stamped Shop Drawings and Submittals: Submit Professional Engineer's Stamped Shop Drawings and Submittals in accordance with Division 01, for aluminum composite material wall panels, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- 1.6.5 Submit for Consultants review, QA checklist used as part of installation process. Make modifications to QA checklist based on Consultant feedback

**1.7 Informational Submittals**

- 1.7.1 Sample Warranties: Submit samples warranties in accordance with Division 01 for extended warranties specified in this Section..

**1.8 Closeout Submittals**

- 1.8.1 Maintenance Data: Submit maintenance data in accordance with Division 01 for aluminum composite material panels to include in maintenance manuals.

**1.9 Quality Assurance**

- 1.9.1 Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- 1.9.2 Mock-ups: Build mock-ups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  - .1 Build mockup of typical aluminum composite material panel assembly including corner, soffits, supports, attachments, and accessories.
  - .2 Water-Spray Test: Conduct water-spray test of mockup of aluminum composite material panel assembly, testing for water penetration according to AAMA 501.2.
  - .3 Review of mock-ups does not constitute approval of deviations from the Contract Documents contained in mock-ups unless Consultant specifically approves such deviations in writing.
  - .4 Subject to compliance with requirements, reviewed mock-ups may become part of the completed Work if undisturbed at time of Substantial Performance of the Work.



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**1.10 Delivery, Storage, And Handling**

- 1.10.1 Deliver components, aluminum composite material panels, and other manufactured items so as not to be damaged or deformed. Package aluminum composite material panels for protection during transportation and handling.
- 1.10.2 Unload, store, and erect aluminum composite material panels in a manner to prevent bending, warping, twisting, and surface damage.
- 1.10.3 Stack aluminum composite material panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store aluminum composite material panels to ensure dryness, with positive slope for drainage of water. Do not store aluminum composite material panels in contact with other materials that might cause staining, denting, or other surface damage.
- 1.10.4 Retain strippable protective covering on aluminum composite material panels during installation.

**1.11 Field Conditions**

- 1.11.1 Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of aluminum composite material panels to be performed according to manufacturers' written instructions and warranty requirements.

**1.12 Coordination**

- 1.12.1 Coordinate aluminum composite material panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

**1.13 Warranty**

- 1.13.1 Extended Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum composite material panel systems that fail in materials or workmanship within specified warranty period.
  - .1 Failures include, but are not limited to, the following:
    - .1 Structural failures including rupturing, cracking, or puncturing.
    - .2 Deterioration of metals and other materials beyond normal weathering.
  - .2 Warranty Period: Five years from date of Substantial Performance of the Work.
- 1.13.2 Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace aluminum

composite material panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

- .1 Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
  - .1 Colour fading more than 5 Hunter units when tested according to ASTM D2244.
  - .2 Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
  - .3 Cracking, checking, peeling, or failure of paint to adhere to bare metal.
- .2 Finish Warranty Period: 30 years from date of Substantial Performance of the Work.

## **2 . PRODUCTS**

### **2.1 Manufacturers**

- 2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.
  - .1 3A Composites USA Inc/Alucobond
  - .2 Alcoa Inc./Reynobond
  - .3 ALPOLIC, Division of Mitsubishi Chemical America, Inc.
  - .4 Alucobond
- 2.1.2 Substitution Limitations: In accordance with requirements of Section, Substitution Procedures.

### **2.2 Performance Requirements**

- 2.2.1 Professional Engineer's Design and Certification: Employ the services of a Professional Engineer licensed to practice in the Province of Ontario carrying professional liability insurance, and who is experienced in providing engineering services of similar kind, scope and complexity; to design and certify aluminum composite material wall panel assemblies, including attachment to building construction.
- 2.2.2 Rain Screen Principle:
  - .1 Ensure system is designated as a "pressure-equalized rainscreen" system based on testing according to AAMA 508.
  - .2 Design exterior envelope cladding systems based on Rain Screen Principle advocated by NRCC and Provide for drainage of water entering building envelope wall systems.

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- .3 Design for compartments at corners to achieve appropriate pressure equalization in exterior cladding system.
  - .4 Provide gaskets, baffles, overlaps, seals and compartmentalization where required to achieve appropriate pressure equalization in exterior envelope cavity wall design. Maintain integrity of continuous air/vapour barrier system with adjacent surrounding air/vapour barrier.
  - .5 Incorporate means of draining moisture to exterior. Design drainage system to provide clear, internal paths of drainage of any trapped moisture within construction to exterior. Ensure weep water discharges in a manner that avoids staining of architectural finishes, collecting in puddles or formation of icicles.
- 2.2.3 Structural Performance: Provide aluminum composite material panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E330:
- .1 Wind Loads: As indicated on Drawings.
  - .2 Maximum Panel Deflection between supports:  $\leq L/180$
  - .3 Maximum Deflection of Individual Panels:  $\leq L/60$ .
  - .4 At connection points of framing members to anchors, anchor deflection in any direction shall not exceed 1.6 mm (1/16").
  - .5 Ensure stress on panel skin does not exceed manufacturer's recommended maximum value to avoid permanent deformation.
- 2.2.4 Seismic Performance: Provide products and systems specified in this Section to withstand the effects of earthquake motions in accordance with OBC 4.1.8.18 and CAN/CSA S832.
- .1 Professional engineer specified in Division 01 and referenced in this Section shall be responsible for designing systems and submitting signed and sealed analysis data and Shop Drawings illustrating seismic-resistant systems.
  - .2 Refer to Structural Drawings for seismic sensitivity values.
- 2.2.5 Air Infiltration: Air leakage of not more than 0.3 L/s per sq. m (0.06 cfm/sq. ft.) when tested according to ASTM E283 at the following test-pressure difference:
- .1 Test-Pressure Difference: 300 Pa (6.24 lbf/sq. ft.).
- 2.2.6 Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:
- .1 Test-Pressure Difference: 300 Pa (6.24 lbf/sq. ft.).
- 2.2.7 Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening

of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

- .1 Temperature Change (Range): 67 deg C (120 deg F), ambient; 100 deg C (180 deg F), material surfaces.
- 2.2.8 System Fire Propagation Characteristics: Aluminum composite material aluminum composite material wall panel system passes CAN/ULC-S134.
- 2.2.9 Panel Fire Performance: Flame spread less than 25 and smoke developed less than 450, in accordance with CAN/ULC S102/S102.2 or equivalent to ASTM E84 (subject to approval by Authorities Having Jurisdiction).
- 2.2.10 Peel Strength: Provide aluminum composite material panels having not less than 100 N x mm/mm (22.5 in-lb/in.) when tested for bond integrity in accordance with ASTM D1781.

## **2.3 Aluminum Composite Material Wall Panels**

- 2.3.1 Material Tag: This item is noted as "EW4/EW5" on Drawings and Schedules.
- 2.3.2 Aluminum Composite Material Wall Panel Systems: Provide factory-formed and -assembled, aluminum composite material wall panels fabricated from two metal facings that are bonded to a solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment assembly components, panel stiffeners, and accessories required for weathertight system.
  - .1 Panel Thickness: Not less than 4 mm (0.157 inch).
  - .2 Core: Fire retardant.
  - .3 Exterior Finish: Three-coat fluoropolymer.
  - .4 Colour: as indicated on Drawings.
- 2.3.3 Attachment Assembly Components: Formed from material compatible with panel facing.
- 2.3.4 Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide concealed fasteners unless indicated otherwise. In conditions where exposed fasteners are acceptable to Consultant, ensure fasteners are obscured in panel joinery.
- 2.3.5 Basis-of-Design: "Alumitex" as manufactured by Elemex or approved equivalent.

## **2.4 Miscellaneous Materials**

- 2.4.1 Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet ASTM A653/A653M, Z275 hot-

dip galvanized (G90) coating designation or ASTM A792/A792M, Class AZM150 (Class AZ50) aluminum-zinc-alloy coating designation unless otherwise indicated.

- .1 Provide manufacturer's standard sections as required for support and alignment of Aluminum composite material aluminum composite material panel system.
  - .2 Minimum thickness: 1.219 mm (18 ga.).
  - .3 Transfer grid to be hat bars, Z-bars, adjustable Z-bars or combination thermal clip and Z-bar.
  - .4 Material visible after assembly of wall panel shall be finished to match panels.
- 2.4.2 Thermally-Broken Sub-framing: Low-conductivity thermally-broken, intermittent structural attachment insulation clips designed maintain insulation effectiveness, with adjustable depth and suitable for vertical and horizontal sub-girts.
- .1 Basis-of-Design: "Cascadia Clip" by Cascadia Windows
  - .2 Acceptable Products:
    - .1 "ISO Clip" by Northern Facades Ltd.
    - .2 "TAC Thermal Spacer" Exterior Technologies Group
    - .3 "TClip Thermally Broken Façade Substructure" by Engineered Assemblies
    - .4 "NVELOPE NV1 Cladding Attachment System" by SFS Group.
- 2.4.3 Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of aluminum composite material panels unless otherwise indicated.
- 2.4.4 Fire Blocks: In accordance with OBC Article "3.1.11. Fire Blocks in Concealed Spaces" consisting of minimum 0.38 mm (28 ga) galvanized sheet steel complying with ASTM A653/A653M; minimum Z275 (G90) coating.
- 2.4.5 Flashing and Trim: Provide flashing and trim formed from same material as aluminum composite material panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent aluminum composite material panels.
- 2.4.6 Air Barrier/Vapour Retarder: As specified in Section 07 27 14.
- 2.4.7 Insulation: As specified in Section 07 21 00.

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**2.5     Fabrication**

- 2.5.1 Fabricate and finish aluminum composite material panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- 2.5.2 Fabricate aluminum composite material panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
  - .1 Panel Tolerances:
    - .1 Panel Bow: Not to exceed 0.8% of panel overall dimension in width or length.
    - .2 Length & Width: +0 mm, -3.2 mm (1/8 inch).
    - .3 Squareness: 1.3 mm per linear m (0.02 inch per ft) .
- 2.5.3 Sheet Metal Flashing and Trim: Wherever practical at corners, jambs and abutments, no flashings will be permitted. Ensure panel is designed to include for these connections. Where flashings are unavoidable, fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
  - .1 Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  - .2 Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
  - .3 Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
  - .4 Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
  - .5 Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
  - .6 Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
    - .1 Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for

application but not less than thickness of metal being secured.

## **2.6 Finishes**

- 2.6.1 Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- 2.6.2 Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of Samples reviewed by Consultant. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of Samples reviewed by Consultant and are assembled or installed to minimize contrast.
- 2.6.3 Aluminum Panels and Accessories:
  - .1 Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both colour coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - .1 Basis-of-Design: "Duranar XL" by PPG or approved equivalent.

## **3. EXECUTION**

### **3.1 Examination**

- 3.1.1 Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, aluminum composite material panel supports, and other conditions affecting performance of the Work.
  - .1 Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by aluminum composite material wall panel manufacturer.
  - .2 Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by aluminum composite material wall panel manufacturer.
  - .3 Verify that air-barriers/vapour-retarders have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

- 3.1.2 Examine roughing-in for components and assemblies penetrating aluminum composite material panels to verify actual locations of penetrations relative to seam locations of aluminum composite material panels before installation.
- 3.1.3 Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 Preparation**

- 3.2.1 Miscellaneous Supports: Install subframing, furring, thermally-broken subframing and other miscellaneous panel support members and anchorages according to ASTM C754 and aluminum composite material panel manufacturer's written recommendations.

### **3.3 Aluminum Composite Material Panel Installation**

- 3.3.1 Install aluminum composite material panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor aluminum composite material panels and other components of the Work securely in place, with provisions for thermal and structural movement.
  - .1 Shim or otherwise plumb substrates receiving aluminum composite material panels.
  - .2 Flash and seal aluminum composite material panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by aluminum composite material panels are installed.
  - .3 Install screw fasteners in predrilled holes.
  - .4 Locate and space fastenings in uniform vertical and horizontal alignment.
  - .5 Install flashing and trim as aluminum composite material panel work proceeds.
  - .6 Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
  - .7 Align bottoms of aluminum composite material panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
  - .8 Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- 3.3.2 Fasteners:



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- .1 Install exterior metal cladding to structural supports by hidden mechanical fasteners, clips and perimeter framing extrusions
  - .2 Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
  - 3.3.3 Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by aluminum composite material panel manufacturer.
  - 3.3.4 Install attachment assembly required to support aluminum composite material wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels. Conform to AAMA 508. Do not apply sealants to panel joints unless otherwise indicated.
    - .1 Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
    - .2 Install panels using fabricator's standard assembly with vertical channel that provides support and secondary drainage assembly, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by manufacturer.
    - .3 Attach wall panels by inserting horizontal support pins into notches in vertical channels and into flanges of panels. Leave horizontal and vertical joints with open reveal.
    - .4 Install support assembly at locations, spacings, and with fasteners recommended by fabricator. Use Fabricator's standard horizontal tracks and vertical tracks that provide support and secondary drainage assembly, draining to the exterior at horizontal joints through drain tube.
    - .5 Attach routed-and-turned flanges of wall panels to perimeter extrusions with fabricator's standard fasteners.
    - .6 Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
  - 3.3.5 Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
    - .1 Install components required for a complete aluminum composite material panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by aluminum composite material panel manufacturer; or, if not

indicated, provide types recommended in writing by aluminum composite material panel manufacturer.

- 3.3.6 Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
- .1 Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof performance.
  - .2 Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 3 m (10 feet) with no joints allowed within 605 mm (24 inches) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 25 mm (1 inch) deep, filled with mastic sealant (concealed within joints).
- 3.3.7 Fire Blocks: Where cavities exceed 25 mm and contain combustible insulation or cladding materials, provide continuous fire blocks complying with OBC Article "3.1.11. Fire Blocks in Concealed Spaces" as specified in this Section and installed in cavity at every floor level and at intervals exceeding no more than 3m vertically.

### **3.4 Erection Tolerances**

- 3.4.1 Installation Tolerances: Shim and align aluminum composite material wall panel units within installed tolerance of 1:1000 (1 inch in 80 feet), non-accumulative, on level, plumb, and location lines as indicated, and within 5% offset of adjoining faces and of alignment of matching profiles.

### **3.5 Field Quality Control**

- 3.5.1 Testing Agency: Contractor must engage a qualified independent testing agency to perform field tests and inspections.
- 3.5.2 Water-Spray Test: After installation, test area of assembly as directed by Consultant for water penetration according to AAMA 501.2.
- 3.5.3 Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed aluminum composite material wall panel installation, including accessories.

- 3.5.4 Aluminum composite material wall panels will be considered defective if they do not pass test and inspections.
- 3.5.5 Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- 3.5.6 Prepare test and inspection reports.

**3.6 Cleaning And Protection**

- 3.6.1 Remove temporary protective coverings and strippable films, if any, as aluminum composite material panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of aluminum composite material panel installation, clean finished surfaces as recommended by aluminum composite material panel manufacturer. Maintain in a clean condition during construction.
- 3.6.2 After aluminum composite material panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- 3.6.3 Replace aluminum composite material panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Solid Aluminum Plate Wall Panels work specified herein. This includes, but is not necessarily limited, to:
- .1 Custom-fabricated solid aluminum plate wall panel system complete with extruded aluminum fins.
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only.
- .1 Section 06 16 00 - Sheathing.
  - .2 Section 07 21 00 - Thermal Insulation.
  - .3 Section 07 92 00 - Joint Sealants.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Definitions**

- 1.4.1 PER: Pressure equalized rainscreen system; rainscreen system designed for no water intrusion with equal pressure between interior system cavity and outside cladding barrier.

### **1.5 Preinstallation Meetings**

- 1.5.1 Preinstallation Conference: Conduct conference at Project site.
- .1 Meet with Owner, Consultant, Owner's insurer if applicable, solid aluminum plate panel Installer, solid aluminum plate panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects solid aluminum

plate panels, including installers of doors, windows, and louvers.

- .2 Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
- .3 Review methods and procedures related to solid aluminum plate panel installation, including manufacturer's written instructions.
- .4 Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
- .5 Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect solid aluminum plate panels.
- .6 Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
- .7 Review temporary protection requirements for solid aluminum plate panel assembly during and after installation.
- .8 Review procedures for repair of panels damaged after installation.
- .9 Document proceedings, including corrective measures and actions required, and Supply copy of record to each participant.

## **1.6 Action Submittals**

- 1.6.1 Product Data: Submit product data in accordance with Division 01 for the following:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for the Solid Aluminum Plate Wall Panels work and include product characteristics, performance criteria, physical size, finish and limitations.
- 1.6.2 Shop Drawings:
  - .1 Include fabrication and installation layouts of solid aluminum plate panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.
  - .2 Accessories: Include details of the flashing, trim and anchorage, at a scale of not less than 1:10 (1-1/2 inches per 12 inches).
- 1.6.3 Samples : Submit samples in accordance with Division 01, for each type of exposed finish required, prepared on Samples of size indicated below.

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- .1 Solid aluminum plate Panels: 305 mm (12 inches) long by actual panel width. Include fasteners, closures, and other solid aluminum plate panel accessories.
  - 1.6.4 Professional Engineer's Stamped Shop Drawings and Submittals: Submit Professional Engineer's Stamped Shop Drawings and Submittals in accordance with Division 01, for solid aluminum plate wall panels, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1.6.5 Submit for Consultants review, QA checklist used as part of installation process. Make modifications to QA checklist based on Consultant feedback
  - 1.7 Informational Submittals**
    - 1.7.1 Sample Warranties: Submit sample warranties in accordance with Division 01 for extended warranties specified in this Section..
  - 1.8 Closeout Submittals**
    - 1.8.1 Maintenance Data: Submit maintenance data in accordance with Division 01 for solid aluminum plate panels to include in maintenance manuals.
  - 1.9 Quality Assurance**
    - 1.9.1 Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
    - 1.9.2 Mock-ups: Build mock-ups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
      - .1 Build mockup of typical solid aluminum plate panel assembly including corner, soffits, supports, attachments, and accessories.
      - .2 Water-Spray Test: Conduct water-spray test of mockup of solid aluminum plate panel assembly, testing for water penetration according to AAMA 501.2.
  - 1.10 Delivery, Storage, And Handling**
    - 1.10.1 Deliver components, solid aluminum plate panels, and other manufactured items so as not to be damaged or deformed. Package solid aluminum plate panels for protection during transportation and handling.
    - 1.10.2 Unload, store, and erect solid aluminum plate panels in a manner to prevent bending, warping, twisting, and surface damage.
    - 1.10.3 Stack solid aluminum plate panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering.

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Store solid aluminum plate panels to ensure dryness, with positive slope for drainage of water. Do not store solid aluminum plate panels in contact with other materials that might cause staining, denting, or other surface damage.

- 1.10.4 Retain strippable protective covering on solid aluminum plate panels during installation.

**1.11 Field Conditions**

- 1.11.1 Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of solid aluminum plate panels to be performed according to manufacturers' written instructions and warranty requirements.

**1.12 Coordination**

- 1.12.1 Coordinate solid aluminum plate panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

**1.13 Warranty**

- 1.13.1 Extended Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of solid aluminum plate panel systems that fail in materials or workmanship within specified warranty period.

- .1 Failures include, but are not limited to, the following:
  - .1 Structural failures including rupturing, cracking, or puncturing.
  - .2 Deterioration of metals and other materials beyond normal weathering.
- .2 Warranty Period: Five years from date of Substantial Performance of the Work.

- 1.13.2 Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace solid aluminum plate panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

- .1 Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
  - .1 Colour fading more than 5 Hunter units when tested according to ASTM D2244.
  - .2 Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
  - .3 Cracking, checking, peeling, or failure of paint to adhere to bare metal.

- .2 Finish Warranty Period: 30 years from date of Substantial Performance of the Work.

## **2 . PRODUCTS**

### **2.1 Manufacturers**

- 2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.
- 2.1.2 Basis-of-Design: "Alumitex™ AFS Plate" by Ontario Panelization or approved equivalent as follows:
  - .1 "Axiom Aluminum Plate Wall System" by Northern Facades/Flynn Canada Ltd.;
  - .2 "AM 3000" by Architectural Metals North America
  - .3 "SL-2000P" by Sobotec Ltd.;
- 2.1.3 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

### **2.2 Performance Requirements**

- 2.2.1 Professional Engineer's Design and Certification: Employ the services of a Professional Engineer licensed to practice in the Province of Ontario carrying professional liability insurance, and who is experienced in providing engineering services of similar kind, scope and complexity; to design and certify solid aluminum plate wall panel assemblies, including attachment to building construction.
- 2.2.2 Rain Screen Principle:
  - .1 Ensure system is designated as a "pressure-equalized rainscreen" system based on testing according to AAMA 508.
  - .2 Design exterior envelope cladding systems based on Rain Screen Principle advocated by NRCC and Provide for drainage of water entering building envelope wall systems.
  - .3 Design for compartments at corners to achieve appropriate pressure equalization in exterior cladding system.
  - .4 Provide gaskets, baffles, overlaps, seals and compartmentalization where required to achieve appropriate pressure equalization in exterior envelope cavity wall design. Maintain integrity of continuous air/vapour barrier system with adjacent surrounding air/vapour barrier.
  - .5 Incorporate means of draining moisture to exterior. Design drainage system to provide clear, internal paths of drainage of any trapped moisture within construction to exterior. Ensure



weep water discharges in a manner that avoids staining of architectural finishes, collecting in puddles or formation of icicles.

- 2.2.3 Structural Performance: Provide solid aluminum plate panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E330:
- .1 Wind Loads: As indicated on Drawings.
  - .2 Maximum Panel Deflection between supports:  $\leq L/180$
  - .3 Maximum Deflection of Individual Panels:  $\leq L/60$ .
  - .4 At connection points of framing members to anchors, anchor deflection in any direction shall not exceed 1.6 mm (1/16").
  - .5 Ensure stress on panel skin does not exceed manufacturer's recommended maximum value to avoid permanent deformation.
- 2.2.4 Seismic Performance: Provide products and systems specified in this Section to withstand the effects of earthquake motions in accordance with OBC 4.1.8.18 and CAN/CSA S832.
- .1 Professional engineer specified in Division 01 and referenced in this Section shall be responsible for designing systems and submitting signed and sealed analysis data and Shop Drawings illustrating seismic-resistant systems.
  - .2 Refer to Structural Drawings for seismic sensitivity values.
- 2.2.5 Air Infiltration: Air leakage of not more than 0.3 L/s per sq. m (0.06 cfm/sq. ft.) when tested according to ASTM E283 at the following test-pressure difference:
- .1 Test-Pressure Difference: 300 Pa (6.24 lbf/sq. ft.).
- 2.2.6 Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:
- .1 Test-Pressure Difference: 300 Pa (6.24 lbf/sq. ft.).
- 2.2.7 Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
- .1 Temperature Change (Range): 67 deg C (120 deg F), ambient; 100 deg C (180 deg F), material surfaces.
- 2.2.8 System Fire Propagation Characteristics: Solid aluminum plate solid aluminum plate wall panel system passes CAN/ULC-S134.
- 2.2.9 Panel Fire Performance: Flame spread less than 25 and smoke developed less than 450, in accordance with CAN/ULC

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S102/S102.2 or equivalent to ASTM E84 (subject to approval by Authorities Having Jurisdiction).

**2.3     Metal Plate Wall Panels**

- 2.3.1 Material Tag: This item is noted as “EW11” on Drawings and Schedules.
- 2.3.2 Metal Plate Wall Panels: Provide factory-formed, metal plate wall panels fabricated from single sheets of metal formed into profile for installation method indicated. Include attachment assembly components, panel stiffeners, and accessories required for weathertight system.
  - .1 Nominal Joint Thickness: 13 mm (1/2 inch)
  - .2 Joint Type: Dry.
  - .3 Panels to have mechanically fastened 50 mm x 25 mm (2 x 1 inch) extruded aluminum tubes as noted on Drawings.
- 2.3.3 Panel Material: Aluminum Sheet: Tension-leveled, smooth aluminum sheet, ASTM B209M (ASTM B209)
  - .1 Thickness: Not less than 3 mm (0.118 inch) thick.
  - .2 Exterior Finish: Three-coat fluoropolymer.
  - .3 Colour: to be selected by Consultant from manufacturer's full range.
- 2.3.4 Attachment Assembly: Manufacturer's standard.
- 2.3.5 Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide concealed fasteners unless indicated otherwise. In conditions where exposed fasteners are acceptable to Consultant, ensure fasteners are obscured in panel joinery.

**2.4     Miscellaneous Materials**

- 2.4.1 Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet ASTM A653/A653M, Z275 hot-dip galvanized (G90) coating designation or ASTM A792/A792M, Class AZM150 (Class AZ50) aluminum-zinc-alloy coating designation unless otherwise indicated.
  - .1 Provide manufacturer's standard sections as required for support and alignment of Solid aluminum plate solid aluminum plate panel system.
  - .2 Minimum thickness: 1.219 mm (18 ga.).
  - .3 Transfer grid to be hat bars, Z-bars, adjustable Z-bars or combination thermal clip and Z-bar.
  - .4 Material visible after assembly of wall panel shall be finished to match panels.

- 2.4.2 Thermally-Broken Sub-framing: Low-conductivity thermally-broken, intermittent structural attachment insulation clips designed maintain insulation effectiveness, with adjustable depth and suitable for vertical and horizontal sub-girts.
- .1 Basis-of-Design: "Cascadia Clip" by Cascadia Windows
  - .2 Acceptable Products:
    - .1 "ISO Clip" by Northern Facades Ltd.
    - .2 "TAC Thermal Spacer" Exterior Technologies Group
    - .3 "TClip Thermally Broken Façade Substructure" by Engineered Assemblies
    - .4 "NVELOPE NV1 Cladding Attachment System" by SFS Group.
- 2.4.3 Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of solid aluminum plate panels unless otherwise indicated.
- 2.4.4 Flashing and Trim: Provide flashing and trim formed from same material as solid aluminum plate panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent solid aluminum plate panels.
- 2.4.5 Fire Blocks: In accordance with OBC Article "3.1.11. Fire Blocks in Concealed Spaces" consisting of minimum 0.38 mm (28 ga) galvanized sheet steel complying with ASTM A653/A653M; minimum Z275 (G90) coating.
- 2.4.6 Air Barrier/Vapour Retarder: As specified in Section 07 27 14.
- 2.4.7 Insulation: As specified in Section 07 21 00.

## **2.5 Fabrication**

- 2.5.1 Fabricate and finish solid aluminum plate panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- 2.5.2 Fabricate solid aluminum plate panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- .1 Panel Tolerances:

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- .1 Panel Bow: Not to exceed 0.8% of panel overall dimension in width or length.
  - .2 Length & Width: +0 mm, -3.2 mm (1/8 inch).
  - .3 Squareness: 1.3 mm per linear m (0.02 inch per ft) .
- 2.5.3 Sheet Metal Flashing and Trim: Wherever practical at corners, jambs and abutments, no flashings will be permitted. Ensure panel is designed to include for these connections. Where flashings are unavoidable, fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
- .1 Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  - .2 Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
  - .3 Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
  - .4 Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
  - .5 Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
  - .6 Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
- .1 Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

## **2.6 Finishes**

- 2.6.1 Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- 2.6.2 Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of Samples reviewed by Consultant. Noticeable variations in same piece are not acceptable. Variations in appearance of other

components are acceptable if they are within the range of Samples reviewed by Consultant and are assembled or installed to minimize contrast.

2.6.3 Aluminum Panels and Accessories:

- .1 Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both colour coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- .1 Basis-of-Design: "Duranar XL" by PPG or approved equivalent.

### 3 . **EXECUTION**

#### 3.1 **Examination**

- 3.1.1 Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, solid aluminum plate panel supports, and other conditions affecting performance of the Work.
  - .1 Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by solid aluminum plate wall panel manufacturer.
  - .2 Ensure structure is plumb to a tolerance of 1:1000 (1 inch in 80 ft).
  - .3 Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by solid aluminum plate wall panel manufacturer.
  - .4 Verify that air-barriers/vapour-retarders have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- 3.1.2 Examine roughing-in for components and assemblies penetrating solid aluminum plate panels to verify actual locations of penetrations relative to seam locations of solid aluminum plate panels before installation.
- 3.1.3 Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 **Preparation**

- 3.2.1 Miscellaneous Supports: Install subframing, furring, thermally-broken subframing and other miscellaneous panel support

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members and anchorages according to solid aluminum plate panel manufacturer's written recommendations.

### **3.3     Solid Aluminum Plate Panel Installation**

- 3.3.1 Install solid aluminum plate panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor solid aluminum plate panels and other components of the Work securely in place, with provisions for thermal and structural movement.
- .1 Shim or otherwise plumb substrates receiving solid aluminum plate panels.
  - .2 Flash and seal solid aluminum plate panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by solid aluminum plate panels are installed.
  - .3 Install screw fasteners in predrilled holes.
  - .4 Locate and space fastenings in uniform vertical and horizontal alignment.
  - .5 Install flashing and trim as solid aluminum plate panel work proceeds.
  - .6 Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
  - .7 Align bottoms of solid aluminum plate panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
  - .8 Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- 3.3.2 Fasteners:
- .1 Install exterior metal cladding to structural supports by hidden mechanical fasteners, clips and perimeter framing extrusions
  - .2 Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
- 3.3.3 Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by solid aluminum plate panel manufacturer.
- 3.3.4 Install attachment assembly required to support solid aluminum plate wall panels and to provide a complete weathertight wall

system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels. Conform to AAMA 508. Do not apply sealants to panel joints unless otherwise indicated.

- .1 Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
  - .2 Install panels using fabricator's standard assembly with vertical channel that provides support and secondary drainage assembly, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by manufacturer.
  - .3 Attach wall panels by inserting horizontal support pins into notches in vertical channels and into flanges of panels. Leave horizontal and vertical joints with open reveal.
  - .4 Install support assembly at locations, spacings, and with fasteners recommended by fabricator. Use Fabricator's standard horizontal tracks and vertical tracks that provide support and secondary drainage assembly, draining to the exterior at horizontal joints through drain tube.
  - .5 Attach routed-and-turned flanges of wall panels to perimeter extrusions with fabricator's standard fasteners.
  - .6 Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
- 3.3.5 Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
- .1 Install components required for a complete solid aluminum plate panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by solid aluminum plate panel manufacturer; or, if not indicated, provide types recommended in writing by solid aluminum plate panel manufacturer.
- 3.3.6 Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
- .1 Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal

flashing and trim to fit substrates and to result in waterproof performance.

- .2 Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 3 m (10 feet) with no joints allowed within 605 mm (24 inches) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 25 mm (1 inch) deep, filled with mastic sealant (concealed within joints).

- 3.3.7 Fire Blocks: Where cavities exceed 25 mm and contain combustible insulation or cladding materials, provide continuous fire blocks complying with OBC Article "3.1.11. Fire Blocks in Concealed Spaces" as specified in this Section and installed in cavity at every floor level and at intervals exceeding no more than 3m vertically.

### **3.4 Erection Tolerances**

- 3.4.1 Installation Tolerances: Shim and align solid aluminum plate wall panel units within installed tolerance of 1:1000 (1 inch in 80 feet), non-accumulative, on level, plumb, and location lines as indicated, and within 5% offset of adjoining faces and of alignment of matching profiles.

### **3.5 Field Quality Control**

- 3.5.1 Testing Agency: Contractor must engage a qualified independent testing agency to perform field tests and inspections.
- 3.5.2 Water-Spray Test: After installation, test area of assembly as directed by Consultant for water penetration according to AAMA 501.2.
- 3.5.3 Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed solid aluminum plate wall panel installation, including accessories.
- 3.5.4 Solid aluminum plate wall panels will be considered defective if they do not pass test and inspections.
- 3.5.5 Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- 3.5.6 Prepare test and inspection reports.

### **3.6 Cleaning And Protection**

- 3.6.1 Remove temporary protective coverings and strippable films, if any, as solid aluminum plate panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On



completion of solid aluminum plate panel installation, clean finished surfaces as recommended by solid aluminum plate panel manufacturer. Maintain in a clean condition during construction.

- 3.6.2 After solid aluminum plate panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- 3.6.3 Replace solid aluminum plate panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the PER Cementitious Cladding System work specified herein. This includes, but is not necessarily limited, to:
- .1 Custom-fabricated cementitious cladding system.
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only.
- .1 Section 06 16 00 - Sheathing.
  - .2 Section 07 21 00 - Thermal Insulation.
  - .3 Section 07 27 14 – Self-Adhering Sheet Air Barriers and Vapour Retarders
  - .4 Section 07 92 00 - Joint Sealants.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Definitions**

- 1.4.1 PER: Pressure equalized rainscreen system; rainscreen system designed for no water intrusion with equal pressure between interior system cavity and outside cladding barrier.

### **1.5 Preinstallation Meetings**

- 1.5.1 Preinstallation Conference: Conduct conference at Project site.
- .1 Meet with Owner, Consultant, Owner's insurer if applicable, cementitious cladding panel Installer, cementitious cladding panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects

cementitious cladding panels, including installers of doors, windows, and louvers.

- .2 Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
- .3 Review methods and procedures related to cementitious cladding panel installation, including manufacturer's written instructions.
- .4 Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
- .5 Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect cementitious cladding panels.
- .6 Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
- .7 Review temporary protection requirements for cementitious cladding panel assembly during and after installation.
- .8 Review procedures for repair of panels damaged after installation.
- .9 Document proceedings, including corrective measures and actions required, and Supply copy of record to each participant.

## **1.6 Action Submittals**

- 1.6.1 Product Data: Submit product data in accordance with Division 01 for the following:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for the PER Cementitious Cladding System work and include product characteristics, performance criteria, physical size, finish and limitations.
- 1.6.2 Shop Drawings:
  - .1 Include fabrication and installation layouts of cementitious cladding panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.
  - .2 Accessories: Include details of the flashing, trim and anchorage, at a scale of not less than 1:10 (1-1/2 inches per 12 inches).
- 1.6.3 Samples : Submit samples in accordance with Division 01, for each type of exposed finish required, prepared on Samples of size indicated below.

- .1 Cementitious cladding Panels: 305 mm (12 inches) long by actual panel width. Include fasteners, closures, and other cementitious cladding panel accessories.
- 1.6.4 Professional Engineer's Stamped Shop Drawings and Submittals: Submit Professional Engineer's Stamped Shop Drawings and Submittals in accordance with Division 01, for cementitious claddings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- 1.6.5 Submit for Consultants review, QA checklist used as part of installation process. Make modifications to QA checklist based on Consultant feedback
- 1.7 Informational Submittals**
  - 1.7.1 Sample Warranties: Submit samples warranties in accordance with Division 01 for extended warranties specified in this Section..
- 1.8 Closeout Submittals**
  - 1.8.1 Maintenance Data: Submit maintenance data in accordance with Division 01 for cementitious cladding panels to include in maintenance manuals.
- 1.9 Quality Assurance**
  - 1.9.1 Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
  - 1.9.2 Mock-ups: Build mock-ups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
    - .1 Build mockup of typical cementitious cladding panel assembly including corner, soffits, supports, attachments, and accessories.
    - .2 Water-Spray Test: Conduct water-spray test of mockup of cementitious cladding panel assembly, testing for water penetration according to AAMA 501.2.
    - .3 Review of mock-ups does not constitute approval of deviations from the Contract Documents contained in mock-ups unless Consultant specifically approves such deviations in writing.
    - .4 Subject to compliance with requirements, reviewed mock-ups may become part of the completed Work if undisturbed at time of Substantial Performance of the Work.
- 1.10 Delivery, Storage, And Handling**
  - 1.10.1 Deliver components, cementitious cladding panels, and other manufactured items so as not to be damaged or deformed. Package

cementitious cladding panels for protection during transportation and handling.

- 1.10.2 Unload, store, and erect cementitious cladding panels in a manner to prevent bending, warping, twisting, and surface damage.
- 1.10.3 Stack cementitious cladding panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store cementitious cladding panels to ensure dryness, with positive slope for drainage of water. Do not store cementitious cladding panels in contact with other materials that might cause staining, denting, or other surface damage.
- 1.10.4 Retain strippable protective covering on cementitious cladding panels during installation.

**1.11 Field Conditions**

- 1.11.1 Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of cementitious cladding panels to be performed according to manufacturers' written instructions and warranty requirements.

**1.12 Coordination**

- 1.12.1 Coordinate cementitious cladding panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

**1.13 Warranty**

- 1.13.1 Extended Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of cementitious cladding panel systems that fail in materials or workmanship within specified warranty period.
  - .1 Failures include, but are not limited to, the following:
    - .1 Structural failures including rupturing, cracking, or puncturing.
    - .2 Deterioration of metals and other materials beyond normal weathering.
  - .2 Warranty Period: Five years from date of Substantial Performance of the Work.
- 1.13.2 Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace cementitious cladding panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - .1 Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

- .1 Colour fading more than 5 Hunter units when tested according to ASTM D2244.
- .2 Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
- .3 Cracking, checking, peeling, or failure of paint to adhere to bare metal.
- .2 Finish Warranty Period: 30 years from date of Substantial Performance of the Work.

## **2 . PRODUCTS**

### **2.1 Manufacturers**

- 2.1.1 Basis-of-Design: Materials specified in this Section are based on "Ceramitex Façade System" as supplied by Elemex with sintered stone cladding.
- 2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

### **2.2 Performance Requirements**

- 2.2.1 Professional Engineer's Design and Certification: Employ the services of a Professional Engineer licensed to practice in the Province of Ontario carrying professional liability insurance, and who is experienced in providing engineering services of similar kind, scope and complexity; to design and certify cementitious cladding assemblies, including attachment to building construction.
- 2.2.2 Rain Screen Principle:
  - .1 Ensure system is designated as a "pressure-equalized rainscreen" system based on testing according to AAMA 508.
  - .2 Design exterior envelope cladding systems based on Rain Screen Principle advocated by NRCC and Provide for drainage of water entering building envelope wall systems.
  - .3 Design for compartments at corners to achieve appropriate pressure equalization in exterior cladding system.
  - .4 Provide gaskets, baffles, overlaps, seals and compartmentalization where required to achieve appropriate pressure equalization in exterior envelope cavity wall design. Maintain integrity of continuous air/vapour barrier system with adjacent surrounding air/vapour barrier.
  - .5 Incorporate means of draining moisture to exterior. Design drainage system to provide clear, internal paths of drainage of any trapped moisture within construction to exterior. Ensure weep water discharges in a manner that avoids staining of

architectural finishes, collecting in puddles or formation of icicles.

- 2.2.3 Structural Performance: Provide cementitious cladding panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E330:
- .1 Wind Loads: As indicated on Drawings.
  - .2 Maximum Panel Deflection between supports:  $\leq L/180$
  - .3 Maximum Deflection of Individual Panels:  $\leq L/60$ .
  - .4 At connection points of framing members to anchors, anchor deflection in any direction shall not exceed 1.6 mm (1/16").
  - .5 Ensure stress on panel skin does not exceed manufacturer's recommended maximum value to avoid permanent deformation.
- 2.2.4 Seismic Performance: Provide products and systems specified in this Section to withstand the effects of earthquake motions in accordance with OBC 4.1.8.18 and CAN/CSA S832.
- .1 Professional engineer specified in Division 01 and referenced in this Section shall be responsible for designing systems and submitting signed and sealed analysis data and Shop Drawings illustrating seismic-resistant systems.
  - .2 Refer to Structural Drawings for seismic sensitivity values.
- 2.2.5 Air Infiltration: Air leakage of not more than 0.3 L/s per sq. m (0.06 cfm/sq. ft.) when tested according to ASTM E283 at the following test-pressure difference:
- .1 Test-Pressure Difference: 300 Pa (6.24 lbf/sq. ft.).
- 2.2.6 Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:
- .1 Test-Pressure Difference: 300 Pa (6.24 lbf/sq. ft.).
- 2.2.7 Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
- .1 Temperature Change (Range): 67 deg C (120 deg F), ambient; 100 deg C (180 deg F), material surfaces.
- 2.2.8 System Fire Propagation Characteristics: Cementitious cladding cementitious cladding system passes CAN/ULC-S134.
- 2.2.9 Panel Fire Performance: Flame spread less than 25 and smoke developed less than 450, in accordance with CAN/ULC

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S102/S102.2 or equivalent to ASTM E84 (subject to approval by Authorities Having Jurisdiction).

## **2.3 Cementitious Cladding**

- 2.3.1 Material Tag: This item is noted as “EW6/PNL1” on Drawings and Schedules.
- 2.3.2 Panel Description: sintered stone system consisting of blend of Portland Cement, fibers and cementitious materials, extruded into panels and pre-finished with manufacturer’s standard UV-resistant finishing system.
- 2.3.3 Base Material: Cementitious matrix with fibreglass reinforcement conforming to EN-14411 or ANSI equivalent, suitable for exterior use.
- 2.3.4 Sintered Stone Thickness:
  - .1 EW6: Minimum 8 mm (5/16 inch)
  - .2 PNL1: Minimum 6 mm (1/4 inch)
- 2.3.5 Formed from material compatible with panel facing.
- 2.3.6 Fastener Appearance: concealed. Provide manufacturer’s standard fasteners designed to withstand design loads and pull-out strengths required for Project.
- 2.3.7 Basis-of-Design: “Ceramitex Façade System” as supplied by Elemex with sintered stone cladding.
  - .1 Finish: “Dekton - Chromica Baltic” by Consentino.
- 2.3.8 Acceptable Equivalent: Keith Panel Systems; System A-Edge.
  - .1 Finish: “Dekton - Chromica Baltic” by Consentino.

## **2.4 Miscellaneous Materials**

- 2.4.1 Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet ASTM A653/A653M, Z275 hot-dip galvanized (G90) coating designation or ASTM A792/A792M, Class AZM150 (Class AZ50) aluminum-zinc-alloy coating designation unless otherwise indicated.
  - .1 Provide manufacturer's standard sections as required for support and alignment of Cementitious cladding cementitious cladding panel system.
  - .2 Minimum thickness: 1.219 mm (18 ga.).
  - .3 Transfer grid to be hat bars, Z-bars, adjustable Z-bars or combination thermal clip and Z-bar.
  - .4 Material visible after assembly of wall panel shall be finished to match panels.



- 2.4.2 Thermally-Broken Sub-framing: Low-conductivity thermally-broken, intermittent structural attachment insulation clips designed maintain insulation effectiveness, with adjustable depth and suitable for vertical and horizontal sub-girts.
- .1 Basis-of-Design: "Cascadia Clip" by Cascadia Windows
  - .2 Acceptable Products:
    - .1 "ISO Clip" by Northern Facades Ltd.
    - .2 "TAC Thermal Spacer" Exterior Technologies Group
    - .3 "TClip Thermally Broken Façade Substructure" by Engineered Assemblies
    - .4 "NVELOPE NV1 Cladding Attachment System" by SFS Group.
- 2.4.3 Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of cementitious cladding panels unless otherwise indicated.
- 2.4.4 Fire Blocks: In accordance with OBC Article "3.1.11. Fire Blocks in Concealed Spaces" consisting of minimum 0.38 mm (28 ga) galvanized sheet steel complying with ASTM A653/A653M; minimum Z275 (G90) coating.
- 2.4.5 Flashing and Trim: Provide flashing and trim formed from same material as cementitious cladding panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent cementitious cladding panels.
- 2.4.6 Air Barrier/Vapour Retarder: As specified in Section 07 27 14.
- 2.4.7 Insulation: As specified in Section 07 21 00.

## **2.5 Fabrication**

- 2.5.1 Fabricate and finish cementitious cladding panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- 2.5.2 Fabricate cementitious cladding panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- .1 Panel Tolerances:

- .1 Panel Bow: Not to exceed 0.8% of panel overall dimension in width or length.
  - .2 Length & Width: +0 mm, -3.2 mm (1/8 inch).
  - .3 Squareness: 1.3 mm per linear m (0.02 inch per ft) .
- 2.5.3 Sheet Metal Flashing and Trim: Wherever practical at corners, jambs and abutments, no flashings will be permitted. Ensure panel is designed to include for these connections. Where flashings are unavoidable, fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
- .1 Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  - .2 Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
  - .3 Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
  - .4 Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
  - .5 Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
  - .6 Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
- .1 Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

## **2.6 Finishes**

- 2.6.1 Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- 2.6.2 Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of Samples reviewed by Consultant. Noticeable variations in same piece are not acceptable. Variations in appearance of other

components are acceptable if they are within the range of Samples reviewed by Consultant and are assembled or installed to minimize contrast.

### **3 . EXECUTION**

#### **3.1 Examination**

- 3.1.1 Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, cementitious cladding panel supports, and other conditions affecting performance of the Work.
  - .1 Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by cementitious cladding manufacturer.
  - .2 Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by cementitious cladding manufacturer.
  - .3 Verify that air-barriers/vapour-retarders have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- 3.1.2 Examine roughing-in for components and assemblies penetrating cementitious cladding panels to verify actual locations of penetrations relative to seam locations of cementitious cladding panels before installation.
- 3.1.3 Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 Preparation**

- 3.2.1 Miscellaneous Supports: Install subframing, furring, thermally-broken subframing and other miscellaneous panel support members and anchorages according to ASTM C754 and cementitious cladding panel manufacturer's written recommendations.

#### **3.3 Cementitious Cladding Panel Installation**

- 3.3.1 Install cementitious cladding panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor cementitious cladding panels and other components of the Work securely in place, with provisions for thermal and structural movement.

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- .1 Shim or otherwise plumb substrates receiving cementitious cladding panels.
  - .2 Flash and seal cementitious cladding panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by cementitious cladding panels are installed.
  - .3 Install screw fasteners in predrilled holes.
  - .4 Locate and space fastenings in uniform vertical and horizontal alignment.
  - .5 Install flashing and trim as cementitious cladding panel work proceeds.
  - .6 Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
  - .7 Align bottoms of cementitious cladding panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
  - .8 Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- 3.3.2 Fasteners:
- .1 Install exterior metal cladding to structural supports by hidden mechanical fasteners, clips and perimeter framing extrusions
  - .2 Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
- 3.3.3 Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by cementitious cladding panel manufacturer.
- 3.3.4 Install attachment assembly required to support cementitious claddings and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels. Conform to AAMA 508. Do not apply sealants to panel joints unless otherwise indicated.
- .1 Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
  - .2 Install panels using fabricator's standard assembly with vertical channel that provides support and secondary drainage assembly, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by

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- channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by manufacturer.
- .3 Attach wall panels by inserting horizontal support pins into notches in vertical channels and into flanges of panels. Leave horizontal and vertical joints with open reveal.
  - .4 Install support assembly at locations, spacings, and with fasteners recommended by fabricator. Use Fabricator's standard horizontal tracks and vertical tracks that provide support and secondary drainage assembly, draining to the exterior at horizontal joints through drain tube.
  - .5 Attach routed-and-turned flanges of wall panels to perimeter extrusions with fabricator's standard fasteners.
  - .6 Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
- 3.3.5 Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
- .1 Install components required for a complete cementitious cladding panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by cementitious cladding panel manufacturer; or, if not indicated, provide types recommended in writing by cementitious cladding panel manufacturer.
- 3.3.6 Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
- .1 Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof performance.
  - .2 Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 3 m (10 feet) with no joints allowed within 605 mm (24 inches) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 25 mm (1 inch) deep, filled with mastic sealant (concealed within joints).

- 3.3.7 Fire Blocks: Where cavities exceed 25 mm and contain combustible insulation or cladding materials, provide continuous fire blocks complying with OBC Article "3.1.11. Fire Blocks in Concealed Spaces" as specified in this Section and installed in cavity at every floor level and at intervals exceeding no more than 3m vertically.

**3.4 Erection Tolerances**

- 3.4.1 Installation Tolerances: Shim and align cementitious cladding units within installed tolerance of 1:1000 (1 inch in 80 feet), non-accumulative, on level, plumb, and location lines as indicated, and within 5% offset of adjoining faces and of alignment of matching profiles.

**3.5 Field Quality Control**

- 3.5.1 Testing Agency: Contractor must engage a qualified independent testing agency to perform field tests and inspections.
- 3.5.2 Water-Spray Test: After installation, test area of assembly as directed by Consultant for water penetration according to AAMA 501.2.
- 3.5.3 Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed cementitious cladding installation, including accessories.
- 3.5.4 Cementitious claddings will be considered defective if they do not pass test and inspections.
- 3.5.5 Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- 3.5.6 Prepare test and inspection reports.

**3.6 Cleaning And Protection**

- 3.6.1 Remove temporary protective coverings and strippable films, if any, as cementitious cladding panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of cementitious cladding panel installation, clean finished surfaces as recommended by cementitious cladding panel manufacturer. Maintain in a clean condition during construction.
- 3.6.2 After cementitious cladding panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- 3.6.3 Replace cementitious cladding panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

**Regional Municipality  
of Peel  
Procurement Division**

**Document 2024-346P  
CONSTRUCTION OF THE  
DOCKSTEADER PRPS  
REPORTING STATION**

**Division 07  
07 42 46  
PER Cementitious  
Cladding System**

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END OF SECTION

## **1. GENERAL**

### **1.1 GENERAL INSTRUCTIONS**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; as well as the requirements of Division 01 Specifications and any additional documents mentioned in this Section.
- 1.1.2 The Contractor is solely responsible for distributing the Work among Subcontractors and Suppliers. The Consultant and Owner assume no responsibility for acting as arbiters or for establishing subcontract limits within Sections or Divisions of the Work. Any references to related work items in this Section are for convenience only.

### **1.2 SUMMARY**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the work specified herein. This includes, but is not necessarily limited, to:
  - .1 Linear metal soffit systems.
  - .2 Auxiliary materials required for a complete installation including, but not limited to, suspension systems, perimeter mouldings, trims and accessories.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole and may be directly applicable to this Section.
  - .1 Related requirements provided below are for convenience purposes only.
    - .1 Section 07 46 13 – Steel Siding Panels.

### **1.3 REFERENCES**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 – Reference Standards.

### **1.4 ADMINISTRATIVE REQUIREMENTS**

- 1.4.1 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
  - .1 Ensure attendance of Subcontractor performing work of this Section, as well as representatives from manufacturers and fabricators involved in or affected by installation. Notify Consultant and Owner of scheduled meeting dates in advance.



- .2 Agenda:
  - .1 Review progress of related construction activities and preparations for particular activity under consideration.
  - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
  - .3 Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
  - .4 Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.
- 1.4.2 Coordination: Coordinate with Division 23, HVAC and Division 26, Electrical.
  - .1 Integration with Mechanical, Electrical and Security Systems: Ensure compatibility of light fixtures, air diffusers, sprinkler systems, and other soffit-mounted elements with linear metal soffits.

## **1.5 SUBMITTALS**

- 1.5.1 General Requirements and Procedures for Submittals: in accordance with Section 01 33 00, Submittal Procedures.
- 1.5.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for linear metal soffit work specified in this Section.
- 1.5.3 Embodied Carbon / Environmental Product Declarations (EPDs): submit product-specific EPD conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
  - .1 EPD Scope: must cover Cradle-to-Gate (A1 to A3) as a minimum.
  - .2 EPD Impact Categories: must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
- 1.5.4 Product Certificates: Submit certificates for indigenous materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each indigenous material.
- 1.5.5 Sustainability report: Submit corporate sustainability report for manufacturer of products specified in this Section identifying raw material sources.

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- 1.5.6 Shop Drawings: Submit Shop Drawings indicating material layouts, construction details, connections, and relationships with adjacent construction.
- .1 Ensure Shop Drawings are coordinated with other elements occurring within soffit assemblies.
  - .2 Shop Drawings must include hanger locations, suspension systems, access panels, light fixtures, diffusers and return grilles, changes in soffit height elevation, control joints, edge profiles and trims, life safety devices and other miscellaneous items that must be integrated with soffit system.
- 1.5.7 Delegated Design Submittals:
- .1 Engineering design completion of linear metal soffit work is delegated to Contractor based on structural design criteria indicated in Contract Documents.
  - .2 Submit Shop Drawings for work of this Section that bear the stamp of a Professional Engineer registered in Province of Ontario.
  - .3 Submit copy of structural calculations upon request by Consultant.
- 1.5.8 Samples:
- .1 Initial Selection: For Products requiring colour, texture, or design selection, submit manufacturer's list of finishes or colour swatches for Consultant's selection.
  - .2 Verification Samples: Submit verification samples confirming colour and finish selections:
    - .1 Acoustical Panels: each type, colour, pattern, and texture; minimum 150 by 150 mm (6 by 6 in.) size.
    - .2 Exposed Suspension System, Mouldings, Trim: each type, finish, and colour; minimum 150 mm (6 in) long.
    - .3 Clips: Each type of hold-down and seismic clip

## **1.6 CLOSEOUT SUBMITTALS**

- 1.6.1 General Requirements and Procedures for Closeout Submittals: in accordance with Section 01 78 00, Closeout Submittals.
- 1.6.2 Operating and Maintenance Data: Submit care and maintenance instructions for linear metal soffits to be included in operation and maintenance manual. Include precautions for use of and composition of cleaning materials detrimental to acoustic panels and accessories.
- 1.6.3 Warranty Documentation: Submit copy of extended warranties specified in this Section.

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**1.7     MAINTENANCE MATERIAL SUBMITTALS**

- 1.7.1 Panel Removal Tools: Provide Owner with acoustical soffit removal devices of type suitable for removal of linear metal soffit assemblies.

**1.8     QUALITY ASSURANCE**

- 1.8.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.
- 1.8.2 Installer Qualifications: Engage an entity with experience installing, erecting, or assembling work similar in material, design, and extent to that shown, and whose work has resulted in construction with a track record of successful in-service performance.
- .1 Certification: Installer must be trained and certified by manufacturer.
- 1.8.3 Professional Engineer's Qualifications: Employ Professional Engineer licensed to practice in Province of Ontario who carries professional liability insurance and has at least five years' experience providing engineering services of similar kind, scope, and complexity.
- .1 Professional Engineer's Responsibility:
- .1 production and review of Shop Drawings,
- .2 design and certification of soffit, including attachments for building construction, in accordance with applicable codes and regulations,
- .3 stamping and signing of each Shop Drawing and associated calculations.
- 1.8.4 Single Source Responsibility: Obtain primary materials such as soffit panels and suspension assemblies from a single source by a single manufacturer, and secondary materials such as sealants from sources recommended by manufacturers of primary materials.
- 1.8.5 Mock-Ups: Construct mock-ups to verify selections made under submittals, demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
- .1 Location: In-situ (i.e., first installation), as directed on site by Consultant.
- .2 Purpose: To set benchmarks for installation and to judge subsequent work. Maintain Mock-ups during construction in undisturbed condition.
- .3 Reviewed mock-ups: may become part of the completed work if undisturbed at the time of Substantial Performance of The work, provided they are undisturbed, and comply with requirements outlined in Contract Documents.

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**1.9 DELIVERY, STORAGE AND HANDLING**

- 1.9.1 General Product Requirements: in accordance with Section 01 61 00, Common Product Requirements. Deliver, store and handle linear metal soffit materials in accordance with manufacturer's written instructions.
- 1.9.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.9.3 Deliver linear metal soffit and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- 1.9.4 Replace defective or damaged materials with new.

**2 . PRODUCTS**

**2.1 MANUFACTURERS**

- 2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:
  - .1 Armstrong World Industries
  - .2 CGC/USG Inc.
  - .3 Hunter Douglas
  - .4 Rockfon

**2.2 PERFORMANCE / DESIGN CRITERIA**

- 2.2.1 Structural Performance: Provide linear metal soffit systems capable of withstanding effects of following loads, and stresses:
  - .1 Wind Loads: As indicated on Drawings, determined in accordance with requirements of Ontario Building Code for the geographical location of the project (1 in 50-year return probability), but not more than 0.96 kPa (20 psf).
  - .2 Seismic Performance:
    - .1 Design: linear metal soffit assemblies must withstand effects of earthquake motions in compliance with requirements of Ontario Building Code as validated by a Professional Engineer.
    - .2 Installation: Install system to requirements of ASTM E580 for Seismic Design Category D, E, F.
- 2.2.2 Surface Burning Characteristics: to ASTM E84, tested by a qualified agency. Products must be marked with certification of testing agency and demonstrate following characteristics:
  - .1 Flame-Spread Index: not more than 0

- .2 Smoke Developed Index: not more than 0

## **2.3 LINEAR METAL SOFFIT SYSTEM**

- 2.3.1 Material Tag: This item is identified as "S1/S2" on Drawings and Schedules.
- 2.3.2 General Description: manufacturer's standard linear metal soffit system conforming to ASTM E1264 consisting of metal soffit panels for installation in specialty suspension systems.
- 2.3.3 Material:
- .1 Aluminum: 0.61 mm (0.024 in) thick, conforming to ASTM B209/B209M; minimum 85% recycled content.
  - .2 Surface Quality: Exposed surfaces must be smooth, flat, and free from blemishes including pitting, seam marks, roller marks, roughness, stains, or discolorations.
- 2.3.4 Panel Configuration:
- .1 Width: 200 mm (8 in)
  - .2 Depth: 16 mm (5/8 inch)
  - .3 Length: Custom length cut to suit soffit dimensions (2436 mm / 96 in)
- 2.3.5 Edge Detail: Square unless indicated otherwise.
- 2.3.6 Perforations (M1 / SOLID): 0% open area
- 2.3.7 End Caps: To match linear metal soffit panels.
- 2.3.8 Filler Strips: Manufacturer's standard.
- .1 Finish: To match linear metal soffit panels.
- 2.3.9 Installation Pattern: As indicated on reviewed Shop Drawings..
- 2.3.10 Colours and Finishes:
- .1 Metallic Colour Finish: to match "Fluoropon Continuum Celestial Silver"
- 2.3.11 Basis-of-Design Products: "Armstrong Metalworks" by Armstrong World Industries or approved equivalent by manufacturers indicated in this Section.

## **2.4 SUSPENSION SYSTEMS**

- 2.4.1 Suspension Systems: manufacturer's specialty pre-slotted suspension systems, including carriers, runners, splice sections, connector clips, alignment clips, levelling clips, hangers, mouldings, trims, and other necessary components to support linear metal soffit and other soffit-supported elements.
- .1 Manufacturing standard: to ASTM C635/C635M.
  - .2 Structural Classification: Heavy-duty.

- 2.4.2 Attachment Devices: must be capable of supporting 5 times the design load specified in ASTM C635/C635M, Table 1, complete with load test data from an independent test laboratory certifying performance.
- 2.4.3 Wire Hangers, Braces, and Ties: galvanized, soft-annealed, mild steel wire conforming to ASTM A641/A641M, Class 1 zinc coating, soft temper; not less than 2.70 mm (12 ga) diameter.
- 2.4.4 Perimeter Detail: manufacturer's standard perimeter support framing.

## **2.5      ACCESSORIES AND AUXILIARY MATERIALS**

- 2.5.1 Provide necessary associated accessories and auxiliary materials required to provide complete installation of linear metal soffit work. Ensure such materials are recommended in writing by linear metal soffit manufacturer for intended use and are compatible with adjacent materials.
- 2.5.2 Exposed Metal Edge Mouldings and Trim: Provide manufacturer's standard components and accessories as required for concealment or trimming of soffit penetrations, edge pans and runners, fixture trim and adapters, fasciae at soffit height changes, and other conditions.
  - .1 Metal and Finish: to match linear metal soffit units unless otherwise indicated.
- 2.5.3 Access Panels: Manufacturer's standard access and inspection hatches designed to accommodate field cuts and fit with acoustical soffits.
- 2.5.4 Hold-Down Clips and Inserts: Manufacturer's standard hold-down clips and inserts required to secure linear metal soffit systems at perimeter and other locations required by manufacturer.
- 2.5.5 Seismic Clips: Manufacturer's standard seismic clips designed to secure linear metal soffit in place during seismic event demonstrating compliance to ASTM E580.

## **2.6      finishes**

- 2.6.1 Generally : Comply with requirements in NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for finish application and designation.
- 2.6.2 Surface Protection: Before shipping, protect exposed surfaces of linear metal soffit with removable, temporary protective covering that will not remain adhered to pans.

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### **3 . EXECUTION**

#### **3.1 EXAMINATION**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation.
- 3.1.2 Review substrates, areas, and conditions, including faming required for installation of linear metal soffits. Check for compliance with installation tolerances and conditions that may detrimentally affect performance of linear metal soffits.
- 3.1.3 Examine linear metal soffits before installation. Reject linear metal soffits that are wet, moisture -damaged, or mould-damaged.
- 3.1.4 Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- 3.2.1 Measure each soffit area and establish layout of linear metal soffits to balance border widths at opposite edges of each soffit. Do not use less-than-half-width panels at borders unless otherwise indicated; comply with layout shown on reflected soffit plans.
- 3.2.2 Arrange for penetrations to be centered on items which they penetrate.

#### **3.3 INSTALLATION**

- 3.3.1 Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings.
- 3.3.2 Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.
- 3.3.3 Installation standards:
  - .1 Linear metal soffits: in accordance with ASTM C636/C636M and CISCA's "Soffit System Handbook."
  - .2 Seismic installations: in accordance with ASTM E580.
- 3.3.4 Soffit Hangers Installation: Install hangers plumb; do not permit contact with insulation, sound blocking or other elements not forming part of linear metal soffit assembly.
- 3.3.5 Hanger Spacing: Space hangers at maximum 1220 mm (48 inches) on-center; provide closer placement near member ends as required and in accordance with manufacturer's instructions.
  - .1 Attach hangers to building's structural members. Do not attach to steel deck tabs, bottom chord of open web steel joists or steel roof deck.

- 3.3.6 Splaying: Only splay hangers to avoid obstructions when necessary; counteract horizontal forces with appropriate measures in accordance with ASTM C636/C636M and manufacturer's instructions.
- .1 Where hanger spacings are affected by ducts or other constructions within soffit plenum, provide additional supports as required to increase load-carrying capacity of soffit suspension system commensurate with actual center-to-center hanger distances used.
- 3.3.7 Perimeter Mouldings and Trim: Attach mouldings to substrates at manufacturer-specified intervals but not more than 406 mm (16 in) o.c.; ensure proper level alignment with soffit system. Visible fasteners on moldings and trim are not permitted.
- 3.3.8 Main Runners and Cross-Tees: Install runners and cross-tees square, securely interlocked, and free from damage. Ensure cross-tees are installed at right angles to main runners.
- .1 Tolerances: Ensure suspension system is level to within 6 mm in 3 m (1/4 in in 10 ft) and square to within 1.5 mm in 610 mm (1/16 in in 2 ft).
- 3.3.9 Soffit Installation:
- .1 Install soffits with flush, tight joints between adjoining units. Scribe and cut units for precise fit at room borders and around areas penetrating soffit. Provide pan splices as required.
- .2 Cut and fit linear metal soffit accurately around borders, interruptions, and penetrations, in accordance with manufacturer's instructions.
- .3 Joints Alignment: Align joints uniformly; follow room axes unless indicated otherwise on reflected soffit plans.
- .4 Provide end caps on visible ends of soffits, unless installation of perimeter trims is required. Provide filler strips as required.

### **3.4 PROTECTION**

- 3.4.1 Protect linear metal soffits from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades.
- 3.4.2 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in writing by affected material's manufacturer.
- 3.4.3 Do not use materials or processes that can damage finishes, surfaces, or construction.
- 3.4.4 Promptly replace Linear Metal Soffit Panels work damaged during construction that cannot be satisfactorily repaired.



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**3.5     CLEANING AND WASTE MANAGEMENT**

- 3.5.1    Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
- 3.5.2    Clean exposed surfaces of linear metal soffits. Comply with manufacturer's written instructions for cleaning and touch up of minor finish damage.
- 3.5.3    Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**END OF SECTION**

## **1. GENERAL**

### **1.1 GENERAL INSTRUCTIONS**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 SUMMARY**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the glass-faced rainscreen cladding panels work specified herein. This includes, but is not necessarily limited, to:
  - .1 Glass-faced rainscreen cladding panel system.
  - .2 Accessories including sub-framing, associated flashings, closures, and sealants required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

### **1.3 REFERENCES**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

### **1.4 DEFINITIONS**

- 1.4.1 PER: Pressure equalized rainscreen system; rainscreen system designed for no water intrusion with equal pressure between interior system cavity and outside cladding barrier.

### **1.5 PREINSTALLATION MEETINGS**

- 1.5.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.

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- 1.5.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
- .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.
  - .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.
  - .3 Agenda:
    - .1 Review progress of related construction activities and preparations for particular activity under consideration.
    - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
    - .3 Review and finalize construction schedule and verify availability of materials, personnel, equipment, and facilities needed to make progress and avoid delays.
    - .4 Review methods and procedures for glass-faced rainscreen cladding panel installation, including manufacturer's instructions.
    - .5 Examine supports, including alignment and attachment to structural members.
    - .6 Review flashing, details, penetrations, openings, and conditions of other elements that may affect glass-faced rainscreen cladding panels.
    - .7 Discuss governing regulations, insurance, certificates, tests, and inspections as applicable.
    - .8 Review temporary protection requirements for glass-faced rainscreen cladding panels before, during and after installation.
    - .9 Discuss procedures repair procedures for glass-faced rainscreen cladding panels where permitted by Consultant.
  - .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
  - .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

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**1.6 SUBMITTALS**

- 1.6.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.6.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for glass-faced rainscreen cladding panels work specified in this Section.
- 1.6.3 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:
  - .1 Include plans, elevations, sections and details as applicable.
  - .2 Illustrate fabrication and installation layouts of glass-faced rainscreen cladding panels such as details of edge conditions, joints, panel profiles, corners, anchoring, attachment assembly, trims, flashings, closures, accessories and other special conditions.
  - .3 Scale for details of flashings, trims and anchorages: minimum 1:10 (1-1/2 inches per 12 inches).
  - .4 Indicate field-measured dimensions on Shop Drawings.
- 1.6.4 Effective R-Value Thermal Performance Report: Submit analysis report demonstrating that glass-faced rainscreen cladding assemblies, including framing components, as proposed by Contractor, meet thermal and structural performance requirements established by Contract Documents. As a minimum, report must include the following:
  - .1 Each wall's nominal R-value and effective R-value.
  - .2 Clip spacing (vertical and horizontal).
  - .3 Maximum allowable wind loads, demonstrating compliance with requirements specified in this Section.
  - .4 Cladding dead loads, demonstrating compliance with requirements specified in this Section.
  - .5 Fastener types.
- 1.6.5 Delegated Design Submittals:
  - .1 Engineering design completion of glass-faced rainscreen cladding panels work is delegated to Contractor based on structural design criteria indicated in Contract Documents.
  - .2 Submit Shop Drawings for work of this Section that bear the stamp of a Professional Engineer registered in Province of Ontario.
  - .3 Submit copy of structural calculations upon request by Consultant.

- 1.6.6 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
- .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
  - .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
  - .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.6.7 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:
- .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.
  - .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.6.8 Samples: Submit selection and verification samples for Products requiring colour, texture, or design selection. Submit manufacturer's list of finishes or colour swatches for Consultant's selection.
- .1 As a minimum submit samples of the following:
    - .1 Glass-faced rainscreen cladding panels: Submit two (2), 305 mm (12 inches) long by actual panel width. Include fasteners, closures, and other glass-faced rainscreen cladding panel accessories demonstrating system's water-management and pressure-equalization characteristics.

## **1.7 CLOSEOUT SUBMITTALS**

- 1.7.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.
- 1.7.2 Operating and Maintenance Data: Submit care and maintenance instructions for glass-faced rainscreen cladding panels to be included in building operation and maintenance manual.
- 1.7.3 Warranty Documentation: Submit copy of extended warranties specified in this Section.

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**1.8 QUALITY ASSURANCE**

- 1.8.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.
- 1.8.2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.
  - .1 Certifications: Installer must be certified by manufacturer. Submit proof of certification upon request.
- 1.8.3 Professional Engineer's Qualifications: Employ Professional Engineer licensed to practice in Province of Ontario who carries professional liability insurance and has at least five years' experience providing engineering services of similar kind, scope, and complexity.
  - .1 Professional Engineer's Responsibility:
    - .1 production and review of Shop Drawings,
    - .2 design and certification of glass-faced rainscreen cladding panels, including attachments for building construction, in accordance with applicable codes and regulations,
    - .3 stamping and signing of each Shop Drawing and associated calculations.
- 1.8.4 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.
- 1.8.5 Mock-Ups / First Installation Review: Construct mock-ups to verify selections made under submittals, demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - .1 Location: In-situ (i.e. first installation), as directed on site by Consultant.
  - .2 Build mockup of typical glass-faced rainscreen cladding panel assembly including corner, soffits, supports, attachments, and accessories.
  - .3 Water-Spray Test: Conduct water-spray test of glass-faced rainscreen cladding panel assembly mockup for water penetration in accordance with AAMA 501.2.

- .4 Purpose: To perform testing and set benchmarks for installation and to judge subsequent work. Maintain Mock-ups during construction in undisturbed condition.
- .5 Reviewed mock-ups: May become part of the completed work if undisturbed at the time of Substantial Performance of The work, provided they are undisturbed, and comply with requirements outlined in Contract Documents.

**1.9 DELIVERY, STORAGE AND HANDLING**

- 1.9.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.
- 1.9.2 Deliver, store and handle glass-faced rainscreen cladding panels materials in accordance with manufacturer's written instructions.
- 1.9.3 Store panels horizontally on pallets in a dry, well-ventilated space, under temporary or permanent shelter.
- 1.9.4 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.9.5 Prevent contact with other materials to avoid staining, denting, or other damage to glass-faced rainscreen cladding panels.
- 1.9.6 Replace defective or damaged materials with new.

**1.10 FIELD CONDITIONS**

- 1.10.1 Field Measurements: Verify actual dimensions of construction contiguous with glass-faced rainscreen cladding panels by field measurements before fabrication.

**1.11 COORDINATION**

- 1.11.1 Coordinate glass-faced rainscreen cladding panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, weather-tight, secure, and noncorrosive installation.

**1.12 WARRANTY**

- 1.12.1 Extended warranty: Submit for Owner's review and acceptance, manufacturer's extended warranty in which manufacturer commits to repair or replace components of glass-faced rainscreen cladding panels that fail within specified warranty period. Manufacturer's extended warranty is in addition to, and does not supersede, any other rights that Owner may have under Contract Documents.
  - .1 Failures include, but are not limited to, the following:
    - .1 Structural failures, including rupturing, cracking, or puncturing.

- .2 Deterioration of metals and other materials beyond normal weathering.
- .2 Warranty Period: Not less than 10 years from date of Substantial Performance of The work.
  - .1 Special Warranty on Finishes: not less than 30 from date of Substantial Performance of The work.

## **2 . PRODUCTS**

### **2.1 SYSTEMS AND FABRICATORS**

- 2.1.1 Provided requirements of Contract Documents are satisfied, the following fabricators may supply their systems for work this Section:
  - .1 Basis-of-Design: Materials specified in this Section are based on “StoVentec Glass” as supplied by Sto.
- 2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

### **2.2 PERFORMANCE / DESIGN CRITERIA**

- 2.2.1 Glass-faced rainscreen cladding panel system must be designed to withstand project-specific design loads and their effects within constraints specified in this Section and Ontario Building Code without defects, damage, or failure, including but not limited to the following:
  - .1 Dead Loads: Including those transferred from structural elements.
  - .2 Environmental Loads: Such as wind, snow, rain, hydrostatic, seismic and earth pressures as applicable.
  - .3 Live Loads: Including those arising from use and occupancy.
  - .4 Loads from Temperature and Moisture Loads: Including expansion, contraction, deflection, deformation, creep, shrinkage, settlement, and differential movement.
  - .5 Fire Loads: as determined by fire performance testing specified.
- 2.2.2 Employ a qualified professional engineer, as specified in this Section, to design and certify aluminum panel assemblies, including attachment to building construction.
- 2.2.3 Intended aesthetics: Drawings and Specifications provide requirements regarding system’s aesthetic and performance criteria. Unless indicated otherwise, preserve intended aesthetic effects. For any proposed deviations, provide detailed explanation to Consultant for evaluation. Acceptance or rejection of proposed deviations rests solely with Consultant.
- 2.2.4 Moisture Control and Weathertightness:



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- .1 Air Infiltration: Air leakage of not more than 0.6 L/s/m<sup>2</sup> (0.12 cfm/sq. ft.) when tested according to ASTM E283 at 75 Pa (1.57 psf) test pressure differential.
  - .2 Water Penetration (Static Pressure): No water penetration when tested according to ASTM E331 at 300 Pa (6.24 psf) test pressure differential.
  - .3 Water Penetration (Dynamic Pressure): No water penetration when tested according to AAMA 501.1 at 300 Pa (6.24 psf) test pressure differential.
  - .4 Building Enclosure Design Principle: Exterior envelope construction for this Project is based on "Rain Screen" design principle, as recommended by National Research Council of Canada. Face sealed assemblies are not permitted.
    - .1 Continuity: Maintain integrity and continuity of building enclosure's thermal, air, and vapour control layers at all times by using appropriate insulation, air barriers, vapour retarders to tie work of this Section with adjacent construction.
    - .2 Design for compartments to achieve appropriate pressure equalization in exterior cladding system.
  - .5 Incorporate means of draining moisture to exterior. Drainage system must provide clear, internal paths of drainage of trapped moisture within Glass-faced rainscreen assemblies to exterior of wall assemblies.
  - .6 System must discharge water in manner that avoids staining of architectural finishes, formation of puddles or formation of icicles.
- 2.2.5 Structural Performance: Provide Glass-faced rainscreen panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E330:
- .1 Wind Loads: As indicated on Drawings, determined in accordance with OBC requirements (5.2.2.2. Determination of Wind Load) for the geographical location of the project (1 in 50-year return probability).
  - .2 Allowable deflection normal to the plane of the wall for back-up wall construction: L/300
  - .3 Design glass, including comprehensive engineering analysis according to CAN/CGSB-12.20 or equivalent to ASTM E1300 by a Professional Engineer licensed to practice in the Province of Ontario, using the design criteria indicated.
  - .4 Design Wind Pressures: Determine design wind pressures applicable to Project according to the requirements of the

Ontario Building Code, based on heights above grade indicated on Drawings.

- .5 Probability of Breakage for Glazing: Design glass for a probability of breakage not greater than 1 in 1000 for glass installed in sloped applications and 8 in 1000 for glass installed in vertical applications.
  - .6 Differential Shading: Design glass to resist thermal stresses induced by differential shading within glazing.
- 2.2.6 Seismic Performance: Provide products and systems specified in this Section to withstand the effects of earthquake motions in accordance with OBC 4.1.8.18 and CAN/CSA S832.
- .1 Professional engineer specified in Division 01 and referenced in this Section shall be responsible for designing systems and submitting signed and sealed analysis data and Shop Drawings illustrating seismic-resistant systems.
  - .2 Refer to Structural Drawings for seismic sensitivity values.
- 2.2.7 Thermal Movements: fabricate and install Glass-faced rainscreen panel systems to prevent buckling, opening up of joints and overstressing of welds and fasteners under the following temperature conditions:
- .1 Temperature Change: ambient temperature cycling of - 30 deg C (-22 deg F) to 82 deg C (180 deg F) over a 12 hour period.
  - .2 Account for thermal stresses, drilling impacts, or other causes before or during Glass-faced rainscreen installation. Implement handling and storage methods for Glass-faced rainscreen panels to reduce such stresses.
- 2.2.8 System Fire Propagation Characteristics: Wall assemblies containing Glass-faced rainscreen panels must meet requirements of CAN/ULC S134 within limits specified by Ontario Building Code but generally as follows:
- .1 Flaming on or in wall assembly: must not spread more than 5 m above opening.
  - .2 Heat flux during flame exposure: less than 35 kW/m<sup>2</sup> measured at 3.5 m above opening.

## **2.3 GLASS-FACED RAINSCREEN CLADDING PANELS**

- 2.3.1 Material Tag: This item is noted as "EW10" on Drawings and Schedules.
- 2.3.2 Glass Panel: pre-fabricated panel with 8mm (0.31 in) opaque, heat soaked and fully tempered glass fully bonded with silicone adhesive to manufacturer's standard 20 mm carrier profile.

- 2.3.3 Base Material: ASTM C1048 Type I; Quality-Q3; Class I (clear); Kind FT or equivalent to CAN/CGSB-12.1. Perform heat strengthening using horizontal tong free method; surface compression not less than 69 MPa (10,000 psi). Glazing must comply with testing requirements in 16 CFR 1201 for Category II materials.
- .1 Heat-Soaking: Provide in-line heat soaking of tempered glass in accordance with BS EN 14179 (2 hour dwell at 290°C±10°C)
- 2.3.4 Joint Type: Dry.
- 2.3.5 Surface Burning Characteristics:
- .1 Compliance: CAN/ULC S114.
- .2 Combustibility: Non-combustible.

## **2.4 AUXILIARY MATERIALS**

- 2.4.1 Wall Brackets: 2 mm stainless steel or minimum 3 mm aluminum x 70 mm – 320 mm sliding point brackets, and 2.5 mm stainless steel or minimum 3 mm aluminum x 70 mm – 320 mm fixed point brackets. Brackets to be spaced and connected to supporting structure as required in accordance with manufacturer's written instructions.
- 2.4.2 Vertical Profiles: T-Profiles made of aluminum alloy EN AW 6063 Temper 6 or EN AW 6005A Temper 5, with 2.7 mm x 90 mm plate and 2.4 mm x 52.7 mm leg, in lengths to 3 m, are attached to wall brackets using stainless steel screws. Wall brackets to be positioned. Spacing of T-Profiles to be as required by engineering analysis.
- 2.4.3 Panel Agraffe profiles: 62.5 mm x 28.8 mm, manufactured from aluminum alloy EN AW 6063 Temper 6 or EN AW 6005A Temper 5 and pre-mounted to carrier boards using stainless steel screws.
- 2.4.4 Metal Sub-framing and Furring: Minimum 1.219 mm (18 ga.) thick, cold-formed, galvanized sheet steel conforming to ASTM C645. Protective Coating: Hot-dip galvanized Z275 (G90) coating to ASTM A653/A653M.
- .1 Transfer Grid: Provide manufacturer's standard sections as required for support and alignment of glass-faced rainscreen cladding panel system consisting of hat bars, Z-bars, adjustable Z-bars or combination thermal clip and transfer grids as noted on Drawings.
- .2 Material visible after assembly: finished to match panels.
- 2.4.5 Thermally-Broken Sub-framing: Low-conductivity thermally-broken, intermittent structural attachment insulation clips designed maintain

insulation effectiveness, with adjustable depth and suitable for vertical and horizontal sub-girts.

- .1 Basis-of-Design: “Cascadia Clip” by Cascadia Windows
- .2 Acceptable Products:
  - .1 “ISO Clip” by Northern Facades Ltd.
  - .2 “TAC Thermal Spacer” Exterior Technologies Group
  - .3 “TClip Thermally Broken Façade Substructure” by Engineered Assemblies
  - .4 “NVELOPE NV1 Cladding Attachment System” by SFS Group.

**2.4.6 Panel Accessories:**

- .1 Perimeter Components and Trim: Use extruded or formed aluminum. Do not use galvanized steel clips or aluminum angles for panel-to-panel attachment. Fabricate flashings from glass-faced rainscreen cladding panel material and finish with same finish system as adjacent glass-faced rainscreen cladding panels.
  - .1 Locations: Generally, provide flashings at locations including, but not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, fasciae, parapet caps, soffits, reveals, and fillers as required to provide finished appearance and divert water away from wall assemblies.
- .2 Opening head and sill flashing:
  - .1 Material: Minimum 26 ga steel.
  - .2 Head Flashing: Attach with silicone or mechanical fasteners at top of opening, treated with air barrier.
  - .3 Sill Flashing: Attach with silicone at bottom, reinforced with additional fasteners.
- .3 Opening jamb detail:
  - .1 Material: Minimum 26 ga steel for jamb profile.
- .4 Accessories: Provide components required for a complete, watertight and airtight Glass-faced rainscreen cladding panel assembly including, but not limited to, trims, copings, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar elements. Match material and finish to glass-faced rainscreen cladding system unless otherwise indicated.

**2.4.7 Fire Blocks: Manufacturer’s standard to comply with OBC and ASTM E2307.**

- 2.4.8 Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching colour of glass-faced rainscreen cladding systems by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- 2.4.9 Air Barrier/Vapour Retarder: Manufacturer's standard as required for application and compatible with type specified in 07 27 14 - Self-Adhering Sheet Air Barriers and Vapour Retarders.
  - .1 Basis-of-Design: StoGuard VaporSeal R
- 2.4.10 Insulation: Manufacturer's standard as required for application and compatible with type specified in 07 21 00 - Thermal Insulation.

## **2.5 FABRICATION**

- 2.5.1 Factory Fabrication: Fabricate panels in accordance with manufacturer's instructions as required to meet performance requirements specified in this Section. Comply with indicated profiles, dimensions, and structural requirements specified in Contract Documents.
- 2.5.2 Visual Quality: Provide sharp, clean edges without displacement of glass-faced rainscreen cladding panels. Minimize oil canning.
- 2.5.3 Joints: Provide factory-installed captive gaskets or separator strips to ensure weathertightness and noise reduction.

## **2.6 FINISHES**

- 2.6.1 Protect mechanical and painted finishes on exposed surfaces from damage by applying strippable, temporary protective covering that will not remain adhered to panels in the field before shipping.
- 2.6.2 Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- 2.6.3 Appearance of Finished Work: Noticeable variations in same piece of glass-faced rainscreen cladding are not acceptable. Variations in appearance of other components are acceptable if they are within range of Samples reviewed by Consultant and are assembled or installed to minimize contrast.

## **3 . EXECUTION**

### **3.1 EXAMINATION**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions

which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.

- .1 Examine wall framing to verify that girts, angles, channels, studs, and other panel support members and anchorages have been installed within alignment tolerances required by glass-faced rainscreen cladding panel manufacturer.
  - .2 Examine wall sheathing to ensure that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by glass-faced rainscreen cladding panel manufacturer.
  - .3 Verify that air-barriers and vapour-retarders have been installed over sheathing or backing substrate to prevent air infiltration and water penetration.
- 3.1.2 Examine roughing-in for components and assemblies penetrating glass-faced rainscreen cladding panels to verify actual locations of penetrations relative to seam locations of glass-faced rainscreen cladding panels before installation.
- 3.1.3 Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- 3.2.1 Install subframing, furring, thermally-broken sub framing and other miscellaneous panel support members and anchorages according to ASTM C754 and glass-faced rainscreen cladding panel manufacturer's written recommendations.

### **3.3 INSTALLATION**

- 3.3.1 Installation, generally: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.
- 3.3.2 Install panels perpendicular to supports unless otherwise indicated. Anchor glass-faced rainscreen cladding panels and other components of the Work securely in place, with provisions for thermal and structural movement.
- 3.3.3 Fasteners: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
- 3.3.4 Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by glass-faced rainscreen cladding panel manufacturer.

- 3.3.5 Flash and seal glass-faced rainscreen cladding panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air barriers, vapour retarders, and flashings that will be concealed by glass-faced rainscreen cladding panels are installed.
- 3.3.6 Provide weathertight escutcheons for pipe- and conduit-penetrating panels. Seal with manufacturer's recommended sealants.
- 3.3.7 Fasteners: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
- 3.3.8 Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

### **3.4 ERECTION TOLERANCES**

- 3.4.1 Installation Tolerances: Shim and align glass-faced rainscreen cladding panel units within installed tolerance of 1:1000 (1 inch in 80 feet), non-accumulative, on level, plumb, and location lines as indicated, and within 5% offset of adjoining faces and of alignment of matching profiles.

### **3.5 FIELD QUALITY CONTROL**

- 3.5.1 Manufacturer's Field Service: Engage a site representative qualified by glass-faced rainscreen cladding panel manufacturer to inspect substrate conditions, surface preparation, panel application, flashings, protection, and drainage components, and to Supply reports to Consultant.
- 3.5.2 Glass-faced rainscreen cladding panels will be considered defective if they do not pass tests and inspections.
- 3.5.3 Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- 3.5.4 Prepare test and inspection reports.

### **3.6 PROTECTION**

- 3.6.1 Protect glass-faced rainscreen cladding panels from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades.
- 3.6.2 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in

writing by affected material's manufacturer. Do not use materials or process that can damage finishes, surfaces, or construction.

- 3.6.3 Promptly replace glass-faced rainscreen cladding panels work damaged during construction that cannot be satisfactorily repaired.
- 3.6.4 Remove temporary protective coverings and strippable films as glass-faced rainscreen cladding panels are installed. On completion of glass-faced rainscreen cladding panel installation, clean finished surfaces as recommended by glass-faced rainscreen cladding panel manufacturer. Maintain in a clean condition during construction.

### **3.7 CLEANING AND WASTE MANAGEMENT**

- 3.7.1 Cleaning and Waste Management, generally: in accordance with Section 01 74 00, Cleaning and Waste Management.
- 3.7.2 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
- 3.7.3 Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**END OF SECTION**



## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the steel siding panels work specified herein. This includes, but is not necessarily limited, to:
  - .1 Steel siding wall panels.
  - .2 Accessories including associated flashings, closures, sealants required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.
  - .1 Related requirements provided below are for convenience purposes only.
    - .1 Section 06 16 00 - Sheathing.
    - .2 Section 07 21 00 - Thermal Insulation.
    - .3 Section 07 92 00 - Joint Sealants.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Preinstallation Meetings**

- 1.4.1 Pre-installation Meetings: Schedule, and conduct pre-installation meeting at Project Site, in order to coordinate work of this Section, with work of related Subcontractors.

- .1 Ensure attendance of Subcontractor performing work of this Section and representatives of manufacturers and fabricators involved in, or affected by, installation and coordination with other materials and installations that have preceded or will follow. Advise Consultant and Owner in advance of scheduled meeting dates.
- .2 Agenda: Review progress of other construction activities and preparations for the particular activity under consideration.
- .3 Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
- .4 Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
- .5 Meet with Owner, Consultant, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of doors, windows, and louvers.
- .6 Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
- .7 Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
- .8 Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
- .9 Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal panels.
- .10 Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
- .11 Review temporary protection requirements for metal panel assembly during and after installation.
- .12 Review of procedures for repair of metal panels damaged after installation.
- .13 Document proceedings, including corrective measures and actions required, and Supply copy of record to each participant.

## **1.5 Action Submittals**

- 1.5.1 General Requirements and Procedures for Submittals: In accordance with Section 01 33 00, Submittal Procedures.
- 1.5.2 Product Data: Submit for each type of product.

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- .1 Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- 1.5.3 Product Disclosure and Transparency:
  - .1 Environmental Product Declarations (EPD): When available, submit Product-specific Type III EPD or industry-wide (generic) EPD conforming to ISO 14025 or other recognized environmental product declaration framework.
  - .2 Material Ingredient Reporting: When available, submit documentation demonstrating chemical inventory of materials to at least 0.1% (1000ppm) and conforming to one of the following:
    - .1 Health Product Declaration open Standard,
    - .2 Cradle to Cradle v2 Basic level or Cradle to Cradle v3 Bronze level,
    - .3 International Living Future Institute Declare
    - .4 Other approved framework.
  - .3 When multiple Products are specified, give preference to Products with compliant documentation.
- 1.5.4 Shop Drawings:
  - .1 Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
- 1.5.5 Delegated Design Submittals:
  - .1 Engineering design completion of aluminum composite material wall panels work is delegated to Contractor based on structural design criteria indicated in Contract Documents.
  - .2 Submit Shop Drawings for work of this Section that bear the stamp of a Professional Engineer registered in Province of Ontario.
  - .3 Submit copy of structural calculations upon request by Consultant.
- 1.5.6 Samples: Submit for each type of metal panel indicated on Drawings and Schedules with factory-applied finishes.
  - .1 Include Samples of trim and accessories involving colour selection.
  - .2 Metal Panels: 305 mm (12 inches) long by actual panel width. Include fasteners, closures, and other metal panel accessories.

- 1.5.7 Submit for Consultants review, QA checklist used as part of installation process. Make modifications to QA checklist based on Consultant feedback

**1.6 Closeout Submittals**

- 1.6.1 Maintenance Data: Submit for metal panels to include in maintenance manuals.

**1.7 Quality Assurance**

- 1.7.1 Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- 1.7.2 Mock-ups: Build mock-ups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  - .1 Build mock-up of typical metal panel assembly as designated on site by Consultant, including corner, supports, attachments, and accessories.
  - .2 Review of mock-ups does not constitute approval of deviations from the Contract Documents contained in mock-ups unless Consultant specifically approves such deviations in writing.
  - .3 Reviewed mock-ups may become part of the completed Work if undisturbed at time of Substantial Performance of the Work.

**1.8 Delivery, Storage, And Handling**

- 1.8.1 Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- 1.8.2 Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- 1.8.3 Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- 1.8.4 Retain strippable protective covering on metal panels during installation.

**1.9 Field Conditions**

- 1.9.1 Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

**1.10     Coordination**

- 1.10.1 Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

**1.11     Warranty**

- 1.11.1 Extended Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

- .1 Failures include, but are not limited to, the following:
  - .1 Structural failures including rupturing, cracking, or puncturing.
  - .2 Deterioration of metals and other materials beyond normal weathering.
- .2 Warranty Period: Two years from date of Substantial Performance of the Work.

- 1.11.2 Extended Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

- .1 Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
  - .1 Colour fading more than 5 Hunter units when tested according to ASTM D 2244.
  - .2 Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
  - .3 Cracking, checking, peeling, or failure of paint to adhere to bare metal.
- .2 Finish Warranty Period: 20 years from date of Substantial Performance of the Work.

**2 .     PRODUCTS**

**2.1     Manufacturers**

- 2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.
- .1 Agway Metals Inc.;
  - .2 Morin; a Kingspan Group company;

.3 Vicwest;

.4 West-Form Metals;

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

## **2.2 Design And Performance Requirements**

2.2.1 Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads in accordance with requirements of Ontario Building Code, and CSA-S136:

.1 Determine specified loads, principal and companion load factors, building importance category, and load distributions in accordance with requirements of Ontario Building Code.

.1 Wind Loads: Determined in accordance with OBC requirements for geographical location of project, with 1 in 50 year return probability.

.2 Design steel cladding components to be adequately interconnected and adequately fastened to structural supports to sustain loads.

.3 Deflection of sheet steel cladding components due to uniformly distributed specified loads (eg. wind, snow) shall not exceed 1/90 of the span for walls, nor 1/180 of the span for roofs.

.4 Deflection Limits: for uniformly distributed specified loads (eg. wind, snow), no greater than 1/180 of the span.

.5 Wherever structural framing permits, and subject to reasonable limitations for handling, design and fabricate cladding to span continuously over at least four structural supports (three spans).

2.2.2 Seismic Performance: Provide products and systems specified in this Section to withstand the effects of earthquake motions in accordance with OBC 4.1.8.18 and CAN/CSA S832.

.1 Professional engineer specified in Division 01 and referenced in this Section shall be responsible for designing systems and submitting signed and sealed analysis data and Shop Drawings illustrating seismic-resistant systems.

.2 Refer to Structural Drawings for seismic sensitivity values.

2.2.3 Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

- .1 Temperature Change (Range): 67 deg C (120 deg F), ambient; 100 deg C (180 deg F), material surfaces.

## **2.3 Materials**

- 2.3.1 Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet; minimum Grade 230 complying with ASTM A653/A 653M, Z275 (G90) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A 792M, Class AZM150 (Class AZ50) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A 755M.

## **2.4 Corrugated Metal Cladding**

- 2.4.1 Material Tag: This item is noted as "EW3" on Drawings and Schedules.
- 2.4.2 Provide factory-formed metal panels designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps. Include accessories required for weathertight installation.
- 2.4.3 Corrugated-Profile, Exposed-Fastener Metal Wall Panels: formed with alternating ribs spaced across width of panel.
  - .1 Rib Spacing: 68 mm (2-5/8 inches) o.c.
  - .2 Panel Coverage: 878 mm (34-1/4 inches)
  - .3 Panel Height: 22 mm (7/8 inch)
  - .4 Perforations: as per SolarWall requirements where indicated on Drawings.
  - .5 Nominal Thickness: As determined by Project-specified loadings, but not less than 0.71 mm (24ga - 0.028 inch).
  - .6 Acceptable Products: "7/8 Corrugated" by Vicwest or approved equivalent.
- 2.4.4 Exterior Panel Finish (PVDF): 2-coat fluoropolymer conforming to AAMA 2605 and containing minimum 70 % PVDF resin by weight.
  - .1 Basis-of-Design: "10 000 Series" by ArcelorMittal (Dofasco) or approved equivalent.
  - .2 Colour: as indicated on Drawings.

## **2.5 Metal Soffit Panels**

- 2.5.1 Refer to Section 07 42 96 – Linear Metal Soffit Panels.

## **2.6 Auxiliary Materials**

- 2.6.1 Miscellaneous Metal Subframing and Furring: Thermally-broken materials conforming to 07 21 60. Provide sections as required for support and alignment of metal panel system.

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- 2.6.2 Screws: ANSI B18.6.4. Purpose made aluminum alloy or stainless steel.
- 2.6.3 Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated on Drawings and Schedules.
- .1 Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
  - .2 Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  - .3 Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 25-mm- (1-inch-) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated on Drawings and Schedules or necessary to ensure weathertight construction.
- 2.6.4 Thermally-Broken Sub-framing: Low-conductivity thermally-broken, intermittent structural attachment insulation clips designed maintain insulation effectiveness, with adjustable depth and suitable for vertical and horizontal sub-girts.
- .1 Basis-of-Design: "ISO Clip" by Northern Facades Ltd.
  - .2 Acceptable Products:
    - .1 "Cascadia Clip" by Cascadia Windows
    - .2 "TClip Thermally Broken Façade Substructure" by Engineered Assemblies
    - .3 "NVELOPE NV1 Cladding Attachment System" by SFS Group.
    - .4 Approved equivalent.
- 2.6.5 Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- .1 Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 13 mm (1/2 inch) wide and 3 mm (1/8 inch) thick.



- .2 Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.

## **2.7     Fabrication**

- 2.7.1 Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- 2.7.2 Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- 2.7.3 Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- 2.7.4 Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

## **2.8     Finishes**

- 2.8.1 Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- 2.8.2 Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

# **3 .     EXECUTION**

## **3.1     Examination**

- 3.1.1 Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

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- .1 Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
- .2 Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
- .3 Verify that air- or vapour barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- 3.1.2 Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- 3.1.3 Commencement of work implies acceptance of previously completed work.

**3.2 Preparation**

- 3.2.1 Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

**3.3 Metal Panel Installation**

- 3.3.1 Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings and Schedules. Install panels perpendicular to supports unless otherwise indicated on Drawings and Schedules. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
  - .1 Shim or otherwise plumb substrates receiving metal panels.
  - .2 Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
  - .3 Install continuous starter strips, corners, edgings, soffit, drip, cap, sill and window/door opening flashings as indicated.
  - .4 Install outside corners, fillers and closure strips with carefully formed and profiled work.
  - .5 Install siding and attachments sequentially from sill up, to manufacturer written instructions
  - .6 Attach components to allow for thermal movement.
  - .7 Install screw fasteners in predrilled holes.

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- .8 Locate and space fastenings in uniform vertical and horizontal alignment.
- .9 Install flashing and trim as metal panel work proceeds.
- .10 Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- .11 Apply joint sealant at junctions with adjoining work with sealant. Do work in accordance with Section 07 92 00 - Joint Sealants.

**3.3.2 Fasteners:**

- .1 Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

**3.3.3 Metal Protection:** Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

**3.3.4 Accessory Installation:** Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

- .1 Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated on Drawings and Schedules by metal wall panel manufacturer; or, if not indicated on Drawings and Schedules, provide types recommended by metal panel manufacturer.

**3.3.5 Flashing and Trim:** Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated on Drawings and Schedules. Install work with laps, joints, and seams that are permanently watertight.

- .1 Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated on Drawings and Schedules, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.

**3.4 Field Quality Control**

**3.4.1 Manufacturer's Field Service:** Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.

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Steel Siding Panels And  
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- 3.4.2 Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements.
- 3.4.3 Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- 3.4.4 Prepare test and inspection reports.

**3.5 Cleaning And Protection**

- 3.5.1 Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- 3.5.2 After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- 3.5.3 Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the interlocking metal cladding work specified herein. This includes, but is not necessarily limited, to:
  - .1 Interlocking metal cladding for wall applications.
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

### **1.4 Preinstallation Meetings**

- 1.4.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.
- 1.4.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
  - .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.
  - .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.

.3 Agenda:

- .1 Review progress of related construction activities and preparations for particular activity under consideration.
- .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
- .3 Review and finalize construction schedule and verify availability of materials, personnel, equipment, and facilities needed to make progress and avoid delays.
- .4 Review methods and procedures for interlocking metal cladding panel installation, including manufacturer's instructions.
- .5 Examine supports, including alignment and attachment to structural members.
- .6 Review flashing, details, wall penetrations, openings, and conditions of other elements that may affect interlocking metal cladding.
- .7 Discuss governing regulations, insurance, certificates, tests, and inspections as applicable.
- .8 Review temporary protection requirements for interlocking metal cladding before, during and after installation.
- .9 Discuss procedures repair procedures for interlocking metal cladding where permitted by Consultant.
- .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
- .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

**1.5 Submittals**

- 1.5.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.5.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for interlocking metal cladding work specified in this Section.
- 1.5.3 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:
  - .1 Include plans, elevations, sections and details as applicable.
  - .2 Indicate field-measured dimensions on Shop Drawings.

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- .3 Include fabrication and installation layouts of interlocking metal cladding; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
  - .4 Scale for details of flashings, trims and anchorages: minimum 1:10 (1-1/2 inches per 12 inches).
  - 1.5.4 Delegated Design Submittals:
    - .1 Engineering design completion of interlocking metal cladding work is delegated to Contractor based on structural design criteria indicated in Contract Documents.
    - .2 Submit Shop Drawings for work of this Section that bear the stamp of a Professional Engineer registered in Province of Ontario.
    - .3 Calculation shall clearly indicate structural support type, spacing requirements of structural supports by zone, and fastener requirements.
    - .4 Calculate pullout, pullover, and shear strength of fasteners in accordance with test data published by the fastener manufacturer, utilizing applicable material safety factors.
    - .5 Submit copy of structural calculations upon request by Consultant.
  - 1.5.5 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
    - .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
    - .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
    - .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
  - 1.5.6 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:
    - .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.
    - .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
  - 1.5.7 Effective R-Value Thermal Performance Report: Submit analysis report demonstrating that interlocking metal cladding assemblies,

including framing components, as proposed by Contractor, meet thermal and structural performance requirements established by Contract Documents. As a minimum, report must include the following:

- .1 Each wall's nominal R-value and effective R-value.
  - .2 Clip spacing (vertical and horizontal).
  - .3 Maximum allowable wind loads, demonstrating compliance with requirements specified in this Section.
  - .4 Cladding dead loads, demonstrating compliance with requirements specified in this Section.
  - .5 Fastener types.
- 1.5.8 Samples: Submit selection and verification samples for Products requiring colour, texture, or design selection. Submit manufacturer's list of finishes or colour swatches for Consultant's selection.
- .1 As a minimum submit samples of the following:
    - .1 Include samples of trim and accessories involving colour selection.
    - .2 Interlocking metal cladding: Submit two (2), 305 mm (12 inches) long by actual panel width. Include fasteners, closures, and other accessories.
- 1.5.9 Submit for Consultants review, QA checklist used as part of installation process. Make modifications to QA checklist based on Consultant feedback

## **1.6 Closeout Submittals**

- 1.6.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.
- 1.6.2 Operating and Maintenance Data: Submit care and maintenance instructions for interlocking metal cladding to be included in building operation and maintenance manual.
- 1.6.3 Warranty Documentation: Submit copy of extended warranties specified in this Section.

## **1.7 Quality Assurance**

- 1.7.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.
- 1.7.2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.



1.7.3 Professional Engineer's Qualifications: Employ Professional Engineer licensed to practice in Province of Ontario who carries professional liability insurance and has at least five years' experience providing engineering services of similar kind, scope, and complexity.

.1 Professional Engineer's Responsibility:

- .1 production and review of Shop Drawings,
- .2 design and certification of interlocking metal cladding, including attachments for building construction, in accordance with applicable codes and regulations,
- .3 stamping and signing of each Shop Drawing and associated calculations

1.7.4 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.

1.7.5 Mock-Ups / First Installation Review: Construct mock-ups to verify selections made under submittals, demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

- .1 Location: In-situ (i.e. first installation), as directed on site by Consultant.
- .2 Purpose: To set benchmarks for installation and to judge subsequent work. Maintain Mock-ups during construction in undisturbed condition.
- .3 Water-Spray Test: Conduct water-spray test of aluminum siding plank assembly mockup, testing for water penetration according to AAMA 501.2.
- .4 Reviewed mock-ups: May become part of the completed work if undisturbed at the time of Substantial Performance of The work, provided they are undisturbed, and comply with requirements outlined in Contract Documents.

## **1.8 Delivery, Storage And Handling**

- 1.8.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.
- 1.8.2 Deliver, store and handle interlocking metal cladding materials in accordance with manufacturer's written instructions.
- 1.8.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.8.4 Store materials in off-ground, in clean, dry, well-ventilated area.
- 1.8.5 Replace defective or damaged materials with new.

- 1.8.6 Retain strippable protective covering on interlocking metal cladding during installation.
- 1.8.7 Avoid direct contact with alkali-bearing material such as lime based cement, concrete/mortar.

**1.9 Field Conditions**

- 1.9.1 Field Measurements: Verify actual dimensions of construction contiguous with interlocking metal cladding by field measurements before fabrication.

**1.10 Warranty**

- 1.10.1 Extended warranty: Submit for Owner's review and acceptance, manufacturer's extended warranty in which manufacturer commits to repair or replace components of interlocking metal cladding that fail within specified warranty period. Manufacturer's extended warranty is in addition to, and does not supersede, any other rights that Owner may have under Contract Documents.
  - .1 Failures include, but are not limited to, the following:
    - .1 Corrosion.
    - .2 Rupture.
    - .3 Perforation.
  - .2 Warranty Period: Not less than 20 years from date of Substantial Performance of The work.

**2 . PRODUCTS**

**2.1 Manufacturers**

- 2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:
  - .1 Kalzip as supplied by Exterior Technologies Group.
- 2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

**2.2 Performance / Design Criteria**

- 2.2.1 Interlocking metal cladding must be designed to withstand project-specific design loads and their effects within constraints specified in this Section and Ontario Building Code without defects, damage, or failure, including but not limited to the following:
  - .1 Dead Loads: Including those transferred from structural elements.
  - .2 Environmental Loads: Such as wind, snow, rain, hydrostatic, seismic and earth pressures as applicable.

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- .3 Live Loads: Including those arising from use and occupancy.
  - .4 Loads from Temperature and Moisture Loads: Including expansion, contraction, deflection, deformation, creep, shrinkage, settlement, and differential movement.
  - .5 Fire Loads: as determined by fire performance testing specified.
  - 2.2.2 Employ a qualified professional engineer, as specified in this Section, to design and certify aluminum siding plank assemblies, including attachment to building construction.
  - 2.2.3 Intended aesthetics: Drawings and Specifications provide requirements regarding system's aesthetic and performance criteria. Unless indicated otherwise, preserve intended aesthetic effects. For any proposed deviations, provide detailed explanation to Consultant for evaluation. Acceptance or rejection of proposed deviations rests solely with Consultant.
    - .1 Profile: Ensure uniform and matching profile.
  - 2.2.4 Building Enclosure Design Principle: Exterior envelope construction for this Project is based on "Rain Screen" design principle, as recommended by National Research Council of Canada. Face sealed assemblies are not permitted.
    - .1 Resistance to Water Penetration: Provide resistance to water penetration from the exterior.
    - .2 Venting and Drainage: Provide for venting and drainage of space immediately behind panel (or backing material) to permit escape of moisture.
    - .3 Continuity: Maintain integrity and continuity of building enclosure's thermal, air, and vapour control layers at all times by using appropriate insulation, air barriers, vapour retarders to tie work of this Section with adjacent construction.
  - 2.2.5 Structural Performance: Design interlocking metal cladding panels in accordance with the requirements of Ontario Building Code and CSA S157/S157.1.
    - .1 Wind Loads: As indicated on Drawings, determined in accordance with OBC requirements (5.2.2.2. Determination of Wind Load) for the geographical location of the project (1 in 50-year return probability).
    - .2 Maximum deflection of interlocking metal cladding components due to uniformly distributed loads:  $L/180$ .
    - .3 Panel structural properties are to be determined in accordance with latest edition of Aluminum Association's "Aluminum Design Manual-Specifications and Guidelines for Aluminum Structures"

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- 2.2.6 Seismic Performance: Provide products and systems specified in this Section to withstand the effects of earthquake motions in accordance with OBC 4.1.8.18 and CAN/CSA S832.
- .1 Professional engineer specified in Division 01 and referenced in this Section shall be responsible for designing systems and submitting signed and sealed analysis data and Shop Drawings illustrating seismic-resistant systems.
  - .2 Refer to Structural Drawings for seismic sensitivity values.
- 2.2.7 Design interlocking metal cladding and components to be adequately interconnected and adequately fastened to structural supports to sustain loads.
- 2.2.8 Design expansion joints to accommodate movement in cladding and between cladding and structure to prevent permanent distortion or damage to cladding.
- 2.2.9 Thermal Movements: fabricate and install interlocking metal cladding panels to prevent buckling, opening up of joints and overstressing of welds and fasteners under the following temperature conditions:
- .1 Temperature Change: ambient temperature cycling of - 30 deg C (-22 deg F) to 82 deg C (180 deg F) over a 12-hour period.
  - .2 Account for thermal stresses, drilling impacts, or other causes before or during interlocking metal cladding installation. Implement handling and storage methods for interlocking metal cladding to reduce such stresses.
- 2.2.10 System Fire Propagation Characteristics: Wall assemblies containing aluminum siding planks must meet requirements of CAN/ULC S134 within limits specified by Ontario Building Code but generally as follows:
- .1 Flaming on or in wall assembly: must not spread more than 5 m above opening.
  - .2 Heat flux during flame exposure: less than 35 kW/m<sup>2</sup> measured at 3.5 m above opening.
  - .3 Exemption: If permitted by Authorities Having Jurisdiction, compliance with CAN/ULC S134 may be waived provided aluminum planks can be demonstrated to be non-combustible when tested in accordance with CAN/ULC S114.

### **2.3 Interlocking Metal Cladding**

- 2.3.1 Material Tag: This item is noted as "EW1A, EW1B, EW2A, EW2B" on Drawings and Schedules.
- 2.3.2 Base Material: Extruded aluminum planks to ASTM B221/ ASTM B221M, 6063 T5 alloy as standard with manufacturer, with temper as required for forming and structural performance.

- 2.3.3 Configuration: interlocking metal panels.
- 2.3.4 Plank Width: 400 mm
- 2.3.5 Length: As required.
- 2.3.6 Corners: Factory finished.
- 2.3.7 Thickness: Not less than 1.19 mm (0.047 in) base metal thickness.
- 2.3.8 Fasteners: Concealed.
- 2.3.9 Exterior Panel Finish (PVDF): 3-coat fluoropolymer conforming to AAMA 2605 and containing minimum 70 % PVDF resin by weight for colour coat and clear topcoat.
  - .1 Colour / Pattern: Duranar XL Bright Silver
- 2.3.10 Basis-of-Design: "Kalzip FC 30/400" by Kalzip® or approved equivalent.

## **2.4 Auxiliary Materials**

- 2.4.1 Metal Sub-framing and Furring: Minimum 1.219 mm (18 ga.) thick, cold-formed, galvanized sheet steel conforming to ASTM C645.
  - .1 Protective Coating: Hot-dip galvanized Z275 (G90) coating to ASTM A653/A653M.
  - .2 Transfer Grid: Provide manufacturer's standard sections as required for support and alignment of aluminum plate panel system consisting of hat bars, Z-bars, adjustable Z-bars or combination thermal clip and transfer grids as noted on Drawings.
  - .3 Material visible after assembly: finished to match panels.
- 2.4.2 Thermally-Broken Sub-framing: Low-conductivity thermally-broken, intermittent structural attachment insulation clips designed maintain insulation effectiveness, with adjustable depth and suitable for vertical and horizontal sub-girts.
  - .1 Basis-of-Design: "Cascadia Clip" by Cascadia Windows
  - .2 Acceptable Products:
    - .1 "ISO Clip" by Northern Facades Ltd.
    - .2 "TAC Thermal Spacer" Exterior Technologies Group
    - .3 "TClip Thermally Broken Façade Substructure" by Engineered Assemblies
    - .4 "NVELOPE NV1 Cladding Attachment System" by SFS Group.
- 2.4.3 Accessories: Provide components required for a complete, weathertight panel system including trim, end caps, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match

material and finish of interlocking metal cladding unless otherwise indicated on Drawings and Schedules.

- .1 Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.
  - .2 Plank Clips: Manufacturer's standard stainless-steel clips for field installation.
  - .3 Provide accessories made from the same material as adjacent siding unless otherwise indicated. Where accessories are exposed, match colour and finish of adjacent exposed elements.
- 2.4.4 Flashing and Trim: Provide flashing and trim formed from same material as interlocking metal cladding as required to seal against weather and to provide finished appearance. Finish flashing and trim with same finish system as adjacent interlocking metal cladding.
- 2.4.5 Fire Blocks: In accordance with OBC Article "3.1.11. Fire Blocks in Concealed Spaces" consisting of minimum 0.38 mm (28 ga) galvanized sheet steel complying with ASTM A653/A653M; minimum Z275 (G90) coating.
- 2.4.6 Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching colour of interlocking metal cladding by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- 2.4.7 Bird and Insect Screening: Aluminum mesh with minimum wire diameter of 0.30 mm (0.012 inch), painted as necessary to be concealed behind panel open joints. Screening must provide at least 50% open area.

## **2.5 Fabrication**

- 2.5.1 Factory Fabrication: Fabricate interlocking metal cladding in accordance with manufacturer's instructions as required to meet performance requirements specified in this Section. Comply with indicated profiles, dimensions, and structural requirements specified in Contract Documents.
- 2.5.2 Visual Quality: Provide sharp, clean edges without displacement of interlocking metal cladding. Minimize oil canning.

## **2.6 Finishes**

- 2.6.1 Protect mechanical and painted finishes on exposed surfaces from damage by applying strippable, temporary protective covering that will not remain adhered to panels in the field before shipping.

- 2.6.2 Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- 2.6.3 Appearance of Finished Work: Noticeable variations in same piece of aluminum plate are not acceptable. Variations in appearance of other components are acceptable if they are within range of Samples reviewed by Consultant and are assembled or installed to minimize contrast.

### **3 . EXECUTION**

#### **3.1 Examination**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.
  - .1 Examine wall framing to verify that girts, angles, channels, studs, and other panel support members and anchorages have been installed within alignment tolerances required by aluminum plate panel manufacturer.
  - .2 Examine wall sheathing to ensure that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by aluminum plate panel manufacturer.
  - .3 Verify that air-barriers and vapour-retarders have been installed over sheathing or backing substrate to prevent air infiltration and water penetration.
- 3.1.2 Examine roughing-in for components and assemblies penetrating interlocking metal cladding to verify actual locations of penetrations relative to seam locations of interlocking metal cladding before installation.
- 3.1.3 Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 Preparation**

- 3.2.1 Install subframing, furring, thermally-broken sub framing and other miscellaneous panel support members and anchorages according to ASTM C754 and aluminum plate panel manufacturer's written recommendations.

#### **3.3 Installation, General**

- 3.3.1 Installation, generally: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation

instructions with additional installation requirements specified in this Section to produce specified work results.

- 3.3.2 Install panels perpendicular to supports unless otherwise indicated on Drawings and Schedules. Anchor interlocking metal cladding and other components of the Work securely in place, with provisions for thermal and structural movement.
- 3.3.3 Fasteners: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
- 3.3.4 Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by aluminum siding plank manufacturer.
- 3.3.5 Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
- 3.3.6 Fire Blocks: Where cavities exceed 25 mm and contain combustible insulation or cladding materials, provide continuous fire blocks complying with OBC Article "3.1.11. Fire Blocks in Concealed Spaces" as specified in this Section and installed in cavity at every floor level and at intervals exceeding no more than 3m vertically.

### **3.4 Protection**

- 3.4.1 Protect interlocking metal cladding from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades.
- 3.4.2 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in writing by affected material's manufacturer. Do not use materials or process that can damage finishes, surfaces, or construction.
- 3.4.3 Promptly replace interlocking metal cladding work damaged during construction that cannot be satisfactorily repaired.
- 3.4.4 Remove temporary protective coverings and strippable films as interlocking metal cladding are installed. On completion of aluminum plate panel installation, clean finished surfaces as recommended by aluminum plate panel manufacturer. Maintain in a clean condition during construction.

### **3.5 Cleaning And Waste Management**

- 3.5.1 Cleaning and Waste Management, generally: in accordance with Section 01 74 00, Cleaning and Waste Management.
- 3.5.2 After aluminum siding plank installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.



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- 3.5.3 Replace interlocking metal cladding that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
  - 3.5.4 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
  - 3.5.5 Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**END OF SECTION**

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the modified bituminous membrane roofing work specified herein. This includes, but is not necessarily limited, to:
  - .1 Conventional roof assembly system consisting of cap sheet materials, base-sheet materials, flashing membrane materials, support boards, insulation, and vapour retarders.
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only:
  - .1 Section 06 10 00 - Rough Carpentry
  - .2 Section 07 21 00 - Thermal Insulation
  - .3 Section 07 62 00 - Sheet Metal Flashing and Trim.
  - .4 Section 07 92 00 - Joint Sealants
  - .5 Division 22, Plumbing

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

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**1.4 Definitions**

- 1.4.1 Roofing Terminology: Refer to CRCA Specifications Manuals and ASTM D1079 for the definition of terms related to roofing work in this Section.

**1.5 Preinstallation Meetings**

- 1.5.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.
- 1.5.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
- .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.
  - .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.
  - .3 Agenda:
    - .1 Review progress of related construction activities and preparations for particular activity under consideration.
    - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
    - .3 Review and finalize construction schedule and verify availability of materials, personnel, equipment, and facilities needed to make progress and avoid delays.
    - .4 Review methods and procedures for roofing installation, including manufacturer's instructions.
    - .5 Review structural loading limitations of roof deck during and after roofing.
    - .6 Examine supports, deck, and alignment and attachment to structural members.
    - .7 Review flashing, details, penetrations, openings, and conditions of other elements that may affect roofing system installation.
    - .8 Discuss governing regulations, insurance, certificates, tests, and inspections as applicable.
    - .9 Review temporary protection requirements for roofing system before, during and after installation.
    - .10 Discuss roof observation and repair procedures after roofing installation.

- .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
- .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

**1.6 Submittals**

- 1.6.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.6.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for modified bituminous membrane roofing work specified in this Section.
- 1.6.3 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:
  - .1 Include plans, elevations, sections and details as applicable.
  - .2 Indicate field-measured dimensions on Shop Drawings.
  - .3 Base flashings and membrane terminations.
  - .4 Tapered insulation, including slopes.
  - .5 Crickets, saddles, and tapered edge strips, including slopes.
  - .6 Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
  - .7 Include coping design including fastening type and frequency.
- 1.6.4 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
  - .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
  - .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
  - .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.6.5 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:
  - .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.

- .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
  - 1.6.6 Manufacturer's Certificate:
    - .1 Submit letter signed by manufacturer certifying that products meet or exceed specified requirements. Submit evidence of meeting performance requirements by submitting additional test and evaluation reports as well as conformance to applicable listings.
    - .2 Compatibility: Compatibility between components of roofing system is essential. Provide written declaration to Consultant stating that materials and components, as assembled in system, meet this requirement.
  - 1.6.7 Warranties: Submit copies of warranties specified in this Section for Consultant's review.
  - 1.6.8 System Test Reports: Submit reports substantiating conformance with requirements of CSA A123.21 based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.
  - 1.6.9 Submit for Consultants review, QA checklist used as part of installation process. Make modifications to QA checklist based on Consultant feedback
- 1.7 Closeout Submittals**
  - 1.7.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.
  - 1.7.2 Operating and Maintenance Data: Submit care and maintenance instructions for modified bituminous membrane roofing to be included in building operation and maintenance manual.
  - 1.7.3 Warranty Documentation: Submit copy of extended warranties specified in this Section.
- 1.8 Quality Assurance**
  - 1.8.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 15 years' experience manufacturing such materials.
    - .1 Manufacturer shall employ trained technical service representatives, independent of sales.
    - .2 Manufacturer shall be an ISO 9001 registered company and provide a 'Quality Compliance Certificate (QCC)' for reporting/confirming tested values of modified bitumen membrane materials upon request.

- .3 Manufacturer's Representative: Contractor to arrange for a daily on-site technical representative of the manufacturer or a third-party roofing consultant to review substrate conditions and new roof system applications.
- 1.8.2 Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to obtain manufacturer's extended warranty specified in this Section.
  - .1 Installer must be approved by manufacturer for installing roof system and to authenticate warranties.
  - .2 Installer must have a minimum 10 years of experience in low sloped roofing systems.
  - .3 Installer must be an active member of Ontario Industrial Roofing Contractors Association (OIRCA) or CRCA.
- 1.8.3 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.
  - .1 Mixing Products across from various manufacturers without manufacturer's or Consultant's written permission is not permitted.
- 1.8.4 Mock-Ups / First Installation Review: Construct mock-ups to verify selections made under submittals, demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - .1 Location: In-situ (i.e. first installation), as directed on site by Consultant.
  - .2 Construct mock-up 10 m<sup>2</sup> (100 sq ft.) minimum size showing typical lap joint, one inside corner and one outside corner.
  - .3 Purpose: To set benchmarks for installation and to judge subsequent work. Maintain Mock-ups during construction in undisturbed condition.
  - .4 Reviewed mock-ups: May become part of the completed work if undisturbed at the time of Substantial Performance of The work, provided they are undisturbed, and comply with requirements outlined in Contract Documents.

## **1.9 Delivery, Storage And Handling**

- 1.9.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.
- 1.9.2 Deliver, store and handle modified bituminous membrane roofing materials in accordance with manufacturer's written instructions.
- 1.9.3 Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product

brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

- 1.9.4 Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

.1 Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

- 1.9.5 Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

- 1.9.6 Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

#### **1.10 Field Conditions**

- 1.10.1 Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements. Do not install roofing system during inclement weather that may affect adhesion, curing or sealing of membranes or components.

#### **1.11 Warranty**

- 1.11.1 Contractor's Warranty: Provide a two-year written warranty on CRCA standard warranty form, covering replacement or repair of defective roofing components, including membrane, flashing, insulation, and accessories, to maintain a watertight system at no expense to the Owner. Conduct necessary repairs during the warranty period without additional cost to the Owner. Perform a final inspection at warranty end and repair all defects. Emergency repairs by the Owner during the warranty period do not void the warranty.
- 1.11.2 Manufacturer's Warranty: Provide a 25-year, non-prorated, no dollar limit warranty covering labor, materials, and workmanship for the roofing system. This warranty must cover repairs for defects and leaks, be transferable at no cost, and allow for emergency repairs by the Owner without voiding the warranty.

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## **2 . PRODUCTS**

### **2.1 Manufacturers**

2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:

- .1 Henry Company
- .2 IKO.
- .3 Johns Manville.
- .4 Siplast, Inc.
- .5 Soprema.

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

### **2.2 Performance / Design Criteria**

2.2.1 General Performance: installed membrane roofing and flashing system must remain watertight and withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defects in manufacture, fabrication, installation, or construction.

2.2.2 Wind Uplift Design Criteria: Roofing system must have undergone testing by a qualified testing and inspection agency to resist uplift pressure based on Ontario Building Code and CAN/CSA A123.21 requirements as follows:

- .1 Corner Uplift Pressure: -2.2 kPa
- .2 Perimeter Uplift Pressure: -1.2 kPa
- .3 Field-of-Roof Uplift Pressure: -0.9 kPa

2.2.3 Roof Fire Covering Classification: Conforming to CAN/ULC-S107 and to OBC 3.1.15.2.

2.2.4 Material Compatibility: Ensure compatibility between roofing system components and interfacing materials. Roof system must not adversely affect adjacent materials.

### **2.3 Cap Sheet Membrane**

2.3.1 **Modified Bitumen Membrane (Composite-reinforced), torched – High HRI:**

- .1 Classification: CSA A123.15, Type C, Grade 1 or 2.
- .2 Reinforcement: combination of polyester and glass fibres to ASTM D6162, having nominal weight of 160 g/m<sup>2</sup>
- .3 Top/bottom surfaces: Manufacturer's standard suitable for application indicated.
- .4 Granule colour: Bright white.



- .1 Solar Reflectance Index (SRI) (ASTM E1980)
  - .1 Initial SRI:  $\geq 82$
  - .2 3-year-aged SRI:  $\geq 64$ .
- .5 Application: Torched.
- .6 Basis-of-Design Products: "SOPRASTAR FLAM HD GR" by Soprema Inc or approved equivalent as follows:
  - .1 "DynaWeld FR CR (coated)" by Johns Manville
  - .2 "Armourcool Granular TP-HD " by IKO
  - .3 "Parafor 30 TG BW" by Siplast
  - .4 "modifiedPLUS® NP250gT4 with Solarflex Coating" by Henry Company

## **2.4 Base Sheet Membrane**

### **2.4.1 Modified Bitumen Membrane (Composite-reinforced), adhered in cold adhesive:**

- .1 Classification: CSA A123.15; Type C, Grade 3.
- .2 Reinforcement: combination of polyester and glass fibres to ASTM D6162, having nominal weight of 160 g/m<sup>2</sup>
- .3 Top/bottom surfaces: Manufacturer's standard suitable for application indicated.
- .4 Application: Fully adhered with hot-asphalt.
- .5 Basis-of-Design Products: "Colply Base 410" by Soprema Inc or approved equivalent as follows:
  - .1 "DynaLastic 180 S " by Johns Manville
  - .2 "Modiflex MP-HD-SS-BASE" by IKO
  - .3 "Paradiene 20 " by Siplast
  - .4 "modifiedPlus NP180 s/s" by Henry Company

## **2.5 Insulation Cover Board**

- 2.5.1 Manufacturer's standard type designed to protect insulation and provide firm substrate for roof installation:
- 2.5.2 Fire Response:
  - .1 Combustibility: non-combustible in accordance with CAN/ULC S114.
  - .2 Surface Burning Characteristics: Flame spread: 0 / Smoke developed: 0 in accordance with CAN/ULC S102.
- 2.5.3 Mould Resistance (ASTM D3273): Minimum 10 rating (no mould growth after four week).
- 2.5.4 Maximum Board Size: 1220 mm x 1220 mm (4 ft x 4 ft).

2.5.5 Mineral Fiber Insulation Board: to ASTM C726, Type I, Class 1, with rigid surface.

- .1 Basis-of-Design: "Soprarock DD Plus" by SOPREMA, Inc. or approved equivalent.

## **2.6 Roof Insulation**

2.6.1 Material Tag: This item is noted as "INS-2" on Drawings and Schedules.

### **2.6.2 Polyisocyanurate foam insulation board:**

- .1 Classification: CAN/ULC-S704, Type 2 and ASTM C 1289, Type II, Class 2, Grade 2 inorganic glass-fibre mat facer on both major surfaces. Organic facers are not permitted.
- .2 Compressive strength: minimum 138 kPA (20 psi).
- .3 Minimum RSI (R) Value: 1.0 per 25 mm (5.7 per 1") based on LTTR testing per CAN/ULC-S770.
- .4 Thickness: As indicated on Drawings and required to provide specified R-values.
- .5 Application: Fully adhered with hot-asphalt.
- .6 Basis-of-Design Products: "Sopra-ISO Plus" by SOPREMA, Inc. or approved equivalent as follows:
  - .1 "ENRGY 3® CGF" Johns Manville.
  - .2 "IKOTerm III" by IKO Industries Inc.
  - .3 "Paratherm Poly ISO" by Siplast
  - .4 Approved equivalent by Atlas Roofing Corporation.

2.6.3 Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of not less than 1:48 (1/4 inch per 12 inches) unless otherwise indicated. Refer to Drawings for specific slopes. Tapered insulation to be of identical composition as roof insulation board.

2.6.4 Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

## **2.7 Roof Vapour Retarder**

2.7.1 Material Tag: This item is noted as "VCM-1" on Drawings and Schedules.

2.7.2 Description: minimum 0.80- mm (31.5-mil) thick, self-adhering-sheet vapour retarder consisting of tri-laminate woven polyethylene film laminated to layer of SBS-modified bitumen with slip-resisting surface and release film backing specifically designed for use in roofing assembly specified.

- .1 Basis-of-Design Products: "Sopralene 180 Sanded" by SOPREMA, Inc. or approved equivalent.
- 2.7.3 Primer: Low-VOC, water-based polymer emulsion primer as recommended by roofing membrane manufacturer.
- .1 Basis-of-Design Products: "Elastocol Stick Zero" or "Elastocol H2O" by SOPREMA, Inc. or approved equivalent as follows:
  - .1 "SAM LVC" by IKO Industries
  - .2 "TA 119" by Siplast
  - .3 "Blueskin LVC Primer" by Henry Company

## **2.8 Thermal Barrier (Roof Sheathing Board)**

- 2.8.1 Manufacturer's standard type designed to provide thermal barrier and provide firm substrate for vapour retarder installation:
- 2.8.2 Fire Response:
  - .1 Combustibility: non-combustible in accordance with CAN/ULC S114.
  - .2 Surface Burning Characteristics: Flame spread: 0 / Smoke developed: 0 in accordance with CAN/ULC S102.
- 2.8.3 Mould Resistance (ASTM D3273): Minimum 10 rating (no mould growth after four week).
- 2.8.4 Maximum Board Size: 1220 mm x 1220 mm (4 ft x 4 ft).
- 2.8.5 Following types are acceptable:
  - .1 Fibre-Reinforced Roof Sheathing Board: ASTM C1278/ASTM C1278M, cellulosic-fibre-reinforced, water-resistant gypsum substrate.
    - .1 Basis-of-Design Products: "Securock® - Brand Gypsum-Fiber Roof Board" by CGC Inc. or approved equivalent.
- 2.8.6 Adhesive: Insulation manufacturer's recommended bead-applied, low-rise, multicomponent urethane adhesive or full-spread spray-applied, low-rise, two-component urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer
  - .1 Basis-of-Design Product: "Duotack" by SOPREMA, Inc.; or approved equivalent as follows:
    - .1 "Millenium Adhesive" by IKO Industries;
    - .2 "MJM Green 2-Part UIA Canister" by Johns Manville.

## **2.9 Flashing Membranes**

- 2.9.1 Flashing Base Sheet: SBS-modified asphalt sheet (reinforced with polyester fabric or composite glass fibre/polyester); smooth surfaced; suitable for application method specified.
  - .1 Classification: CSA A123.15; Type B or C.

- .2 Reinforcement: nonwoven polyester fibres to ASTM D6164, having nominal weight of 180 g/m<sup>2</sup> or combination of polyester and glass fibres to ASTM D6162, having nominal weight of 160 g/m<sup>2</sup>
  - .3 Top/bottom surfaces: Manufacturer's standard suitable for application indicated.
  - .4 Products: As recommended by roof manufacturer.
- 2.9.2 Flashing Cap Sheet: Identical to field roofing cap sheet membrane.
- 2.9.3 Liquid-Applied Flashing: Low-VOC resin-based, seamless, reinforced waterproofing system flashing that is compatible with adjacent materials.
- .1 Provide at all flashing details including, but not limited to, mechanical equipment, roof/wall penetrations and similar locations.
  - .2 Basis-of-Design Products: "Alsan Flashing" by Soprema Inc. or approved equivalent as follows:
    - .1 "MS Detail" by IKO Industries.
    - .2 "PermaFlash" by Johns Manville.
- 2.9.4 Flashing sheets shall extend a minimum of 150 mm (6 inches) beyond the cant strip onto the horizontal field of roof for base sheets and 200 mm (8 inches) for cap sheets.

## **2.10 Walkways**

- 2.10.1 Walkway Pads: Polyester reinforced SBS modified bitumen pads with slip-resisting mineral-granule surface, manufactured as a traffic pad for foot traffic and acceptable to roofing system manufacturer, 5 mm (3/16 inch) thick, minimum.
- .1 Pad Size: Manufacturer's standard type.
  - .2 Granule Colour: Contrasting colour as selected by Consultant at a later date.
- 2.10.2 Roof Pavers: CSA A23.1/A23.2 Heavyweight, hydraulically pressed, concrete units, square edged manufactured for use as plaza deck pavers; minimum average cube compressive strength 50 MPa (7250 psi), with no individual unit less than 45 MPa (6525 psi) . Additional reinforcement to be added at paver locations.
- .1 Size: 610 mm x 610 mm x 45 mm (24 inch x 24 inch x 1-3/4 inch)
  - .2 Finish: non-slip finish – shot blast.
  - .3 Colour: As selected by Consultant from manufacturer's full range.
    - .1 Colour Pigment Material Standard: Comply with ASTM C 979.

- .4 Freeze/Thaw Deicing Salt Resistance: Required.
- .5 Water Absorption: not greater than 5 percent.
- .6 SRI: Provide Products having minimum Solar Reflective Index (SRI) values as follows:
  - .1 Initial: Not less than 80
  - .2 3-year test results: Not less than 78.
- .7 Acceptable Products: "Solar Reflective Slabs" by Brooklin Concrete Products or approved equivalent.
- .8 Provide pavers at traffic concentration points (i.e. roof hatches, access doors, rooftop ladders, etc.), regardless of traffic frequency or whether or not these are explicitly indicated on Drawings.

2.10.3 Paver Supports:

- .1 Paver manufacturer's standard SBR rubber, high-density polyethylene, or polyurethane paver support assembly, including fixed-height, adjustable or stackable pedestals, shims, and spacer tabs for flush joint spacing sufficient to allow for expansion and contraction while avoiding tripping hazards.
  - .1 Acceptable Manufacturers:
    - .1 "Paver Pedestals" by SOPREMA, Inc.
    - .2 Approved equivalent by Bison Innovative Products
    - .3 Approved Equivalent.
  - .2 Polystyrene: Extruded polystyrene insulation as fabricated with both sides having a matrix of drainage, size as required to support pavers.
    - .1 Grooves: 13 mm x 13 mm (½" x ½"); staggered

**2.11 Auxiliary Materials**

- 2.11.1 Use accessory materials recommended by the modified bituminous membrane manufacturer to create a complete roof assembly. Ensure compatibility between materials.
- 2.11.2 Roof Hatches: Refer to Section 07 72 76 - Roof Access Hatches.
- 2.11.3 Equipment Supports: Provide required associated roofing accessories and supports as necessary to provide complete roofing work and support roof equipment shown on Drawings.
  - .1 Coordinate with Divisions 23, HVAC and Division 22, Plumbing. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.
  - .2 Acceptable Manufacturers: Thaler Metal Industries Ltd. Or approved equivalent.
- 2.11.4 Wood Nailer Strips: Comply with requirements in Section 06 10 00.

- 2.11.5 Mastic Sealant: CAN/CGSB-37.29, Polyisobutylene, plain or modified bitumen; nonhardening, nonmigrating, non-skinning, and nondrying.
- 2.11.6 Board Fasteners: Factory-coated steel fasteners and metal plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roofing components to substrate; tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.
- 2.11.7 Conductive Medium: Conductive primer is to be applied atop of cover board to ensure valid electronic leak detection (ELD) testing per ASTM D7877 and ATSM D8231.
  - .1 Acceptable Product: "Truground Conductive Primer" by Detec Systems or approved equivalent.

### **3 .     EXECUTION**

#### **3.1     Examination**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.
- 3.1.2 Inspect materials for defects before installation.
- 3.1.3 Comply with safety regulations of Authority Having Jurisdiction.
- 3.1.4 Roof Openings and Penetrations:
  - .1 Ensure roof openings, penetrations are in place, curbs are set and braced.
  - .2 Ensure roof drain bodies are securely clamped in place.
- 3.1.5 Wood Cants, Blocking, Curbs, and Nailers:
  - .1 Ensure wood cants, blocking, curbs, nailers and similar components are securely anchored to roof deck at penetrations and terminations.
- 3.1.6 For Steel Decks:
  - .1 Verify surface plane flatness and fastening of steel roof deck. Coordinated with Section 05 31 00 - Steel Decking.
  - .2 Verify deck is securely fastened with no projecting fasteners.

#### **3.2     Preparation**

- 3.2.1 Design and selection of materials for temporary roofing are responsibilities of Contractor.

- 3.2.2 Clean substrate of dust, debris, moisture, and substances detrimental to roofing installation in accordance with manufacturer's written instructions. Remove sharp projections.
- 3.2.3 Prevent materials from entering and clogging roof drains and conductors.
- 3.2.4 Avoid spillage or migration of materials onto surfaces of other construction.
- 3.2.5 Remove roof-drain plugs when work is not in progress or when rain is forecast.

### **3.3 Installation, Generally**

- 3.3.1 Installation Compliance: Install roofing membrane system in accordance with roofing system manufacturer's written instructions, reviewed Shop Drawings and applicable recommendations in CRCA's Roofing Specification Manual.
- 3.3.2 Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.

### **3.4 Asphalt Heating**

- 3.4.1 Heat and apply roofing asphalt according to roofing system manufacturer's written instructions.
- 3.4.2 Asphalt Temperature: Heat asphalt to equiviscous temperature before application. Maintain asphalt within recommended temperature limits. Avoid heating near the flash point. Do not heat asphalt within 25 deg F (14 deg C) of flash point. Discard overheated asphalt.
- 3.4.3 Roofing Asphalt Application: Apply within  $\pm 25^{\circ}\text{F}$  ( $\pm 14^{\circ}\text{C}$ ) of equiviscous temperature.
- 3.4.4 Substrate-Joint Penetrations: Prevent asphalt and adhesives from damaging substrate joints or entering building during application.

### **3.5 Thermal Barrier (Roof Sheathing Board) Installation**

- 3.5.1 Install roof sheathing board with long joints in continuous straight lines, perpendicular to roof slopes and with end joints staggered between rows. Tightly butt roof sheathing boards together. Align panels without significant height differences.
- 3.5.2 For adhered applications: use adhesive specified in roof assembly's CSA A123.21 wind uplift test report.

### **3.6 Self-Adhering Sheet Vapour Retarder Installation**

- 3.6.1 Prime substrate as required by manufacturer. Ensure full adhesion by applying pressure during protective film removal.

- 3.6.2 Laps:
- .1 Minimum required side laps for each sheet: 100 mm (4 inches)
  - .2 Minimum required end laps for each sheet: 150 mm (6 inches), respectively.
  - .3 Seal laps by rolling.
- 3.6.3 Completely seal vapour retarder at terminations, obstructions, and penetrations to prevent air infiltration into roofing system.

**3.7 Insulation Installation**

- 3.7.1 Follow manufacturer's instructions for insulation installation. Do not install insulation boards displaying signs of moisture damage.
- 3.7.2 Install insulation using staggered layers to minimize thermal bridging.
- 3.7.3 Install insulation with long joints in a continuous straight line. Stagger end joints between rows.
- 3.7.4 Ensure that edges and ends between boards abut each other. Fill gaps exceeding 6 mm (1/4 inch) with insulation. Cut and fit insulation within 6 mm (1/4 inch) of nailers, projections, and penetrations.
- 3.7.5 Secure preformed 45-degree insulation cant strips at junctures of roofing membrane systems with vertical surfaces or angle changes exceeding 45 degrees.
- 3.7.6 Install tapered insulation under roofing to match slopes indicated on Drawings. Install insulation under roofing membrane to reach required thickness.
- 3.7.7 Provide two or more layers when overall insulation thickness is 75 mm (3 inches) or more.
- 3.7.8 Stagger joints of each succeeding layer at least 150 mm (6 inches) in each direction from joints of previous layer.
- 3.7.9 Trim surface of insulation as needed at roof drains. Ensure completed surface is flush and does not impede flow of water.
- 3.7.10 Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.

**3.8 Cover Board Installation**

- 3.8.1 Install cover board over insulation to protect insulation from roof traffic. Ensure tight, staggered joints. Use adhesive specified in roof assembly's CSA A123.21 wind uplift test report.

**3.9 Roofing Membrane Installation**

- 3.9.1 Presence of Technical Personnel: Begin installation of roofing membrane only in the presence of roofing system manufacturer's



technical personnel. Cooperate with Owner's inspection and testing agencies as needed.

- 3.9.2 Slope Consideration: For roof slopes exceeding 1:12 (1 inch per 12 inches), install roofing membrane sheets parallel to slope. Comply with roofing manufacturers' instructions for steep slope installation. Backnail roofing membrane sheets to nailer strips in accordance with manufacturer's instructions.

3.9.3 Temporary Protection:

- .1 Coordinate roofing system installation to ensure insulation and other non-permanent components are protected against precipitation and are not left uncovered at end of workday or when rain is anticipated.
- .2 Provide tie-offs at the end of each day of work to cover exposed roofing sheets and insulation.
- .3 Complete terminations and base flashings; provide temporary seals to prevent water ingress into completed sections of roofing system.
- .4 Remove and discard temporary seals before starting work on adjoining roofing areas.

3.9.4 **Installation of Roofing Base Sheet Membrane:**

- .1 Procedure:
  - .1 Unroll roofing base sheets. Allow roofing base sheets to relax.
  - .2 Lay base sheet membrane over insulation cover board or substrate indicated.
  - .3 Start installation at low point of roof system and install base sheet according to manufacturer's instructions.
  - .4 Extend and terminate roofing base sheet beyond cants, where applicable.
- .2 Installation Method: As specified in this section.
- .3 Laps:
  - .1 Align roofing sheets accurately, without stretching, ensuring uniform side and end laps with staggered end laps.
  - .2 Bond and seal laps completely, leaving no voids.
  - .3 Repair tears and voids in laps and lapped seams that are not completely sealed.

3.9.5 **Installation of Roofing Cap Sheet Membrane:**

- .1 Procedure:
  - .1 Unroll roofing cap sheets. Allow roofing cap sheets to relax.

- .2 Apply cap sheet over base sheet, starting at low of roofing system.
- .3 Extend and terminate roofing cap sheets beyond cants, where applicable.
- .2 Installation Method: As specified in this section.
- .3 Laps:
  - .1 Accurately align roofing sheets, maintaining uniform side and end laps with staggered end laps.
  - .2 Bond and seal laps completely, leaving no voids.
  - .3 Repair tears and voids in laps and lapped seams that are not completely sealed.
  - .4 Install roofing sheets to ensure side laps and end laps shed water.

**3.10 Membrane Flashing Installation**

- 3.10.1 Install membrane flashing at roof penetrations, walls, and intersections.
- 3.10.2 Install base flashing over cant strips and other sloped and vertical surfaces, at roof edges, and at penetrations through roof. Secure to substrates according to roofing system manufacturer's written instructions.
- 3.10.3 Extend base flashing up walls or parapets a minimum of 200 mm (8 inches) above roofing membrane and 100 mm (4 inches) onto field of roofing membrane.
- 3.10.4 Mechanically fasten top of base flashing securely at terminations and perimeter of roofing. Seal top termination of base flashing.
- 3.10.5 Install roofing membrane cap-sheet flashing where metal flanges and edgings are set on membrane roofing according to roofing system manufacturer's written instructions.

**3.11 Walkway Installation**

- 3.11.1 Install walkway pads using units of size indicated or, if not indicated, of manufacturer's standard size according to walkway pad manufacturer's written instructions.

**3.12 Field Quality Control**

- 3.12.1 Roof Inspection: Contractor must have roof system manufacturer's technical personnel to inspect roofing during installation and on completion to confirm substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components; and to supply reports to Consultant.

- 3.12.2 Roofing system will be considered defective if it does not pass tests and inspections.
- 3.12.3 Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.
- 3.12.4 Roofs are to be tested via Electronic Leak Detection (ELD) as per ASTM D7877. Furnish report prepared by third party testing agency confirming entire roof area is deemed 'watertight'. Any noted breaches are to be repaired and retested prior to issuing report
  - .1 Basis-of-Design: Detec System or approved equivalent not necessitating a stainless steel mesh.

**3.13     Protection**

- 3.13.1 Protect modified bituminous membrane roofing from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades.
- 3.13.2 Promptly replace modified bituminous membrane roofing work damaged during construction that cannot be satisfactorily repaired.

**3.14     Cleaning And Waste Management**

- 3.14.1 Cleaning and Waste Management, generally: in accordance with Section 01 74 00, Cleaning and Waste Management.
- 3.14.2 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
- 3.14.3 Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.
- 3.14.4 Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**END OF SECTION**

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the sheet metal flashing and trim work specified herein. This includes, but is not necessarily limited, to:
  - .1 Exposed sheet metal flashing, trim, and fascia.
  - .2 Flashing accessories.
  - .3 Reglets.
  - .4 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.
  - .1 Related requirements provided below are for convenience purposes only.
    - .1 Section 04 22 00 – Concrete Unit Masonry.
    - .2 Section 07 27 14 – Self-Adhering Sheet Air Barriers and Vapour Retarders
    - .3 Section 07 52 16 - Modified Bituminous Membrane Roofing
    - .4 Section 08 44 13 - Glazed Aluminum Curtain Walls.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

## 1.4 Definitions

1.4.1 Sheet metal thicknesses: Where sheet metal thicknesses and gauges are specified in this Section, they must be in accordance with the following table.

Galvanized			Stainless			Copper			Aluminum		
Gauge	Nominal thickness		Gauge	Nominal thickness		ozs	Theoretical Thickness		Gauge	Standard thickness	
	in	mm		in	mm		in	mm		in	mm
28	0.019	0.48	28	0.015	0.38	10	0.0135	0.34	22	0.025	0.60
26	0.022	0.56	26	0.018	0.46	12	0.0162	0.42	20	0.032	0.80
24	0.028	0.71	24	0.024	0.61	16	0.0216	0.56	18	0.040	1.0
22	0.034	0.87	22	0.030	0.76	20	0.0270	0.68	16	0.051	1.2

## 1.5 Submittals

1.5.1 General Requirements and Procedures for Submittals: In accordance with Section 01 33 00, Submittal Procedures.

1.5.2 Product Data: Submit product data for the following:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for the sheet metal flashing and trim work and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

1.5.3 Product Disclosure and Transparency:

- .1 Environmental Product Declarations (EPD): When available, submit Product-specific Type III EPD or industry-wide (generic) EPD conforming to ISO 14025 or other recognized environmental product declaration framework.
- .2 Material Ingredient Reporting: When available, submit documentation demonstrating chemical inventory of materials to at least 0.1% (1000ppm) and conforming to one of the following:
  - .1 Health Product Declaration open Standard,
  - .2 Cradle to Cradle v2 Basic level or Cradle to Cradle v3 Bronze level,
  - .3 International Living Future Institute Declare
  - .4 Other approved framework.
- .3 When multiple Products are specified, give preference to Products with compliant documentation.

- 1.5.4 Samples: Submit samples for each type of metal panel indicated with factory-applied finishes.
  - .1 Submit two color charts and two finish sample chips from manufacturer's standard color and finish options for each type of finish indicated.
- 1.5.5 Submit for Consultants review, QA checklist used as part of installation process. Make modifications to QA checklist based on Consultant feedback.

**1.6 Quality Assurance**

- 1.6.1 Fabricator's Qualifications: Ensure work of this Section is installed by a company specializing in sheet metal flashing work with five years documented experience and a member in good standing of CRCA.
- 1.6.2 Sealant Compatibility and Adhesion Testing: Use sealant manufacturer's standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
- 1.6.3 Mock-ups: Provide Mock-ups in locations designated by Consultant and as required to demonstrate quality of workmanship. Maintain Mock-ups during construction in an undisturbed condition as a standard for judging the completed work. Coordinate with adjacent building envelope material mock-ups including roofing, cladding, insulation and air barrier work

**1.7 Delivery, Handling, And Storage**

- 1.7.1 Package and protect materials during shipment. Uncrate and inspect materials for damage, dampness, and wet-storage stains upon delivery to job site.
- 1.7.2 Remove from site and replace damaged materials that cannot be satisfactorily restored to like-new condition.
- 1.7.3 Handle sheet metal items to avoid damage to surfaces, edges, and ends.
- 1.7.4 Store materials in dry, weather-tight, ventilated areas until installation.

**1.8 Warranty**

- 1.8.1 Provide warranty covering the Work of this Section in accordance with Supplementary Condition SC49 / GC 12.3 WARRANTY.

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## **2 .     PRODUCTS**

### **2.1     Design/Performance Criteria**

- 2.1.1 Design sheet metal flashing and trim assemblies to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction in accordance with requirements of authorities having jurisdiction.
- 2.1.2 Finished sheet metal assemblies must form a weathertight enclosure without waves, warps, buckles, fastening stresses or distortion, while allowing for expansion and contraction without damage to the system.
- 2.1.3 Provide sheet metal items in 2400 to 3000 mm (8 to 10 ft.) lengths. Single pieces less than 2400 mm (8 ft) long may be used to connect to factory-fabricated inside and outside corners, and at ends of runs.
- 2.1.4 Factory fabricate corner pieces with minimum 300 mm (12 in) legs. Provide accessories and other items essential to complete the sheet metal installation.
- 2.1.5 Provide accessories made of the same or compatible materials as the items to which they are applied. Fabricate sheet metal items of the materials specified below and to the gauge, thickness, or weight Specified in this section.
- 2.1.6 Do not use lead or lead-coated sheet metals.
- 2.1.7 Seismic Performance: Provide products and systems specified in this Section to withstand the effects of earthquake motions in accordance with OBC 4.1.8.18 and CAN/CSA S832.
  - .1 Professional engineer specified in Division 01 and referenced in this Section shall be responsible for designing systems and submitting signed and sealed analysis data and Shop Drawings illustrating seismic-resistant systems.
  - .2 Refer to Structural Drawings for seismic sensitivity values.
- 2.1.8 Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

### **2.2     Materials**

- 2.2.1 Following minimum gauges and / or weights for each metal is as follows:
  - .1 Prepainted Galvanized Steel: 0.71 mm (0.028 in., 24 ga.), commercial quality to ASTM A653/A653M with Z275 (G90) zinc

coating prepainted with baked on enamel with colours of proven durability for exterior exposure, to CSSBI Technical Bulletin No. 7, 5000 series.

- .1 Thickness tolerance: to ASTM A924/A924M  $\pm 0.08$  mm (0.003 in.) for sheet widths not exceeding 1500 mm (60 in.).
  - .2 Aluminium: 1 mm (0.04 in., 18 ga.) aluminium sheet, utility quality to CSA HA Series, plain or embossed finish.
    - .1 Thickness tolerance variation:  $\pm 0.06$  mm (0.0025 in.) based on 1200 mm (48 in.) wide sheet.
- 2.2.2 Sheet Metal Gauges: Unless otherwise indicated on the drawings, use the minimum gauges for the following conditions:
- .1 Fascia Metal: 0.87 mm (0.034 in., 22 ga.) prepainted galvanized sheet steel. Fabricate in minimum 2400 mm (96 in.) long, but not exceeding 3000 mm (10 ft.) long sections. Furnish with 150 mm (6 in.) wide joint cover plates.
  - .2 Counterflashing: 0.71 mm (0.028 in., 24 ga.) prepainted galvanized sheet steel.
  - .3 Other Flashings: 0.50 mm (0.0196 in., 26 ga.) prepainted galvanized sheet steel.
  - .4 Scuppers: 0.71 mm (0.028 in., 24 ga.) prepainted galvanized sheet steel with one piece deck flange, minimum 150 mm. Contour scuppers to cant strips.
  - .5 Hanging Gutters and Downspouts: 0.87 mm (0.034 in., 22 ga.) prepainted galvanized sheet steel. or as required to support loads.
  - .6 Copings: Unless indicated otherwise, provide 0.87 mm (0.034 in., 22 ga.) prepainted galvanized sheet steel. At curtain wall terminations and parapets, provide 3 mm (1/8 in) prefinished aluminum with AAMA 2605 coating to match curtain wall. Fabricate in minimum 2400 mm (96 in.) long, but not exceeding 3000 mm (10 ft.) long sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and interior leg. Miter corners, seal, and solder or weld watertight.
  - .7 Sill Flashing: 0.56 mm (0.022 in, 26 ga.) prepainted galvanized sheet steel.

## **2.3 Underlayment Materials**

### **2.3.1 Self-Adhering, High-Temperature Sheet Underlayment:**

- .1 Material Tag: This item is noted as "AVBM-2" on Drawings and Schedules.



- .2 Description: Minimum 0.76 mm (30 mils) thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.
- .3 Thermal Stability: ASTM D1970 or equivalent to CAN/CGSB-51.33; stable after testing at 116 deg C (240 deg F) or higher.
- .4 Low-Temperature Flexibility: ASTM D1970 or equivalent to CAN/CGSB-51.33; passes after testing at minus 29 deg C (20 deg F) or lower.
- .5 Basis-of-Design: "Blueskin PE200 HT" by Henry Company or approved equivalent as follows:
  - .1 "Grace Ultra" by GCP Applied Technologies.
  - .2 "Lastobond Shield HT" by Soprema.
- .6 Install self-adhering, high-temperature sheet underlayment over top of parapet walls, at flashing cricket, and where necessary for watertightness. Extend underlayment down the front and back sides of parapet wall to extent covered by metal cap/coping.

## **2.4 Flexible Flashing (Thru-Wall)**

- 2.4.1 Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 1.0 mm (0.039 in)
  - .1 Acceptable Products:
    - .1 "CCW-705-TWF Thru-Wall Flashing" by Carlisle Coatings & Waterproofing
    - .2 "Perm-A-Barrier Wall Flashing" by GCP Applied Technologies.
    - .3 "Blok Lok Airtight 40 Self Adhered Air and Vapour Barrier" by Hohmann & Barnard, Inc.
    - .4 "Air-Shield Thru-Wall Flashing" by W.R. Meadows Inc., Canada
    - .5 "Blueskin TWF" by Henry Company
    - .6 "AquaBarrier™ TWF" by IKO Industries Ltd.
    - .7 "ExoAir TWF" by Tremco Incorporated, an RPM company
    - .8 "Soprseal WFM" by Soprema Inc.
  - .2 Primer: as per manufacturer's recommendation.

- .3 Mechanical fasteners: recommended by flashing manufacturer to suit project requirements.

## **2.5     Liquid Flashing Materials**

- 2.5.1 Liquid-Applied Flashing: Low-VOC resin-based, seamless, reinforced waterproofing system flashing that is compatible with adjacent materials.
  - .1 Provide for waterproofing of atypical flashing details including, but not limited to, mechanical equipment, roof/wall penetrations and similar locations.
  - .2 Acceptable Products:
    - .1 "Alsan Flashing" by Soprema Inc.
    - .2 "MS Detail" by IKO Industries.
    - .3 "PermaFlash" by Johns Manville.

## **2.6     Accessories**

- 2.6.1 Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal unless otherwise indicated.
- 2.6.2 Isolation coating: to ASTM D1187, alkali resistant bituminous paint or epoxy resin solution to provide dielectric separation which will dry to be tack-free and withstand high temperatures.
- 2.6.3 Flashing Nails: #12 hot dipped zinc coated, annular ringed.
- 2.6.4 Plastic Cement: to ASTM D2822.
- 2.6.5 Lap Cement: to ASTM D3019.
- 2.6.6 Sealant: one component, elastomeric, chemical curing, to ASTM C920 with VOC content compliant with SCAQMD Rule #1168.
- 2.6.7 Fasteners: Same metal as sheet metal flashing or other noncorrosive metal as recommended by sheet metal manufacturer. Match finish of exposed heads with material being fastened. Confirm compatibility of fasteners and items to be fastened to avoid galvanic corrosion due to dissimilar materials.
- 2.6.8 Mastic Sealant: Polyisobutylene; non-hardening, non-skinning, nondrying, non-migrating sealant.
- 2.6.9 Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior and interior nonmoving joints, including riveted joints.

- 2.6.10 Adhesives: Type recommended by flashing sheet metal manufacturer for waterproof and weather-resistant seaming and adhesive application of flashing sheet metal.
- 2.6.11 Metal Accessories: Use sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of Work, matching or compatible with material being installed; noncorrosive, size and thickness required for performance.

## **2.7      Fabrication, Generally**

- 2.7.1 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- 2.7.2 Backpaint sheet metal with bituminous paint on surface in contact with concrete, masonry, cementitious materials or dissimilar metal.
- 2.7.3 Provide coping and cap flashing at all parapets, and other flashing and trim where appropriate and necessary for a complete, weather-tight construction.
- 2.7.4 Sheet Metal Fabrication Standard: Fabricate units to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, material, metal thickness, and other characteristics of item indicated.
- 2.7.5 Fabricate units that fit substrates and result in waterproof and weather-resistant performance once installed. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
- 2.7.6 Form exposed sheet metal without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems.
- 2.7.7 Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- 2.7.8 Expansion Provisions: Space movement joints at maximum of 3 m (10-ft) with no joints allowed within 600 mm (24 in) of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 25 mm (1 in) deep, filled with mastic sealant (concealed within joints).
- 2.7.9 Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
- 2.7.10 Separate metal from non-compatible metal or corrosive substrates by coating concealed surfaces at locations of contact with asphalt mastic or other permanent separation as recommended by manufacturer.

- 2.7.11 Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of sheet metal exposed to public view.
- 2.7.12 Fabricate cleats and attachment devices from same material as sheet metal component being anchored or from compatible, noncorrosive metal recommended by sheet metal manufacturer.
  - .1 Size Cleats and clips as recommended by SMACNA manual or sheet metal manufacturer for application but not less than thickness of metal being secured.

### **3 . EXECUTION**

#### **3.1 Examination**

- 3.1.1 Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.
- 3.1.2 Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, cant strips and reglets in place and nailing strips located.
- 3.1.3 Verify membrane termination and base flashings are in place, sealed and secure.
- 3.1.4 Notify Consultant of any unsatisfactory conditions. Do not proceed with this work until conditions have been corrected.
- 3.1.5 Commencement of work shall imply acceptance of conditions and substrates.

#### **3.2 Examination**

- 3.2.1 Site Verification of Conditions:
  - .1 Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.
- 3.2.2 Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, cant strips and reglets in place and nailing strips located.
- 3.2.3 Verify membrane termination and base flashings are in place, sealed and secure.
- 3.2.4 Notify Consultant of any unsatisfactory conditions. Do not proceed with this work until conditions have been corrected.

- 3.2.5 Commencement of work shall imply acceptance of conditions and substrates.

### **3.3 Preparation**

- 3.3.1 Field measure site conditions prior to fabricating work.
- 3.3.2 Install starter, edge strips and cleats before starting installation.
- 3.3.3 Install surface mounted reglets true to lines and levels. Seal top of reglets with sealant.
- 3.3.4 Insert flashings into reglets to form tight fit. Secure in place with plastic wedges. Seal flashings into reglets with sealant.
- 3.3.5 Secure flashings in place using concealed fasteners. Use exposed fasteners only in locations accepted by Consultant.
- 3.3.6 Apply plastic cement compound between metal flashings and felt flashings.
- 3.3.7 Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- 3.3.8 Provide and maintain continuity of air barrier/vapour barrier to adjacent dissimilar materials. Seal to form weathertight seal between flashing and adjoining surfaces and between flashing and other work.

### **3.4 Installation**

- 3.4.1 Conform to drawing details included in CRCA manuals (FL series details) as applicable. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
- 3.4.2 Anchor units of Work securely in place, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install Work with laps, joints, and seams that will be permanently watertight and weatherproof.
- 3.4.3 Install exposed units that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
- 3.4.4 Install units to fit substrates and to result in waterproof and weather-resistant performance.
- 3.4.5 Expansion Provisions: Accommodate thermal expansion of exposed sheet metal. Space movement joints at maximum of 3 m (10 ft) with no joints allowed within 600 mm (24 in.) of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weatherproof and

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- waterproof, form expansion joints of intermeshing hooked flanges, not less than 25 mm (1 in.) deep, filled with mastic sealant (concealed within joints).
- 3.4.6 Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 38 mm (1-1/2-in.), except where pre-tinned surface would show in finished Work.
- .1 Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
- 3.4.7 Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards. Fill joint with sealant and form metal to completely conceal sealant.
- .1 Use joint adhesive for nonmoving joints specified not to be soldered.
- 3.4.8 Seams: Install flat-lock seams at nonmoving seams. Tin edges to be seamed, form seams, and solder.
- 3.4.9 Separations: Separate metal from non-compatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as recommended by manufacturer.
- 3.4.10 Install reglets to receive counter-flashing according to manufacturer's installation instructions. Select appropriate reglet configuration to assure a weather-tight installation.
- 3.4.11 Counter-flashings: Coordinate installation of counter-flashings with installation of assemblies to be protected by counter-flashing. Install counter-flashings in reglets or receivers. Secure in a waterproof manner by means of snap-in installation and sealant, lead wedges and sealant, interlocking folded seam, or blind rivets and sealant. Lap counter-flashing joints a minimum of 50 mm (2 in) and bed with sealant.
- 3.4.12 Parapet Scuppers: Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
- .1 Anchor scupper closure trim flange to exterior wall and seal with elastomeric sealant to scupper.
- .2 Loosely lock front edge of scupper with conductor head.
- .3 Seal with elastomeric sealant exterior wall scupper flanges into back of conductor head.
- 3.4.13 Cap/Coping: Anchor to resist uplift and outward for wind zone indicated on Structural Drawings.

- .1 Interlock exterior bottom edge of coping with continuous cleats anchored to substrate at 600 mm (24-in) centers.
  - .2 Anchor interior leg of coping with screw fasteners and washers at 600 mm (24 in) centers.
  - .3 Splice joints to have 150 mm (6 in) wide concealed splice plates. Bed with sealant for watertightness.
  - .4 Provide shop welded, prefabricated corners. Provide continuous hold-down strips. Provide all fasteners in a finish and colour to match the coping.
- 3.4.14 Equipment Support Flashing: Coordinate equipment support flashing installation with roofing and equipment installation. Weld or seal flashing to equipment support member.
- 3.4.15 Roof-Penetration Flashing: Coordinate roof-penetration flashing installation with roofing and installation of items penetrating roof. Install flashing as follows:
- .1 Turn lead flashing down inside vent piping, being careful not to block vent piping with flashing.
  - .2 Seal and clamp flashing to pipes penetrating roof, other than lead flashing on vent piping.
- 3.4.16 Immediately after installation, clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.

### **3.5 Cleaning And Protection**

- 3.5.1 Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.
- 3.5.2 Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

**END OF SECTION**

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**1. GENERAL**

**1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

**1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the roof accessories work specified herein. This includes, but is not necessarily limited, to:
- .1 Roof hatches.
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

**1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

**1.4 Action Submittals**

- 1.4.1 Product Data: Submit in accordance with Division 01 for each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- 1.4.2 Shop Drawings: Submit in accordance with Division 01 for roof accessories. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

**1.5 Informational Submittals**

- 1.5.1 Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
- .1 Size and location of roof accessories specified in this Section.
  - .2 Method of attaching roof accessories to roof or building structure.



- .3 Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
- .4 Required clearances.

**1.6 Closeout Submittals**

- 1.6.1 Operation and Maintenance Data: Submit in accordance with Division 01 for roof accessories to include in operation and maintenance manuals.

**1.7 Coordination**

- 1.7.1 Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
- 1.7.2 Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

**1.8 Warranty**

- 1.8.1 Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.
- .1 Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
    - .1 Colour fading more than 5 Hunter units when tested according to ASTM D 2244.
    - .2 Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - .3 Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - .2 Finish Warranty Period: 20 years from date of Substantial Performance of the Work.

**2 . PRODUCTS**

**2.1 Roof Hatch**

- 2.1.1 Roof Hatches: Metal roof-hatch units with lids and insulated single-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.

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- .1 Acceptable Manufacturers
    - .1 Babcock-Davis.
    - .2 Bilco Company (The).
    - .3 Nystrom.
    - .4 Approved equivalent.
  - 2.1.2 Type and Size: Single-leaf lid, 915 by 915 mm (36 by 36 inches).
  - 2.1.3 Loads: Minimum 1.9-kPa (40-lbf/sq. ft.) external live load and 0.95-kPa (20-lbf/sq. ft.) internal uplift load, but not less than calculated loadings for roofing membrane. .
  - 2.1.4 Hatch Material: Zinc-coated (galvanized) steel sheet, 2.01 mm (0.079 inch) thick.
    - .1 Finish: Baked enamel or powder coat.
    - .2 Colour: As selected by Consultant from manufacturer's full range.
  - 2.1.5 Construction:
    - .1 Insulation: Polyisocyanurate board.
    - .2 Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
    - .3 Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
    - .4 Fabricate curbs to minimum height of 300 mm (12 inches) unless otherwise indicated.
  - 2.1.6 Hardware: Stainless-steel spring latch with turn handles, butt- or pintle-type hinge system, and padlock hasps inside and outside.
    - .1 Provide two-point latch on lids larger than 2130 mm (84 inches).
  - 2.1.7 Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with OHSa requirements and authorities having jurisdiction.
  - 2.1.8 Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.
  - 2.1.9 Basis-of-Design: "Thermally Broken Roof Hatch – Type E-50-TB" by Bilco or approved equivalent.
  - 2.1.10 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

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**2.2     General Finish Requirements**

- 2.2.1 Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- 2.2.2 Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

**3 .     EXECUTION**

**3.1     Examination**

- 3.1.1 Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- 3.1.2 Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- 3.1.3 Verify dimensions of roof openings for roof accessories.
- 3.1.4 Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2     Installation**

- 3.2.1 General: Install roof accessories according to manufacturer's written instructions.
  - .1 Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
  - .2 Anchor roof accessories securely in place so they are capable of resisting indicated loads.
  - .3 Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
  - .4 Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- 3.2.2 Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

- .1 Coat concealed side of uncoated aluminum and stainless-steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
- .2 Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene sheet.
- .3 Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

3.2.3 Roof-Hatch Installation:

- .1 Install roof hatch so top surface of hatch curb is level.
- .2 Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
- .3 Attach safety railing system to roof-hatch curb.
- .4 Attach ladder-assist post according to manufacturer's written instructions.

3.2.4 Seal joints with methylmetacrylate roof flashing materials and elastomeric sealants as required by roof accessory manufacturer.

**3.3 Repair And Cleaning**

- 3.3.1 Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780.
- 3.3.2 Clean exposed surfaces according to manufacturer's written instructions.
- 3.3.3 Clean off excess sealants.
- 3.3.4 Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 72 76

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## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Applied Fireproofing work specified herein. This includes, but is not necessarily limited, to:
  - .1 Sprayed fire-resistive materials (SFRM).
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only.
  - .1 Section 07 81 23, Intumescent Fireproofing for mastic and intumescent fire-resistive coatings.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Preinstallation Meetings**

- 1.4.1 Pre-installation Meetings: Schedule, and conduct pre-installation meeting at Project Site, in order to coordinate work of this Section, with work of related Subcontractors.
  - .1 Ensure attendance of Subcontractor performing work of this Section and representatives of manufacturers and fabricators involved in, or affected by, installation and coordination with other materials and installations that have preceded or will

follow. Advise Consultant and Owner in advance of scheduled meeting dates.

- .2 Agenda: Review progress of other construction activities and preparations for the particular activity under consideration.
- .3 Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
- .4 Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
- .5 Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

## **1.5 Submittals**

1.5.1 General Requirements and Procedures for Submittals: In accordance with Section 01 33 00, Submittal Procedures.

1.5.2 Product Data: Submit product data for each type of product.

- .1 Submit manufacturer's instructions, printed product literature and data sheets for the Applied Fireproofing work and include product characteristics, performance criteria, physical size, finish and limitations.

1.5.3 Product Disclosure and Transparency:

- .1 Environmental Product Declarations (EPD): When available, submit Product-specific Type III EPD or industry-wide (generic) EPD conforming to ISO 14025 or other recognized environmental product declaration framework.
- .2 Material Ingredient Reporting: When available, submit documentation demonstrating chemical inventory of materials to at least 0.1% (1000ppm) and conforming to one of the following:
  - .1 Health Product Declaration open Standard,
  - .2 Cradle to Cradle v2 Basic level or Cradle to Cradle v3 Bronze level,
  - .3 International Living Future Institute Declare
  - .4 Other approved framework.
- .3 When multiple Products are specified, give preference to Products with compliant documentation.

1.5.4 Shop Drawings: Submit framing plans, schedules, or both, indicating the following:

- .1 Extent of fireproofing for each construction and fire-resistance rating.

- .2 Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
- .3 Minimum fireproofing thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
- .4 Treatment of fireproofing after application.
- 1.5.5 Fire Resistance Rating Listings: Submit listings from UL, ULC, or other accredited testing agency indicating type and size of steel member to receive intumescent fire-resistive coatings and minimum dry thickness (mils) to achieve specified fire resistance rating.
- 1.5.6 Samples: Submit samples for each exposed product and for each colour and texture specified, in manufacturer's standard dimensions in size.

## **1.6 Quality Assurance**

- 1.6.1 Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.
- 1.6.2 Mockups: Build mockups to set quality standards for materials and execution.
  - .1 Build mockup of each type of fireproofing and different substrate and each required finish as shown on Drawings.
  - .2 Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Consultant specifically approves such deviations in writing.
  - .3 Reviewed mockups may become part of the completed Work if undisturbed at time of Substantial Performance of the Work.
- 1.6.3 Source Limitations: Obtain fireproofing from single source.

## **1.7 Preconstruction Testing**

- 1.7.1 Preconstruction Testing Service: Contractor must engage a qualified testing agency to perform preconstruction testing on field mockups of fireproofing.
  - .1 Provide test specimens and assemblies representative of proposed materials and construction.
- 1.7.2 Preconstruction Adhesion and Compatibility Testing: Test for compliance with requirements for specified performance and test methods.

- .1 Bond Strength: Test for cohesive and adhesive strength according to ASTM E736. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
- .2 Density: Test for density according to ASTM E605. Provide density indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
- .3 Verify that manufacturer, through its own laboratory testing or field experience, attests that primers or coatings are compatible with fireproofing.
- .4 Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
- .5 For materials failing tests, obtain applied-fireproofing manufacturer's written instructions for corrective measures including the use of specially formulated bonding agents or primers.

#### **1.8     Field Conditions**

- 1.8.1 Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 5 deg C (41 deg F) or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.
- 1.8.2 Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

#### **1.9     Warranty**

- 1.9.1 Provide warranty covering the Work of this Section in accordance with Supplementary Condition SC49 / GC 12.3 WARRANTY.

### **2 .     PRODUCTS**

#### **2.1     Manufacturers**

- 2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.
  - .1 A/D Fire Protection Systems.
  - .2 Carboline Company.
  - .3 GCP Applied Technologies Inc.
  - .4 Isolatek International (Cafco)



- 2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

## **2.2 Design And Performance Requirements**

- 2.2.1 Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.
- 2.2.2 Fire-Resistance Design: Indicated on Drawings, tested according to CAN/ULC-S101 and in accordance with OBC Subsection 3.1.7 "Fire Resistance Rating". Identify products with appropriate markings of applicable testing agency.
- .1 Steel members in floor and roof construction are to be chosen from designs in which the load was calculated using the Limit States Design method.
  - .2 Beam or joists designs bearing the language "Load Restricted — Assembly evaluated in accordance with Working Stress Design methods" or similar Load Restricted language is not to be considered, unless specifically noted otherwise.
  - .3 Engineered Judgment: For assemblies not tested and rated in accordance with CAN/ULC-S101 or equivalent method, submit proposals based on related designs using accepted fireproofing design criteria acceptable to authorities having jurisdictions.
- 2.2.3 Low-Emitting Materials: Fireproofing used within the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- 2.2.4 Provide products containing no asbestos.
- 2.2.5 Ensure materials do not induce deterioration of members to which they are applied.
- 2.2.6 Ensure bonding agents, binders, accessories, cleaning solvents, aggregates and sealers are in accordance with base material manufacturer's recommendation.
- 2.2.7 Ensure mixing water is potable, clear and free from injurious amounts of oil, acid, alkali, organic matter, sediment or any other deleterious or stain-producing substances harmful to fireproofing materials.

## **2.3 Sprayed Fire-Resistive Materials (SFRM)**

- 2.3.1 SFRM Type 1 - Standard Durability: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with

indicated fire-resistance design, and mixed with water at Project site to form a slurry or mortar before conveyance and application with following characteristics:

- .1 Bond Strength: Minimum 9.58-kPa (200 psf) cohesive and adhesive strength based on field testing according to ASTM E736.
- .2 Density: Not less than 240 kg/cu. m (15 pcf) and as specified in the approved fire-resistance design, according to ASTM E605.
- .3 Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design or ASTM E605, whichever is thicker, but not less than 9 mm (0.375 inch).
- .4 Surface-Burning Characteristics: Comply with CAN/ULC S102 (or equivalent to ASTM E84, subject to acceptable by authorities having jurisdiction); testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - .1 Flame-Spread Index: 0.
  - .2 Smoke-Developed Index: 0.
- .5 Compressive Strength: Minimum 68.9 kPa (10 psi) according to ASTM E761.
- .6 Corrosion Resistance: No evidence of corrosion according to ASTM E937.
- .7 Deflection: No cracking, spalling, or delamination according to ASTM E759.
- .8 Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E760.
- .9 Air Erosion: Maximum weight loss of 0 g/sq. m (0 g/sq. ft.) in 24 hours according to ASTM E859.
- .10 Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens per ASTM G21.
- .11 Finish: Spray-textured finish.
- .12 Basis-of-Design: "Southwest Type 5GP" by Carboline Company.
- .13 Application: Interior fireproofing for structural components concealed above ceiling, or within wall, chase, or furred space Interior locations.

## **2.4 Auxiliary Materials**

- 2.4.1 Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by ULC, UL or another testing

and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated on Drawings and Schedules.

- 2.4.2 Substrate Primers: Primers approved by fireproofing manufacturer and complying with one or both of the following requirements:
  - .1 Primer and substrate are identical to those tested in required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
  - .2 Primer's bond strength in required fire-resistance design complies with specified bond strength for fireproofing and with requirements in ULC's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction, based on a series of bond tests according to ASTM E736.
- 2.4.3 Bonding Agent: Product approved by fireproofing manufacturer and complying with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction.
- 2.4.4 Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required, according to fire-resistance designs indicated on Drawings and Schedules and fireproofing manufacturer's written recommendations. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive fireproofing.
- 2.4.5 Reinforcing Fabric: Glass- or carbon-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated on Drawings and Schedules; approved and provided by fireproofing manufacturer.
- 2.4.6 Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated on Drawings and Schedules; approved and provided by fireproofing manufacturer. Include pins and attachment.
- 2.4.7 Sealer: Transparent-drying, water-dispersible, tinted protective coating recommended in writing by fireproofing manufacturer for each fire-resistance design.
  - .1 Acceptable Product: as recommended by manufacturer.

### **3 . EXECUTION**

#### **3.1 Examination**

- 3.1.1 Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other

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conditions affecting performance of the Work and according to each fire-resistance design. Verify compliance with the following:

- .1 Substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
  - .2 Objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
  - .3 Substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.
- 3.1.2 Verify that concrete work on steel deck has been completed before beginning fireproofing work.
  - 3.1.3 Verify that roof construction, installation of roof-top HVAC equipment, and other related work is complete before beginning fireproofing work.
  - 3.1.4 On structural steel members to receive sprayed fire resistive materials, ensure corrosion protection primers and galvanized primers are not applied. If primed surfaces cannot be avoided, ensure primers are compatible with fireproofing materials and bond requirements.
  - 3.1.5 Conduct tests according to fireproofing manufacturer's written recommendations to verify that substrates are free of substances capable of interfering with bond.
  - 3.1.6 Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
  - 3.1.7 Proceed with installation only after unsatisfactory conditions have been corrected.

## **3.2 Preparation**

- 3.2.1 Cover other work subject to damage from fallout or overspray of fireproofing materials during application.
- 3.2.2 Clean substrates of substances that could impair bond of fireproofing.
- 3.2.3 For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

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**3.3     Application**

- 3.3.1 Construct fireproofing assemblies that are identical to fire-resistance design indicated on Drawings and Schedules and products as specified, tested, and substantiated by test reports; for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting fireproofing work.
- 3.3.2 Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated on Drawings and Schedules.
- 3.3.3 Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.
  - .1 Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
  - .2 Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.
- 3.3.4 Metal Decks:
  - .1 Do not apply fireproofing to underside of metal deck substrates until concrete topping, if any, has been completed.
  - .2 Do not apply fireproofing to underside of metal roof deck until roofing has been completed; prohibit roof traffic during application and drying of fireproofing.
- 3.3.5 Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written recommendations for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.
- 3.3.6 Spray apply fireproofing to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.
- 3.3.7 Extend fireproofing in full thickness over entire area of each substrate to be protected.
- 3.3.8 Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.
- 3.3.9 For applications over encapsulant materials, including lockdown (post-removal) encapsulants, apply fireproofing that differs in colour from that of encapsulant over which it is applied.

- 3.3.10 Where sealers are used, apply products that are tinted to differentiate them from fireproofing over which they are applied.
- 3.3.11 Provide a uniform finish complying with description directed on Site for each type of fireproofing material and matching finish approved for required mockups.
- 3.3.12 Cure fireproofing according to fireproofing manufacturer's written recommendations.
- 3.3.13 Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.
- 3.3.14 Finishes: Where indicated on Drawings and Schedules, apply fireproofing to produce the following finishes:
  - .1 Manufacturer's Standard Finishes: Finish according to manufacturer's written instructions for each finish selected.
  - .2 Spray-Textured Finish: Finish left as spray applied with no further treatment.
  - .3 Rolled, Spray-Textured Finish: Even finish produced by rolling spray-applied finish with a damp paint roller to remove drippings and excessive roughness.
  - .4 Skip-Troweled Finish: Even leveled surface produced by troweling spray-applied finish to smooth out the texture and neaten edges.
  - .5 Skip-Troweled Finish with Corner Beads: Even, leveled surface produced by troweling spray-applied finish to smooth out the texture, eliminate surface markings, and square off edges.

#### **3.4 Field Quality Control**

- 3.4.1 Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated on Drawings and Schedules and required for approved fire-resistance design.
- 3.4.2 Fireproofing will be considered defective if it does not pass tests and inspections.
- 3.4.3 Remove and replace fireproofing that does not pass tests and inspections, and retest.
- 3.4.4 Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

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3.4.5 Prepare test and inspection reports.

**3.5 Cleaning, Protecting, And Repairing**

- 3.5.1 Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.
- 3.5.2 Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing will be without damage or deterioration at time of Substantial Performance of the Work.
- 3.5.3 As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.
- 3.5.4 Repair fireproofing damaged by other work before concealing it with other construction.
- 3.5.5 Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

**3.6 Fireproofing Schedule**

- 3.6.1 Columns: Refer to Drawings.
- 3.6.2 Floor decks and floor supports: Refer to Drawings.

END OF SECTION

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Intumescent Fire Protection work specified herein. This includes, but is not necessarily limited, to:
- .1 Mastic and intumescent fire-resistive coatings (IFRM).
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only.
- .1 Section 07 81 00 , Applied Fireproofing for sprayed fire-resistive materials (SFRM).

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Preinstallation Meetings**

- 1.4.1 Pre-installation Meetings: Schedule, and conduct pre-installation meeting at Project Site, in order to coordinate work of this Section, with work of related Subcontractors.
- .1 Ensure attendance of Subcontractor performing work of this Section and representatives of manufacturers and fabricators involved in, or affected by, installation and coordination with other materials and installations that have preceded or will follow. Advise Consultant and Owner in advance of scheduled meeting dates.
  - .2 Agenda: Review progress of other construction activities and preparations for the particular activity under consideration.
  - .3 Record significant discussions, agreements, and disagreements, including required corrective measures and actions.



- .4 Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
- .5 Review products, design ratings, restrained and unrestrained conditions, thicknesses, and other performance requirements.

## **1.5      Sequencing**

- 1.5.1 Sequence and coordinate application of intumescent fire-resistive coatings with related work specified in other Sections to comply with the following requirements:
  - .1 Coordinate installation of intumescent fire-resistive coatings with other items of work that may interfere with proper installation of coatings.
  - .2 Do not begin applying intumescent fire-resistive coatings until clips, hangers, supports, and other welded connections have been installed. Intumescent coatings manufacturer must approve in writing any clips, hangers, supports or connections that may be installed over coating using mechanical or adhesive devices.
  - .3 Provide temporary enclosures as necessary to prevent deterioration of intumescent fire-resistive coatings due to exposure to unfavorable environmental conditions.
  - .4 Take appropriate steps to avoid abrasion and other damage to the applied intumescent fire-resistive coatings during construction operations.
  - .5 not protect or conceal structural members to which intumescent fire-resistive coatings have been applied until each area has been inspected, tested, and corrections have been made to deficient areas.

## **1.6      Action Submittals**

- 1.6.1 Product Data: Submit product data in accordance with Division 01 for the following:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for the Intumescent Fire Protection work and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Mastic and intumescent fire-resistive coatings.
  - .3 Substrate primers.
  - .4 Reinforcing fabric.
  - .5 Reinforcing mesh.
  - .6 Topcoat.
- 1.6.2 Shop Drawings: Submit framing plans or schedules, or both, in accordance with Division 01 indicating the following:

- .1 Extent of fire protection for each construction and fire-resistance rating.
  - .2 Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
  - .3 Minimum mastic and intumescent fire-resistive coating thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
  - .4 Treatment of mastic and intumescent fire-resistive coating after application.
- 1.6.3 Fire Resistance Rating Listings: Submit listings from UL, ULC, or other accredited testing agency indicating type and size of steel member to receive intumescent fire-resistive coatings and minimum dry thickness (mils) to achieve specified fire resistance rating.
- 1.6.4 Samples: Submit samples in accordance with Division 01 for each exposed product and for each colour and texture specified, in manufacturer's standard dimensions in size.

**1.7 Informational Submittals**

- 1.7.1 Product Certificates: Submit product certificates in accordance with Division 01 for each type of fireproofing.
- 1.7.2 Evaluation Reports: Submit evaluation reports in accordance with Division 01 for fireproofing, from CCMC or equivalent report from ICC-ES acceptable to authorities having jurisdiction.

**1.8 Quality Assurance**

- 1.8.1 Manufacturer Qualifications: Provide Products from manufacturer with local direct technical employee(s) (as distinct from distributors or authorized agents) readily available at Project site. Intumescent coatings must be manufactured under the follow-up services program of Underwriter's Laboratories (UL) or UL Canada (ULc) and bear the UL (and/or ULc) label mark).
- 1.8.2 Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by mastic and intumescent fire-resistive coating manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.
- 1.8.3 Mock-ups: Build mock-ups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for materials and execution.
- .1 Build mockup of each required finish as shown on Drawings.
  - .2 Extent of Mockups: Approximately 0.5 sq m (5 sq. ft.) of surface for each product indicated.

- .3 Notify Consultant one week in advance of the dates and times when mockups will be built.
- .4 Review of mock-ups does not constitute approval of deviations from the Contract Documents contained in mock-ups unless Consultant specifically approves such deviations in writing.
- .5 Retain and maintain mockups during construction in undisturbed condition as a standard for judging completed units of work.
- .6 Subject to compliance with requirements, reviewed mock-ups may become part of the completed Work if undisturbed at time of Substantial Performance of the Work.

1.8.4 Source Limitations: Obtain fire protection from single source.

## **1.9 Delivery, Storage And Handling**

- 1.9.1 Deliver materials to Project in manufacturer's unopened packages, bearing manufacturer's labels, application instructions and certification labels for fire hazard and fire resistance classifications and other identifying data. Packages shall bear ULC, cUL or WH labels and seals for fire resistance ratings.
- 1.9.2 Deliver and store Products in dry, protected area off ground in original, undamaged sealed containers.
- 1.9.3 Store intumescent fire-resistive coatings protected from direct sunlight and maintained at a temperature as specified by the manufacturer. The product must not be frozen or stored at freezing temperatures. Identify and label material damaged due to improper storage, remove from Project site and properly discard.
- 1.9.4 Remove damaged packages found unsuitable for use and any materials which have come into contact with contaminants prior to use.

## **1.10 Field Conditions**

### **1.10.1 Environmental Limitations:**

- .1 Do not apply fire protection when ambient or substrate temperature is outside of range recommended by manufacturer, or less than 10 deg C (50 deg F) (whichever is less) unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.
- .2 Do not install intumescent fire-resistive coatings when relative humidity is outside the limits established by the manufacturer. Consult manufacturer to determine precautions that may be implemented to prevent condensation from forming on the steel during application of fireproofing.

- 1.10.2 Ventilation: Ventilate building spaces during and after application of fire protection, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fire protection dries thoroughly.

**1.11 Warranty**

- 1.11.1 Provide warranty covering the Work of this Section in accordance with Supplementary Condition SC49 / GC 12.3 WARRANTY.

**2 . PRODUCTS**

**2.1 Manufacturers**

- 2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.
- .1 Contego International Inc.
  - .2 Hilti, Inc.
  - .3 International Protective Coatings (Akzo Nobel).
  - .4 Isolatek International (Cafco)
  - .5 Sherwin Williams Company
- 2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

**2.2 Performance Requirements**

- 2.2.1 Assemblies: Provide fire protection, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.
- 2.2.2 Fire-Resistance Design: Indicated on Drawings, tested according to CAN/ULC-S101 or equivalent to ASTM E119 or UL 263 by a qualified testing agency in accordance with OBC Subsection 3.1.7 "Fire Resistance Rating". Identify products with appropriate markings of applicable testing agency.
- .1 Steel members are to be considered unrestrained unless specifically noted otherwise.
  - .2 Engineered Judgment: For assemblies not tested and rated in accordance with CAN/ULC-S101 or equivalent method, submit proposals based on related designs using accepted fireproofing design criteria acceptable to authorities having jurisdictions.
- 2.2.3 Provide products containing no asbestos.
- 2.2.4 Ensure materials do not induce deterioration of members to which they are applied.

- 2.2.5 Ensure bonding agents, binders, accessories, cleaning solvents, aggregates and sealers are in accordance with base material manufacturer's recommendation.
- 2.2.6 Ensure mixing water is potable, clear and free from injurious amounts of oil, acid, alkali, organic matter, sediment or any other deleterious or stain-producing substances harmful to fireproofing materials.
- 2.2.7 Low-Emitting Materials: Coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

**2.3 Interior-Grade Mastic And Intumescent Fire-Resistive Coating**

- 2.3.1 Material Tag: This item is noted as "IFRM-1" on Drawings and Schedules.
- 2.3.2 Mastic and Intumescent Fire-Resistive Coating: Manufacturer's standard, factory-mixed formulation, and complying with indicated fire-resistance design.
  - .1 Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design.
  - .2 Surface-Burning Characteristics: Per CAN/ULC-S102/S102.2 with results indicated below. Mark products with appropriate testing agency labels.
    - .1 Flame-Spread Index: 0
    - .2 Smoke-Developed Index: 50 or less.
  - .3 Hardness: Not less than 60 Shore D durometer or 96 Shore A durometer hardness, according to ASTM D2240.
  - .4 Finish: As selected by Consultant from manufacturer's standard finishes.
    - .1 Colour and Gloss: As selected by Consultant from manufacturer's full range.
    - .2 Finish: "ARCHITECTURAL FINISH"
  - .5 Application: Designated for "interior general purpose" and "conditioned interior space purpose" use by a qualified testing agency acceptable to authorities having jurisdiction.
  - .6 Basis-of-Design: "Firetex FX5120" by Sherwin Williams or approved equivalent.

**2.4 Auxiliary Materials**

- 2.4.1 Provide auxiliary materials that are compatible with mastic and intumescent fire-resistive coating and substrates and are approved

by ULC, UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.

- 2.4.2 Substrate Primers: Primers approved by mastic and intumescent fire-resistive coating manufacturer which have been tested by manufacturer for compatibility in fire conditions and complying with required fire-resistance design by UL, ULC or another testing and inspecting agency acceptable to authorities having jurisdiction.
- 2.4.3 Reinforcing Fabric: Glass- or carbon-fibre fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by mastic and intumescent fire-resistive coating manufacturer.
- 2.4.4 Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated; approved and provided by mastic and intumescent fire-resistive coating manufacturer. Include pins and attachment.
- 2.4.5 Topcoat: Suitable for application over mastic and intumescent fire-resistive coating; of type recommended in writing by mastic and intumescent fire-resistive coating manufacturer for each fire-resistance design.
  - .1 Colour: To be selected by Consultant at later date, and may include custom colour not necessarily in manufacturer's standard range.

### **3 . EXECUTION**

#### **3.1 Examination**

- 3.1.1 Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design.
  - .1 Verify that substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fire protection with substrates under conditions of normal use or fire exposure.
  - .2 Verify that objects penetrating fire protection, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
  - .3 Verify that substrates receiving fire protection are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fire protection application.

- 3.1.2 Conduct tests according to mastic and intumescent fire-resistive coating manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.
- 3.1.3 Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- 3.1.4 Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2      Preparation**

- 3.2.1 Cover other work subject to damage from fallout or overspray of fire protection materials during application.
- 3.2.2 Clean substrates of substances that could impair bond of fire protection.
- 3.2.3 Prime substrates where included in fire-resistance design and where recommended in writing by mastic and intumescent fire-resistive coating manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fire protection. Primer must be fully cured prior to installation of intumescent coating.
- 3.2.4 For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fire protection. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

### **3.3      Application**

- 3.3.1 Construct fire protection assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, topcoats, finishing, and other materials and procedures affecting fire protection Work.
- 3.3.2 Comply with mastic and intumescent fire-resistive coating manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fire protection; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- 3.3.3 Coordinate application of fire protection with other construction to minimize need to cut or remove fire protection.
  - .1 Do not begin applying fire protection until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.

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- .2 Defer installing ducts, piping, and other items that would interfere with applying fire protection until application of fire protection is completed.
  - 3.3.4 Install auxiliary materials as required, as detailed, and according to fire-resistance design and mastic and intumescent fire-resistive coating manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by mastic and intumescent fire-resistive coating manufacturer.
  - 3.3.5 Spray apply fire protection to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by mastic and intumescent fire-resistive coating manufacturer.
  - 3.3.6 Extend fire protection in full thickness over entire area of each substrate to be protected.
  - 3.3.7 Install body of fire protection in a single course unless otherwise recommended in writing by mastic and intumescent fire-resistive coating manufacturer.
  - 3.3.8 Provide a uniform finish complying with description indicated for each type of fire protection material and matching finish approved for required mock-ups.
  - 3.3.9 Cure fire protection according to mastic and intumescent fire-resistive coating manufacturer's written instructions.
  - 3.3.10 Do not install enclosing or concealing construction until after fire protection has been applied, inspected, and tested and corrections have been made to deficient applications.
  - 3.3.11 Finishes: Where indicated, apply fire protection to produce the following finishes:
    - .1 Manufacturer's Standard Finishes: Finish according to manufacturer's written instructions for each finish selected.
    - .2 Spray-Textured Finish: Finish left as spray applied with no further treatment.
    - .3 Rolled, Spray-Textured Finish: Even finish produced by rolling spray-applied finish with a damp paint roller to remove drippings and excessive roughness.



### 3.4 Finishing Schedule

FINISH	APPLICATION	APPEARANCE	AREA OF USE
BASIC FINISH	Spray applied with no further treatment	Stippled, "orange peel" appearance	Concealed areas
COMMERCIAL FINISH	First coat spray applied, second coat thinned, topcoat spray applied	Uniform appearance with minor "orange peel" appearance	Visible areas viewed at distance greater than 6m
ARCHITECTURAL FINISH	First coat spray applied, sanded flat, second coat thinned, top coat spray applied	Smooth appearance	Visible areas viewed at distance less than or equal to 6m

### 3.5 Field Quality Control

- 3.5.1 Manufacturer's Services: Manufacturer's technical representative must be on site during start of installation and generally available on site as requested during the application process.
- 3.5.2 Inspections: Owner may engage a qualified independent testing agency to perform the following special inspections:
  - .1 Test and inspect as required by AWCI Technical Manual 12-B and NFCA 400 Field Quality Assurance Procedure.
- 3.5.3 Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fire protection for the next area until test results for previously completed applications of fire protection show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.
- 3.5.4 Fire protection will be considered defective if it does not pass tests and inspections.
  - .1 Remove and replace fire protection that does not pass tests and inspections, and retest.
  - .2 Apply additional fire protection, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.
- 3.5.5 Prepare test and inspection reports.

**3.6     Cleaning**

- 3.6.1    Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

**3.7     Protection**

- 3.7.1    Protect fire protection, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fire protection is without damage or deterioration at time of Substantial Performance of the Work.

**3.8     Repairs**

- 3.8.1    As installation of other construction proceeds, inspect fire protection and repair damaged areas and fire protection removed due to work of other trades.
- 3.8.2    Repair fire protection damaged by other work before concealing it with other construction.
- 3.8.3    Repair fire protection by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Firestopping And Smoke Seals work specified herein. This includes, but is not necessarily limited, to:
- .1 Through-penetration firestops:
    - .1 For openings created to allow a penetrating item such as piping, conduits, raceways, ducts, cable trays, cables, tubing or structural components to pass completely through a fire separation or fire-resistance rated assembly.
  - .2 Membrane penetration firestops:
    - .1 For openings where penetrating items such as piping, conduits, raceways, ducts, cable trays, cables, tubing, recessed components (e.g.: panels, electric boxes, devices) or structural components pass through only one membrane of a fire separation or fire-resistance rated assembly.
  - .3 Blank opening firestops:
    - .1 For openings created in a fire separation where the penetrating item has not yet been installed or has been removed.
  - .4 Construction joint firestops:
    - .1 For locations where adjacent fire separations or components of fire separations meet. These locations include: ceiling/wall and roof/wall joints, wall/wall joints at corners or in the same plane, wall/floor joints, floor/floor joints and ceiling/ceiling joints.
    - .2 Includes firestops for seismic joints, vertical control joints, expansion joints, and joints which occur at the tops and bottoms of fire separation walls.
    - .3 Includes firestops for head of wall to non-rated roof or floor assemblies.
  - .5 Building perimeter firestops:

- .1 For the space between a fire-resistance rated floor assembly and the curtain wall (e.g.: safing slot gaps).
  - .6 Auxiliary tested accessories such as sealants, insulation, damming materials, boards, primers, collars required to complete firestopping work, excluding those inside sealed mechanical and electrical assemblies.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only.
- .1 Section 07 81 00, Applied Fireproofing

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Definitions**

- 1.4.1 Fire Blocking: materials, components or system installed in a concealed space in the building to restrict the spread of fire and smoke in that concealed space or from that concealed space to an adjacent space.
- 1.4.2 Firestop: a material, component or system, and its means of support, used to protect gaps between fire separations, between fire separations and other construction assemblies, or used in openings where penetrating items wholly or partially penetrate fire separations, to restrict the spread of fire and smoke thus maintaining the fire-resistance continuity of a fire separation.
- 1.4.3 Firestop System: the combination of specific materials and/or devices required with the penetrating item(s), the assembly and the opening to assemble the firestop.
- 1.4.4 Intumescent: materials that expand with heat to prevent fire spread through fire separations.
- 1.4.5 Listed Firestop System: a specific field erected construction consisting of the assembly, firestop materials, any penetrating items and their means of support which have met the requirements for an F, FT, FH, FTH and/or L rating when tested in a fire-resistance rated assembly in accordance CAN/ULC-S115-18.
- .1 F-Rating: the amount of time a firestop system can remain in place without the passage of flame through the opening or the occurrence of flaming on the unexposed face of the firestop.

- .2 FT-Rating: a firestop system with an F-Rating for the required time period which can also resist the transmission of heat through the firestop during the same period and limit the rise in temperature on the unexposed face and/or penetrating item of the firestop.
- .3 FH-Rating: a firestop system with an F-Rating for the required time period which can also resist the force of a hose stream without developing openings for a prescribed period.
- .4 FTH-Rating: a firestop system with an FT-Rating for the required time period which also passed the hose stream test for a prescribed period.
- .5 L-Rating: largest test sample leakage rate, determined in accordance with CAN/ULC-S115.
- 1.4.6 Multi-penetration: two or more service penetrations through an opening in the fire separation.
- 1.4.7 Non-rated Fire Separation: fire separation acting as a barrier to the spread of smoke until a response is initiated such as the activation of a fire suppression system.
- 1.4.8 Single-penetration: single service penetration through an opening in the fire separation.
- 1.4.9 System Design Listing: document providing proof of testing with technical details, specifications and requirements that leads to the application of a specific listed firestop system.
- 1.4.10 Dry location or area: A location not normally subject to dampness.
- 1.4.11 Damp/wet location or area: Exterior or interior location that is normally or periodically subject to condensation of moisture in, on, or adjacent to, Work of this Section. This includes location in which water or other liquid can drip, splash, or flow on or against Work of this Section. This includes, but is not limited to, mechanical rooms, showers, drying areas, change rooms, kitchen areas, washrooms, and associated vestibules and corridors.

## **1.5 Administrative Requirements**

- 1.5.1 Pre-installation Meetings: Schedule, and conduct pre-installation meeting at Project Site, in order to coordinate work of this Section, with work of related Subcontractors.
  - .1 Ensure attendance of Subcontractor performing work of this Section and representatives of manufacturers and fabricators involved in, or affected by, installation and coordination with other materials and installations that have preceded or will follow. Advise Consultant and Owner in advance of scheduled meeting dates.

- .2 Agenda: Review progress of other construction activities and preparations for the particular activity under consideration.
  - .3 Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
  - .4 Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
- 1.5.2 Sequencing:
- .1 Proceed with installation only when submittals have been reviewed by Consultant.
  - .2 Firestops located in floor assemblies: install before interior partition erections.
  - .3 Metal deck bonding: unless noted otherwise on system design listing and manufacturer's installation instructions, firestopping to precede spray applied fireproofing to ensure required bonding.
  - .4 Pipe and duct insulation: Provide certified firestop system component.
  - .5 Ensure pipe and duct insulation installation precedes firestopping.
- 1.5.3 Coordination:
- .1 Coordinate construction of openings and penetrating items to ensure that Firestopping and smoke seals is installed according to specified requirements.
  - .2 Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate Firestopping and smoke seals.
  - .3 Do not cover up firestopping and smoke seal installations that will become concealed behind other construction until each installation has been examined by inspection and testing agency and authorities having jurisdictions as required.

## **1.6 Action Submittals**

- 1.6.1 Product Data: Submit product data in accordance with Division 01 for each type of product indicated on Drawings and Schedules.
- .1 Submit manufacturer's instructions, printed product literature and data sheets for the Firestopping And Smoke Seals work and include product characteristics, performance criteria, physical size, finish and limitations.
- 1.6.2 Shop Drawings: Submit Shop Drawings in accordance with Division 01 for each Firestopping and smoke seals system. Include location and design designation of qualified testing and inspecting agency.

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- .1 Ensure Shop Drawings indicate material characteristics, details of construction, connections and relationship with adjacent construction. Submit complete and detailed Shop Drawings indicating ULC and/or cUL assembly number certification and material safety data sheets. In addition to minimum requirements, indicate following:
    - .1 Required temperature, hose stream and flame ratings,
    - .2 Material thicknesses,
    - .3 Installation methods,
    - .4 Primers,
    - .5 Damming materials as applicable.
  - .2 Coordinate and ensure shop Drawings for firestopping and smoke seals inside sealed mechanical and electrical assemblies are reviewed by Divisions 21, 22, 23 and 26 respectively.
- 1.6.3 Engineering Judgments (EJs):
- .1 Where there is no specific tested listed firestop system available from the manufacturer for a particular firestop configuration, review systems from other manufacturers to obtain a listed firestop system.
  - .2 Submit an Engineering Judgment (EJ) from the system manufacturer if there are no listed systems available from other manufacturers.
  - .3 Prepare and submit an EJ in accordance with best practices established in the following documents:
    - .1 IFC Guidelines for Evaluating Engineering Judgments.
    - .2 IFC Guidelines for Evaluating Engineering Judgments - Perimeter Fire Barrier Systems.
  - .4 For each EJ submitted, include:
    - .1 Project name, number and location.
    - .2 A description of the proposed system with detailed drawing.
    - .3 Installation instructions.
    - .4 Complete descriptions of critical elements for the firestop configuration.
    - .5 Copies of all referenced system design listings on which the EJ is based on.
    - .6 EJ issuer name and contact information.
    - .7 Date of issue of EJ with authorization signature of issuer.

- .8 Manufacturer letter stating their opinion, with supporting justification, that the EJ will perform as a firestop system were it to be subjected to the appropriate standard fire test method for the required fire rating duration.
- 1.6.4 Once the EJ has been reviewed, submit the EJ to the authority having jurisdiction for final approval.
- 1.6.5 EJ shall be issued only by firestop manufacturer's qualified technical personnel or in concert with the manufacturer by a knowledgeable registered Professional Engineer, a Fire Protection Engineer or an independent testing agency that provides testing and listing services for firestop systems similar to the EJ being contemplated.
- 1.6.6 EJ shall be based upon interpolations of previously tested firestop systems that are either sufficiently similar in nature or clearly bracket the conditions upon which the Engineering Judgment is to be given. Additional knowledge and technical interpretations based upon accepted engineering principles, fire science and fire testing guidelines (e.g.: ASTM E2032) may also be used as further support data.
- 1.6.7 EJ shall be based upon knowledge of the elements of the construction to be protected and understanding of the probable behaviour of that construction and the recommended firestop system protecting it were they to be subjected to the adequate standard fire test method for the required fire rating duration.
- 1.6.8 EJ shall be limited to the specific conditions and configurations upon which EJ was rendered and should be based upon reasonable performance expectations for the recommended firestop system under those conditions.
- 1.6.9 EJ shall be accepted only for a single specific job and location and should not be transferred to any other job or location without thorough and appropriate review of all aspects of the next job or location's circumstances.

**1.7 Closeout Submittals**

- 1.7.1 Submit in accordance with Section 01 78 00.
- 1.7.2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual. Include:
  - .1 WHMIS Safety Data Sheets (SDS).
  - .2 Product data and manufacturer's installation and maintenance instructions for each product/system used on this project.
  - .3 Approved system design listings and Engineering Judgments.



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- .4 Matrix schedule listing all system design listings and Engineering Judgments with a description of their penetration or joint type.
  - .5 Manufacturer's field reports.
  - .6 Warranty information on firestop installations.
  - 1.7.3 As-built Drawings:
    - .1 Submit marked-up set of drawings to provide referencing system identifying the location of each firestop.
    - .2 Identify each penetration type firestop with their penetration identification number.
    - .3 Provide detailed drawings of system design listings for each type of firestop (i.e.: through-penetration, membrane penetration, blank opening, construction joint, building perimeter).
  - 1.7.4 Closeout Firestop Schedules:
    - .1 Submit complete firestop schedules for floors, walls and ceilings. Submit documentation for each application addressed.
    - .2 Indicate all penetration firestops and joint firestops through each reference wall, floor and ceiling in the schedules.
    - .3 Cross-reference firestop schedules with as-built drawings and indicate design listing numbers associated to each penetration firestop and joint firestop.
    - .4 As a minimum, indicate the following for through-penetration firestops and fire-resistive joint systems:
      - .1 Sequential Location Number
      - .2 Project Name
      - .3 Date of Installation
      - .4 Detailed description of the penetration's location
      - .5 Tested System or Engineered Judgment Number
      - .6 Type of assembly penetrated or type of construction joint.
      - .7 Detailed description of the sizes and types of penetrating items
      - .8 Lineal Footage of the joint (joint systems only)
      - .9 Size of opening or width of the joint
      - .10 Number of sides of assemblies addressed
      - .11 Hourly rating
      - .12 Installer's Name

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**1.8      Maintenance Material Submittals**

**1.8.1   Firestop Documentation Software:**

- .1 Provide firestop documentation manager software capable of documenting and tracking firestop systems during construction, and during Owner's operation activities.
- .2 Software solution must be able to track and document every firestop system installed on project and subsequent additions, changes, or removals.
- .3 Software must have internet connectivity and able to operate on smartphone or tablet device (either iOS, Android or Windows capable) to capture relevant information in real-time.
- .4 As a minimum following is required to be tracked for each firestop application:
  - .1 Product installed,
  - .2 System installed,
  - .3 Date of installation,
  - .4 Location of penetration including notations on Architectural Drawings,
  - .5 Hourly ratings,
  - .6 Name of installer,
  - .7 Photos (pre-installation and post-installation),
  - .8 Inspection status.
- .5 Owner may require additional items to be tracked.
- .6 Basis-of-Design Software: "Hilti CFS-DM" by Hilti (Canada) Corporation or approved equivalent.

**1.9      Quality Assurance**

- 1.9.1   Installer Qualifications:** A firm experienced in installing Firestopping and smoke seals similar in material, design, and extent to that indicated on Drawings and Schedules for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its Firestopping and smoke seals products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
- .1 Installer must be recognized as a Member in Good Standing with the Firestop Contractors International Association (FCIA). Submit written proof of current membership.

- .2 Training: workers, including site supervisor, to have completed:
  - .1 Manufacturer training on the products/systems installed as part of this Section.
- .3 Certified Firestop Contractor: company certified with one of the following programs:
  - .1 ULC Qualified Firestop Contractor Program. Submit signed copy of ULC Qualified Firestop Contractor Program certificate.
  - .2 FM 4991 Approved Firestop Contractor. Submit signed copy of FM 4991 Approval certificate.
- 1.9.2 Single Source Responsibility: Provide products from a single manufacturer, to the greatest extent possible, to perform all firestopping work. Materials of different manufacturers will not be permitted without written authorization from Consultant.
  - .1 Materials of different manufacturers than allowed by the tested and listed system shall not be intermixed in the same firestop system or opening.
  - .2 Tested and listed, classified firestop systems are to be used. If another manufacturer has a tested and listed system, then that system shall be used prior to an Engineering Judgment (EJ) or Equivalent Fire Resistance Rated Assembly (EFRRA).
- 1.9.3 Mock-ups: Provide Mock-ups in locations designated by Consultant and as required to demonstrate quality of workmanship. Maintain Mock-ups during construction in an undisturbed condition as a standard for judging the completed work. Provide mock-up of typical firestopping system as shown on reviewed Shop Drawings.

#### **1.10 Delivery, Storage And Handling**

- 1.10.1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle materials in accordance with Section 01 61 00.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
  - .3 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, ULC markings, manufacturing date, shelf life expiry date.
- 1.10.2 Storage and Protection:
  - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

- .2 Replace defective, expired or damaged materials with new.
- .3 Coordinate delivery of materials with scheduled installation dates to allow minimum storage time on site.
- .4 Comply with recommended procedures, precautions and measures described in WHMIS Safety Data Sheets (SDS).

**1.11 Project Conditions**

- 1.11.1 Environmental Limitations: Do not install Firestopping and smoke seals when ambient or substrate temperatures are outside limits permitted by Firestopping and smoke seals manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- 1.11.2 Install and cure Firestopping and smoke seals per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

**1.12 Warranty**

- 1.12.1 Provide warranty covering the Work of this Section in accordance with Supplementary Condition SC49 / GC 12.3 WARRANTY.

**2 . PRODUCTS**

**2.1 Manufacturers**

- 2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.
  - .1 3M Fire Protection Products.
  - .2 A/D Fire Protection Systems Inc.
  - .3 Hilti (Canada) Limited.
  - .4 PFP (Passive Fire Protection Partners)
  - .5 Tremco, Inc.; Tremco Fire Protection Systems Group.
- 2.1.2 Basis-of-Design: This specification is based on Products and Systems by Hilti (Canada) Corporation. Comparable Products from manufacturers listed herein, offering functionally, aesthetically equivalent products in Consultant's opinion and subject to Consultant's review will be considered provided they meet the requirements of this Specification
- 2.1.3 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

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## **2.2 Regulatory Requirements**

2.2.1 Fire testing results: Firestopping and smoke seals shall comply with the following requirements:

- .1 Firestopping and smoke seals tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
- .2 Firestopping and smoke seals are identical to those tested per testing standard referenced in this Section. Provide rated systems complying with the following requirements:
  - .1 Firestopping and smoke seals products bear classification marking of qualified testing and inspecting agency.
  - .2 Classification markings on Firestopping and smoke seals correspond to designations listed by the following:
    - .1 ULC and UL in "Fire Resistance Directory."
    - .2 Intertek ETL SEMKO in its "Directory of Listed Building Products."
    - .3 ULC Guide No. 40 U19.

2.2.2 Provide systems selection and analysis, installation and inspection of firestop systems in accordance with the recommended practices detailed in the following guides:

- .1 FCIA Firestop Manual of Practice (MOP).

## **2.3 Design And Performance Requirements**

2.3.1 Provide firestopping and smoke seals that are produced and installed to resist spread of fire according to requirements indicated on Drawings and Schedules, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

2.3.2 Non-rated fire separations: provide L-Rated smoke protection firestop system for application on both sides of separation.

2.3.3 Dynamic joints: where required, fire and smoke stop systems to be designed to accommodate a defined amount of movement to account for expansion or contraction in construction joints and mechanical piping, for movement in structural elements and to accommodate for movement and sound and vibration control in mechanical installations.

2.3.4 Insulated pipes and ducts: listed firestop system designed and tested with actual insulation materials penetrating the fire separation, as indicated on the system design listing.

2.3.5 Wet areas: water based products are unacceptable in wet areas or areas that may be subject to occasional water exposure or

flooding during and after construction. Products use in such areas must have a W-rating.

- 2.3.6 Architectural considerations: when exposed to view, firestop system to consider architectural finish, potential traffic, physical damage and exposure to moisture and heat. Provide firestop systems suitable for these conditions that meet conditions expected.
- 2.3.7 Environment considerations: materials selected to consider the environment in which they will be used during and after curing as well as the intended use of space. Firestop manufacturer to confirm compatibility of the proposed materials/products for the following cases:
  - .1 Spaces requiring resistance to infection and biological spread through assemblies.
  - .2 Spaces containing sensitive electronic equipment.
  - .3 Preventing contamination of laboratory and manufacturing environments.
- 2.3.8 Seismic Performance: Provide products and systems specified in this Section to withstand the effects of earthquake motions in accordance with OBC 4.1.8.18 and CAN/CSA S832.
  - .1 Professional engineer specified in Division 01 and referenced in this Section shall be responsible for designing systems and submitting signed and sealed analysis data and Shop Drawings illustrating seismic-resistant systems.
  - .2 Refer to Structural Drawings for seismic sensitivity values.
- 2.3.9 Penetrations in Fire-Resistance-Rated Walls: Provide Firestopping and smoke seals with ratings determined per CAN/ULC-S115, based on testing at a positive pressure differential of 2.5 Pa (0.01-inch wg).
  - .1 Fire-resistance-rated walls include fire-rated partitions, smoke-barrier walls (0 hour partitions), and fire walls.
  - .2 F-Rating: Not less than the fire-resistance rating of constructions penetrated.
  - .3 L-Rating: Not exceeding 25 L/s per sq. m (5.0 cfm/sq. ft.) of penetration opening at 75 Pa (0.30-inch wg) at both ambient and elevated temperatures.
- 2.3.10 Penetrations in Horizontal Assemblies: Provide Firestopping and smoke seals with ratings determined per CAN/ULC-S115 or equivalent to ASTM E814 or UL 1479, based on testing at a positive pressure differential of 2.5 Pa (0.01-inch wg).
  - .1 Horizontal assemblies include fire-rated floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.

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- .2 F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
  - .3 T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
  - .4 L-Rating: Not exceeding 25 L/s per sq. m (5.0 cfm/sq. ft.) of penetration opening at 75 Pa (0.30-inch wg) at both ambient and elevated temperatures.
- 2.3.11 Penetrations in Smoke Barriers: Provide Firestopping and smoke seals with ratings determined per UL 1479.
- .1 L-Rating: Not exceeding 25 L/s per sq. m (5.0 cfm/sq. ft.) of penetration opening at 75 Pa (0.30-inch wg) at both ambient and elevated temperatures.
- 2.3.12 W-Rating: Provide Firestopping and smoke seals showing no evidence of water leakage when tested according to UL 1479 (minimum Class 1).
- .1 Provide firestop systems with "W" Water Resistance ratings (minimum Class 1), in addition to F, T and L ratings, where indicated or required by Authorities Having Jurisdiction.
- 2.3.13 Exposed Firestopping and smoke seals: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per CAN/ULC-S102/S102.2 or equivalent to ASTM E84.
- 2.3.14 Joints at Exterior Curtain-Wall/Floor Intersections: Provide fire-resistive joint systems with rating determined by CAN/ULC-S115 based on testing at a positive pressure differential of 2.5 Pa (0.01-inch wg) per ASTM E2307.
- .1 Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.
  - .2 Rain and water resistance: provide perimeter joint sealant tested in accordance with ASTM D6904 with less than 1 hour tack free time as tested in accordance with ASTM C679
- 2.3.15 Low-Emitting Materials: Firestopping and smoke seals sealants and sealant primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- 2.3.16 Microbial and Fungal Resistance: Provide firestopping capable of achieving a Class 1 rating when tested in accordance with ASTM G21 for antibacterial and antifungal properties to inhibit growth of bacteria, mould, mildew and fungi.

2.3.17 Accessories: Provide components for each Firestopping and smoke seals system that are needed to install fill materials and to maintain ratings required. Use only those components specified by Firestopping and smoke seals manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.

- .1 Permanent forming/damming/backing materials, including the following:
  - .1 Slag-wool-fiber or rock-wool-fiber insulation.
  - .2 Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
  - .3 Fire-rated form board.
  - .4 Fillers for sealants.
  - .5 Temporary forming materials.
  - .6 Substrate primers.
  - .7 Collars.
  - .8 Steel sleeves.

2.3.18 Compatibility: Firestopping and smoke seals systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

- .1 Ensure Firestop Materials coming directly in contact with plastic pipe or plastic coated wire have undergone Firestop Material compatibility testing by Systems manufacturer or pipe and wire manufacturer.
- .2 All firestop systems coming into contact with CPVC Piping (direct or indirect) shall be FBC system compatible (This includes spray applied Firestop materials as overspray onto CPVC Pipe)
- .3 Ensure materials and Products provided do not cause stresses, chemical or physical reactions, or other damages to penetrating items or adjacent materials.
- .4 Ensure compatibility of firestop system components with abutting dissimilar membranes, architectural coatings, finishes at floors, walls and ceilings. Check with manufacturer requirements of materials being installed.
- .5 Ensure firestop system exposed to ambient conditions do not deteriorate after curing during and after completion of construction.
- .6 Ensure firestopping systems do not affect structural integrity of load bearing walls and assemblies. Coordinate with Consultant prior to penetrating any load bearing assembly.



.7 Ensure firestopping systems do not affect acoustical performance of acoustical assemblies.

2.3.19 General Emissions Evaluation: Applicable Products (paints, coatings, adhesives, sealants, flooring, ceilings, walls or insulation) specified in this section, including auxiliary materials and accessories must be tested and determined compliant in accordance with California Department of Public Health (CDPH) Standard Method v1.2–2017 "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers", using the applicable exposure scenario.

2.3.20 VOC Content Requirements for Paints and Coatings: Paints and coatings wet-applied on site must meet the applicable VOC limits of the California Air Resources Board (CARB) Suggested Control Measure (SCM) for Architectural Coatings, or the South Coast Air Quality Management District (SCAQMD) Rule 1113. Methylene chloride and perchloroethylene must not be intentionally added in paints, coatings, adhesives, or sealants.

2.3.21 VOC Content Requirements for Adhesives and Sealants: Adhesives and sealants wet-applied on site must meet the applicable chemical content requirements of SCAQMD Rule 1168. Methylene chloride and perchloroethylene must not be intentionally added in paints, coatings, adhesives, or sealants. Do not use adhesives that contain urea formaldehyde.

## **2.4 Materials**

2.4.1 Provide asbestos-free materials and systems capable of maintaining effective barrier against the passage of flame, smoke and water and the transmission of heat in compliance with requirements of CAN-ULC-S115 and not to exceed opening sizes for which they are intended, as indicated on System Design Listing.

2.4.2 Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer plastic sleeve lined with an intumescent strip, a radial or square extended flange attached to one end of the sleeve for fastening to concrete formwork.

2.4.3 Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

2.4.4 Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

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- 2.4.5 Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.
  - 2.4.6 Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
  - 2.4.7 Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
  - 2.4.8 Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
  - 2.4.9 Firestop Block: Ready-to-use, Non-curing, reusable solution intumescent flexible block designed to seal medium to large size openings.
  - 2.4.10 Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
  - 2.4.11 Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
    - .1 Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.
    - .2 Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.
  - 2.4.12 Firestop Joint Spray: sprayable fire rated mastic for construction joint; maximum flexibility in accordance with ASTM E1966 and UL 2079; containing no halogens, solvents or asbestos; water based, paintable.
  - 2.4.13 Cementitious matrices: Capable of providing minimum 2758 kPa (400 psi) compressive strength when cured, to retard cable tray warping within firestop seal.
  - 2.4.14 Primers: As required by firestopping manufacturer and compatible with selected system and contiguous materials.
  - 2.4.15 Water: Potable
  - 2.4.16 Pipe and duct insulation and wrappings: compatible with firestopping systems.
  - 2.4.17 Intumescent pads: Permanently pliable type.
  - 2.4.18 Intumescent composite sheet: Composite sheet, strip or precut shapes.

- 2.4.19 Re-penetrable Sealants: Non curing, re-penetrable intumescent sealants, caulking or putty materials for use with flexible cable or cable bundles.
- 2.4.20 Accessories: Provide miscellaneous components needed to Install fill materials and to maintain ratings required. Use only components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency. Accessories include, but are not limited to, the following items:
- .1 Permanent forming/damming/backing materials in accordance with manufacturer's recommendations, including the following:
    - .1 Slag-/rock-wool-fiber insulation.
    - .2 Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
    - .3 Fire-rated form board.
    - .4 Fillers for sealants.
  - .2 Temporary forming materials.
  - .3 Substrate primers.
  - .4 Collars.
- 2.4.21 Gypsum Products: The use of gypsum products for through-penetration firestopping is strictly prohibited.

## **2.5     Mixing**

- 2.5.1 For those products requiring mixing before application, comply with Firestopping and smoke seals manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated on Drawings and Schedules.

## **3 .     EXECUTION**

### **3.1     Examination**

- 3.1.1 Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- 3.1.2 Examine substrates, openings, voids, adjoining construction and conditions under which firestop is to be installed. Confirm compatibility of surfaces. Verify penetrating items are securely

fixed and properly located with proper space allowance between penetrations and surfaces of openings.

- 3.1.3 Confirm locations of exposed/non-exposed firestopping/smoke seal surfaces prior to application. Provide movement capability at movement joints in accordance with design requirements for movement joint.
- 3.1.4 Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2      Preparation**

- 3.2.1 Surface Cleaning: Clean out openings immediately before installing Firestopping and smoke seals to comply with manufacturer's written instructions and with the following requirements:
  - .1 Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of Firestopping and smoke seals.
  - .2 Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with Firestopping and smoke seals. Remove loose particles remaining from cleaning operation.
  - .3 Remove laitance and form-release agents from concrete.
- 3.2.2 Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- 3.2.3 Masking Tape: Use masking tape to prevent Firestopping and smoke seals from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

### **3.3      Installation**

- 3.3.1 Comply with UL, ULC, and cUL, listings and manufacturer's instructions for type of material and condition of opening in each case. Consult with manufacturer to determine proper procedure for conditions not fully covered by printed instructions. Record in writing any oral instructions received, with copy to manufacturer.
- 3.3.2 Install Firestopping and smoke seals to comply with manufacturer's written installation instructions and published drawings for products and applications indicated on Drawings and Schedules.

- 3.3.3 Provide firestopping to all penetrations passing through fire resistance rated wall and floor assemblies and other locations as indicated on Drawings.
- 3.3.4 Remove excess firestopping material promptly as work progresses and upon completion. Provide leak-proof dams as required to seal openings and contain firestop until cured. Install damming in accordance with test design and manufacturer's instructions.

### **3.4      Identification**

- 3.4.1 Identify Firestopping and smoke seals with pressure-sensitive, self-adhesive, preprinted plastic labels. Attach labels permanently to surfaces adjacent to and within 150 mm (6 inches) of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Include the following information on labels:
  - .1 The words "Warning - Firestopping and smoke seals - Do Not Disturb. Notify Building Management of Any Damage."
  - .2 Contractor's name, address, and phone number.
  - .3 Designation of applicable testing and inspecting agency.
  - .4 Date of installation.
  - .5 Manufacturer's name.
  - .6 Installer's name.
- 3.4.2 Identification labels and markings to be indelible for the expected service life of the installation.
- 3.4.3 Provide identification labels at each penetration.

### **3.5      Field Quality Control**

- 3.5.1 Manufacturer's services: A manufacturer's direct representative (not distributor or agent) must be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures in accordance with manufacturer's written recommendations published in literature and drawing details.

### **3.6      Cleaning And Protection**

- 3.6.1 Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by Firestopping and smoke seals manufacturers and that do not damage materials in which openings occur.
- 3.6.2 Provide final protection and maintain conditions during and after installation that ensure that Firestopping and smoke seals is without damage or deterioration at time of Substantial

Performance of the Work. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated Firestopping and smoke seals and install new materials to produce systems complying with specified requirements.

**3.7 Firestopping And Smoke Seals Schedule**

**3.7.1 Provide listed Firestop and smoke seal systems at:**

- .1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.
- .2 Edge of floor slabs at curtain wall and precast concrete panels.
- .3 Top of fire-resistance rated masonry and gypsum board partitions.
- .4 Intersection of fire-resistance rated masonry and gypsum board partitions.
- .5 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.
- .6 Penetrations through fire-resistance rated floor slabs, ceilings and roofs.
- .7 Openings and sleeves installed for future use through fire separations.
- .8 Around mechanical and electrical assemblies penetrating fire separations.
- .9 At expansion joints between fire-rated walls and other assemblies.
- .10 Openings around structural support members that penetrate floors/walls.
- .11 Openings and penetrations in fire rated walls or partitions containing fire doors.
- .12 Penetrations made through fire-resistant rated assemblies in existing facility buildings for, but not necessarily limited to, mechanical and electrical services.

**3.7.2 Firestopping and smoke seals at openings where reinstallation occurs: UL or cUL listed, Elastomeric or re-useable cementitious matrix or putty seal; do not use permanent cementitious seal at such locations.**

**3.7.3 Firestopping and smoke seals at openings around penetrations for electrical bus ducts, pipes, ductwork and other electrical and mechanical items requiring sound and vibration control or allowance for expansion, contraction and other movement: UL or cUL listed, Elastomeric seal; do not use a cementitious or rigid seal at such locations.**

- 3.7.4 Firestopping and smoke seals at joints and spaces designed and required to allow movement (building movement joints, deflection spaces, control joints, expansion joints, and similar locations): UL or cUL listed, flexible, elastomeric seal suitable to withstand required movement and capable of returning to original configuration without damage to seal and without adhesive or cohesive failure; do not use a cementitious or rigid seal at such locations.

**Firestop Schedule for Through-Penetration Systems.**

TYPE OF PENETRANT	F-RATING (HR)	CONCRETE FLOORS	CONCRETE OR BLOCK WALLS	GYPSUM WALLS
		BASIS OF DESIGN UL/cUL SYSTEM		BASIS OF DESIGN UL/cUL SYSTEM
CIRCULAR BLANK OPENINGS	1	F-A-0006, C-AJ-0055, C-AJ-0090	C-AJ-0055, C-AJ-0090	--
	2	F-A-0006, C-AJ-0055, C-AJ-0090	C-AJ-0055, C-AJ-0090	--
	3	F-A-0006, C-AJ-0055, C-AJ-0086, F-A-0014	C-AJ-0055, C-AJ-0086	--
METAL PIPES OR CONDUIT	1	C-AJ-1226, F-A-1028, F-A-1017	C-AJ-1226, W-J-1067, W-J-1020	W-L-1054, W-L-1058, W-L-1164, W-L-1506
	2	C-AJ-1226, F-A-1028, F-A-1017	C-AJ-1226, W-J-1067, W-J-1020, W-J-1248	W-L-1054, W-L-1058, W-L-1164, W-L-1506
	3	C-AJ-1226, F-A-1017	C-AJ-1226, W-J-1041, W-J-1068	--
	4	C-BJ-1037, C-BJ-1034	C-BJ-1034, C-BJ-1037, W-J-1041, W-J-1042, W-J-1068	W-L-1110, W-L-1111, W-L-1165
NON-METALLIC PIPE OR CONDUIT (I.E. PVC, CPVC, ABS, FRP, ENT)	1	F-A-2053, F-A-2025, C-AJ-2109, C-AJ-2098, C-AJ-2271, C-AJ-2167, C-BJ-2021, C-AJ-2342	C-AJ-2109, C-AJ-2098, C-AJ-2167, C-AJ-2371, C-AJ-2342	W-L-2078, W-L-2075, W-L-2128
	2	F-A-2053, F-A-2025, C-AJ-2109, C-AJ-2098, C-AJ-2271, C-AJ-2167, C-BJ-2021, C-AJ-2371, C-AJ-2342	C-AJ-2109, C-AJ-2098, C-AJ-2167, C-AJ-2371, C-AJ-2342	W-L-2078, W-L-2075, W-L-2128
	3	F-A-2054, C-AJ-2109, C-AJ-2098, C-AJ-2371, C-AJ-2342	C-AJ-2109, C-AJ-2098, C-AJ-2371, C-AJ-2342	--

**Firestop Schedule for Through-Penetration Systems.**

TYPE OF PENETRANT	F-RATING (HR)	CONCRETE FLOORS	CONCRETE OR BLOCK WALLS	GYPSUM WALLS
		BASIS OF DESIGN UL/cUL SYSTEM		BASIS OF DESIGN UL/cUL SYSTEM
	4	C-BJ-2016, C-AJ-2017	W-J-2057, W-J-2091	W-L-2184, W-L-2245
SINGLE OR BUNDLED CABLES	1	F-A-3007, C-AJ-3095, C-AJ-3180, C-AJ-3283	W-J-3036, C-AJ-3095, C-AJ-3180, W-J-3060, W-J-3167	W-L-3065, W-L-3111, W-L-3112, W-L-3334, W-L-3414, W-L-3396
	2	F-A-3007, C-AJ-3095, C-AJ-3334, F-A-3060	W-J-3036, C-AJ-3095, C-AJ-3180, W-J-3060, W-J-3167, W-J-3189	W-L-3065, W-L-3111, W-L-3112, W-L-3334, W-L-3414, W-L-3396
	3	F-A-3007, C-AJ 3095, C-AJ-3285	C-AJ-3095, C-AJ-3180, W-J-3167	--
	4	N/A**	W-J-3050	W-L-3139, W-L-3334
CABLE TRAY	1	C-AJ-4034, C-AJ-4035	W-J-4027, C-AJ-4034, C-AJ-4035	W-L-4011, W-L-4019, W-L-4081
	2	C-AJ-4034, C-AJ-4035	W-J-4027, C-AJ-4034, C-AJ-4035	W-L-4011, W-L-4019, W-L-4081
	3	C-AJ-4034, C-AJ-4035	C-AJ-4034, C-AJ-4035	W-L-3385, W-L-3277
	4	N/A**	W-J-8007	W-L 8014
INSULATED PIPES	1	F-A 5015, F-A 5017, C-AJ-5090, C-AJ-5091, C-AJ-5090, C-AJ-5048	C-AJ-5090, C-AJ-5091, C-AJ 5061, W-J-5042	W-L-5028, W-L-5029, W-L-5047



**Firestop Schedule for Through-Penetration Systems.**

TYPE OF PENETRANT	F-RATING (HR)	CONCRETE FLOORS	CONCRETE OR BLOCK WALLS	GYPSUM WALLS
		BASIS OF DESIGN UL/cUL SYSTEM		BASIS OF DESIGN UL/cUL SYSTEM
	2	F-A 5015, F-A 5017, C-AJ-5090, C-AJ-5091, C-AJ-5090	C-AJ-5090, C-AJ-5091, C-AJ-5061, W-J-5042	W-L-5028, W-L-5029, W-L-5047
	3	F-A 5016, C-AJ-5090, F-A-5018	C-AJ-5090, C-AJ-5061	--
	4	C-BJ-5006	C-BJ-5006, W-J-5028	W-L-5073
ELECTRICAL BUSWAY	1	C-AJ-6006, C-AJ-6017, F-A-6002, C-AJ-6036	C-AJ-6006, C-AJ-6017, C-AJ-6036	--
	2	C-AJ-6006, C-AJ-6017, F-A-6042, C-AJ-6036	C-AJ-6006, C-AJ-6017, C-AJ-6036	--
	3	C-AJ-6006, C-AJ-6017	C-AJ-6006, C-AJ-6017	--
MECHANICAL DUCTWORK WITHOUT DAMPERS (NON-INSULATED)	1	C-AJ-7046, C-AJ-7051, C-AJ-7084	C-AJ-7046, C-AJ-7051, W-J-7021, W-J-7022	W-L-7017, W-L-7040, W-L-7042, W-L-7155
	2	C-AJ-7046, C-AJ-7051, C-AJ-7085	C-AJ-7046, C-AJ-7051, W-J-7021, W-J-7022	W-L-7040, W-L-7042, W-L-7155
	3	C-AJ-7046, C-AJ-7051	C-AJ-7046, C-AJ-7051	--
MECHANICAL DUCTWORK WITHOUT DAMPERS (INSULATED)	1	N/A**	W-J-7029, W-J-7124	W-L-7059, W-L-7153, W-L-7156, W-L-7151
	2	N/A**	W-J-7091, W-J-7112, W-J-7124	W-L-7059, W-L-7153, W-L-7156, W-L-7151
MIXED PENETRANTS	1	C-AJ-8099, C-AJ-8056, C-AJ-8143	C-AJ-8099, C-AJ-8056, W-J-8007, C-AJ-8143	W-L-1095, W-L-8013
	2	C-AJ-8099, C-AJ-8056, C-AJ-8143	C-AJ-8099, C-AJ-8056, W-J-8007, C-AJ-8143	W-L-1095, W-L-8013
	3	C-AJ-8099, C-AJ-8056	C-AJ-8041, C-AJ-8056, W-J-8007, C-AJ-8099	--

**Firestop Schedule for Through-Penetration Systems.**

TYPE OF PENETRANT	F-RATING (HR)	CONCRETE FLOORS	CONCRETE OR BLOCK WALLS	GYPSUM WALLS
		BASIS OF DESIGN UL/cUL SYSTEM		BASIS OF DESIGN UL/cUL SYSTEM
	4	C-AJ-8095	C-AJ-8095, W-J-8007	W-L-8014
<p>** CONTACT MANUFACTURER FOR CURRENT UL-CLASSIFIED SYSTEM OR ENGINEERING JUDGMENT</p> <p>NOTES:</p> <ol style="list-style-type: none"> <li>1. Jobsite conditions of each through-penetration firestop system must meet ALL details of the UL-Classified System selected.</li> <li>2. If jobsite conditions do not match any UL-classified systems in the schedules above, contact Manufacturer for alternative systems or Engineering Judgment</li> <li>3. Where more than one applicable UL-Classified System is listed in the schedules, choose the UL System which is most suited for each through-penetration firestop system.</li> <li>4. Coordinate work with other trades to ensure that penetration opening sizes are appropriate for penetrant locations, and vice versa.</li> </ol>				

**Schedule of Joint Firestop Systems.**

JOINT TYPE	F-RATING (HR)	BASIS OF DESIGN UL/cUL SYSTEM	
		JOINT WIDTH LESS THAN OR EQUAL TO 2"	JOINT WIDTH GREATER THAN 2", LESS THAN OR EQUAL TO 6" <sup>4</sup>
CONCRETE (FLOOR-TO-FLOOR)	1	FF-D-1012, FF-D-1013 <sup>1</sup>	FF-D-1012, FF-D-1013
	2	FF-D-1012, FF-D-1013 <sup>1</sup>	FF-D-1012, FF-D-1013
	3	FF-D-1011, FF-D-1026 <sup>1</sup>	FF-D-1011, FF-D-1026
	4	FF-D-1047	FF-D-1125
CONCRETE (EDGE OF FLOOR SLAB-TO-WALL)	1	FW-D-1011, FW-D-1012, FW-D-1013	FW-D-1011, FW-D-1012, FW-D-1013, FW-D-1021
	2	FW-D-1011, FW-D-1012, FW-D-1013	FW-D-1011, FW-D-1012, FW-D-1013, FW-D-1021
	3	FW-D-1011	FW-D-1011, FW-D-1021
	4	FW-D-1047	FW-D-1092
CONCRETE OR BLOCK WALL TO FLAT CONCRETE FLOOR (TOP-OF-WALL)	1	N/A**	N/A**
	2	HW-D-0097 <sup>1</sup>	HW-D-1009
	3	HW-D-1008 <sup>1</sup> , HW-D 0268	HW-D-1008
	4	HW-D-1042	HW-D-1103
CONCRETE OR BLOCK WALL TO CONCRETE OVER FLUTED METAL DECK (TOP-OF-WALL)	1	HW-D-0098	N/A**
	2	HW-D-0080, HW-D-0081, HW-D-0098	HW-D-1037

**Schedule of Joint Firestop Systems.**

JOINT TYPE	F-RATING (HR)	BASIS OF DESIGN UL/cUL SYSTEM	
		JOINT WIDTH LESS THAN OR EQUAL TO 2"	JOINT WIDTH GREATER THAN 2", LESS THAN OR EQUAL TO 6" <sup>4</sup>
	3	N/A**	N/A**
	4	HW-D-0294	N/A**
GYPSUM WALL TO FLAT CONCRETE FLOOR ( <b>TOP-OF- WALL</b> )	1	HW-D-0757, HW-D-0082, HW-D- 0083, HW-D-0106, HW-D-0119	HW-D-1011, HW-D-1012, HW- 1020
	2	HW-D-0757, HW-D-0082, HW-D- 0083, HW-D-0106, HW-D-0119	HW-D-1011, HW-D-1012, HW- 1020
	3	HW-D-0119	HW-D-1011, HW-D-1012, HW- 1020
GYPSUM SHAFT WALL TO <b>TOP-OF-WALL</b>	2	HW-D-0342 (FLAT CONCRETE) HW-D-0541, HW-D-0542 (CONCRETE OVER METAL DECK)	N/A**
GYPSUM SHAFT WALL TO CONCRETE FLOOR ( <b>BOTTOM-OF-WALL</b> )	1	BW-S-0023	N/A**
	2	BW-S-0023	N/A**
GYPSUM WALL TO CONCRETE FLOOR ( <b>BOTTOM-OF-WALL</b> )	1	BW-S-0001, BW-S-0002, BW-S- 0039	N/A**
	2	BW-S-0001, BW-S-0002, BW-S- 0039	N/A**
GYPSUM WALL TO CONCRETE OVER FLUTED METAL DECK ( <b>TOP-OF-WALL</b> )	1	HW-D-0042*, HW-D-0049*, HW-D- 0087*, HW-D-0089*, HW-D-0045, HW-D-0046*, HW-D-0076*, HW-D- 0077*, HW-D-0154, HW-D-0184*, HW-D-0292, HW-D-0295, HW-D- 538*	HWD-1011, HWD-1012, HW- 1020
	2	HW-D-0042*, HW-D-0049*, HW-D- 0087*, HW-D-0089*, HW-D-0045, HW-D-0046*, HW-D-0076*, HW-D- 0077*, HW-D-0154, HW-D-0184*, HW-D-292, HW-D-0295, HW- D0538*	HW-D-1011, HW-D-1012, HW- D-1020
	3	HW-D-0292, HW-D-0295	HWD-1011, HWD-1012, HW- 1020
	4	HW-D-0292, HW-D-0295	N/A**
CONCRETE ( <b>WALL TO WALL</b> )	2	WW-D-0017, WW-D-0082	WW-D-1080, WW-D-1084
	3	WW-D-1011 <sup>1</sup> , WW-D-0032	WW-D-1011
	4	WW-D-1047	WW-D-1128
GYPSUM TO CONCRETE ( <b>WALL TO WALL</b> )	1	WW-D-0040	N/A**
	2	WW-D-0040	N/A**

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**Schedule of Joint Firestop Systems.**

JOINT TYPE	F-RATING (HR)	BASIS OF DESIGN UL/cUL SYSTEM	
		JOINT WIDTH LESS THAN OR EQUAL TO 2"	JOINT WIDTH GREATER THAN 2", LESS THAN OR EQUAL TO 6" <sup>4</sup>

\* SEE NOTE 3

\*\* Contact manufacturer for current UL/cUL-classified system or engineering judgment

NOTES:

1. Classified systems for 2" - 6" wide joints may be used for joints 2" wide and less.
2. Confirm that movement capabilities of the selected UL/cUL system meets or exceeds the specified movement range of the particular joint.
3. Systems marked with an asterisk (\*) are suitable for top-of-wall joints where the fluted metal deck has sprayed-on fireproofing. Verify with manufacturer prior to application.
4. Verify allowable joint width on specific UL/cUL system drawings.

Schedule of Joints at Exterior Curtain-Wall/Floor Intersections		
Curtain Wall Type	F-Rating (HR)	Basis of Design INTERTEK Systems
Concrete Panel with Steel Framing	2	CEJ 244P (HI/BP 120-07), CEJ 245P (HI/BP 135-01)
Floor to Ceiling Glass, Zero Spandrel	2	HI/BPF 120-10, HI/BPF 120-11, HI/BPF 120-14, HI/BPF 120-15, HI/BPF 120-16
GFRC Spandrel Panel	2	CEJ 400P (HI/BP 120-02)
Glass Spandrel Panel	2	HI/BPF 120-18, HI/BPF 120-19
Glass Spandrel Panel with Back Pan	2	HI/BPF 120-09, HI/BPF 120-12
Granite Spandrel Panel	2	CW-D-1015, CW-D-2026, CW-D-2027, CW-D-2046, CW-S-2031, CW-S-2032
Tilt-Up Concrete Panels	2	CW-D-1001, CW-D-1003, CW-D-1018, CW-S-1007, CW-S-2053, CW-D-2025

END OF SECTION

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Joint Sealants work specified herein. This includes, but is not necessarily limited, to:
- .1 Exterior joint sealants,
  - .2 Interior joint sealants,
  - .3 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only.
- .1 Section 04 22 00, Concrete Unit Masonry for masonry control and expansion joint fillers and gaskets.
  - .2 Section 07 92 00, Joint Sealants
  - .3 Section 08 80 05, General Requirements for Glass and Glazing for glazing sealants.
  - .4 Section 09 21 16, Gypsum Board Assemblies for sealing perimeter joints.
  - .5 Section 09 30 00, Tiling for sealing tile joints.
  - .6 Section 09 51 13, Acoustical Panel Ceilings for sealing edge moldings at perimeters with acoustical sealant.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Administrative Requirements**

- 1.4.1 Pre-installation Meetings: Schedule, and conduct pre-installation meeting at Project Site, in order to coordinate work of this Section, with work of related Subcontractors.

- .1 Ensure attendance of Subcontractor performing work of this Section and representatives of manufacturers and fabricators involved in, or affected by, installation and coordination with other materials and installations that have preceded or will follow. Advise Consultant and Owner in advance of scheduled meeting dates.
- .2 Agenda: Review progress of other construction activities and preparations for the particular activity under consideration.
- .3 Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
- .4 Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.

#### **1.5      Preconstruction Testing**

- 1.5.1 Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
  - .1 Use ASTM C794, ASTM C1087 or manufacturer's standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
  - .2 Stain Testing: Use ASTM C1248 to determine staining potential of silicone sealants in contact with porous and non-porous exterior cladding joint substrates.
  - .3 Submit minimum number of pieces required by sealant manufacturer of each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
  - .4 Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
  - .5 For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
  - .6 Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

#### **1.6      Action Submittals**

- 1.6.1 Product Data: Submit product data in accordance with Division 01 for the following:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for the Joint Sealants work and include product characteristics, performance criteria, physical size, finish and limitations.
- 1.6.2 Samples: Submit manufacturer's colour charts consisting of strips of cured sealants showing the full range of colours available for each product exposed to view.
  - .1 Verification samples: Submit samples of each type and colour of exposed joint sealant required. Provide fully cured joint sealant samples in 19 mm (3/4-inch) wide joints formed between two 300 mm (12-inch) long strips of materials to be sealed.
- 1.6.3 Joint-Sealant Schedule: Include the following information:
  - .1 Joint-sealant application, joint location, and designation.
  - .2 Joint-sealant manufacturer and product name.
  - .3 Joint-sealant formulation.
  - .4 Joint-sealant colour.
- 1.6.4 Submit for Consultants review, QA checklist used as part of installation process. Make modifications to QA checklist based on Consultant feedback.

## **1.7 Informational Submittals**

- 1.7.1 Product Certificates: Submit product certificates in accordance with Division 01 for each kind of joint sealant and accessory, from manufacturer.
- 1.7.2 Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: Submit Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate in accordance with Division 01 for each sealant specified to be validated by SWRI's Sealant Validation Program.
- 1.7.3 Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
  - .1 Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
  - .2 Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- 1.7.4 Field-Adhesion Test Reports: Submit fire-adhesion test reports in accordance with Division 01 for each sealant application tested.
- 1.7.5 Warranties: Submit warranties in accordance with Division 01 for special warranties specified in this section..



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**1.8      Quality Assurance**

- 1.8.1 Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- 1.8.2 Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- 1.8.3 Mockups: Install sealant in mockups of assemblies specified in other Sections that are directed on Site to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

**1.9      Project Conditions**

- 1.9.1 Do not proceed with installation of joint sealants under the following conditions:
  - .1 When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 5 deg C (40 deg F).
  - .2 When joint substrates are wet.
  - .3 Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated on Drawings and Schedules.
  - .4 Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

**1.10     Warranty**

- 1.10.1 Extended Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to Supply joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - .1 Warranty Period:
    - .1 20 years from date of Substantial Performance of the Work for silicone sealants; include coverage against staining substrates exposed to view.
    - .2 Ten years from date of Substantial Performance of the Work for other polymer-modified (hybrid) sealants.
    - .3 Five years from date of Substantial Performance of the Work for polyurethane sealants.
    - .4 Two years from date of Substantial Performance of the Work for latex sealants.

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## **2 . PRODUCTS**

### **2.1 Manufacturers**

2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.

- .1 Master Builders Solutions Canada Inc. (Formerly BASF Canada Inc.);
- .2 GE Silicones (Momentive Performance Materials)
- .3 Master Builders Solutions Canada Inc;
- .4 Pecora Corporation;
- .5 Sika Canada Inc.;
- .6 Tremco Incorporated.

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

### **2.2 Design And Performance Requirements**

2.2.1 Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

2.2.2 Liquid-Applied Joint Sealants: Comply with ASTM C920 and other requirements indicated on Drawings and Schedules for each liquid-applied joint sealant specified, including those referencing ASTM C920 classifications for type, grade, class, and uses related to exposure and joint substrates.

- .1 Suitability for Immersion in Liquids. Where sealants are indicated on Drawings and Schedules for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C1247. Liquid used for testing sealants is deionized water, unless otherwise indicated on Drawings and Schedules.

2.2.3 Stain-Test-Response Characteristics: Where sealants are specified to be non-staining to porous substrates, provide products that have undergone testing according to ASTM C1248 and have not stained porous joint substrates indicated on Drawings and Schedules for Project.

2.2.4 Suitability for Contact with Food: Where sealants are indicated on Drawings and Schedules for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

- 2.2.5 Colours of Exposed Joint Sealants: As selected by Consultant from manufacturer's full range.

## **2.3 Exterior Joint Sealants**

- 2.3.1 Single component, nonsag, neutral curing silicone sealant, ASTM C920, Type S, Grade NS, Class 100/50 or Class 50 as required for applications and joint design, for Use NT or nonstaining silicone sealant according to ASTM C 1248.

- .1 Exterior joints in vertical surfaces and horizontal non-traffic surfaces as follows:

- .1 Construction joints in cast-in-place concrete.
- .2 Control and expansion joints in unit masonry.
- .3 Joints between different materials listed above.
- .4 Perimeter joints between materials listed above and frames of doors, windows and louvers.
- .5 Other joints as indicated on Drawings and Schedules.

- .2 Acceptable Products:

- .1 "Dowsil 790" or "Dowsil 795" or "Dowsil CCS" by Dow Chemical of Canada ULC
- .2 "Spectrem 1" or "Spectrem 2" by Tremco Incorporated
- .3 "Sikasil WS-290" or "Sikasil WS-295" by Sika Canada Inc.
- .4 "Silpruf SCS2000" or "Silpruf LM SCS2700" by GE Silicones (Momentive Performance Materials)
- .5 "890NST" or "864NST" by Pecora Corporation
- .6 Approved equivalent.

- 2.3.2 Single component, nonsag, low dirt pick-up, non-staining, neutral curing silicone sealant, ASTM C920, Type S, Grade NS, Class 100/50 or Class 50 as required for applications and joint design, for Use NT.

- .1 Exterior joints in vertical surfaces and horizontal non-traffic surfaces as follows:

- .1 Joints between plant-precast architectural concrete units.
- .2 Joints in stone masonry and cladding.
- .3 Joints in metal panel substrates.
- .4 Joints between different materials listed above.
- .5 Other joints as indicated on Drawings and Schedules.

- .2 Acceptable Products:

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- .1 "Spectrem 3" or "Spectrem 4 TS" by Tremco Incorporated
  - .2 "Dowsil 756 SMS" by Dow Chemical of Canada ULC
  - .3 "Silpruf NB SCS9000" by GE Silicones (Momentive Performance Materials)
  - .4 "Sikasil WS-290" or "Sikasil WS-295" by Sika Canada Inc
  - .5 Approved equivalent.
- 2.3.3 Single-Component, Nonsag, Traffic-Grade, Neutral-Curing Silicone Joint Sealant, ASTM C920, Type S, Grade NS, Class 100/50, for Use T.
- .1 Exterior joints in horizontal traffic surfaces as follows:
    - .1 Control and expansion joints in brick pavers.
    - .2 Isolation and contraction joints in cast-in-place concrete slabs.
    - .3 Joints between plant-precast architectural concrete paving units.
    - .4 Joints in stone paving units, including steps.
    - .5 Tile control and expansion joints.
    - .6 Joints between different materials listed above.
    - .7 Other joints as indicated on Drawings and Schedules.
  - .2 Acceptable Products:
    - .1 "Dowsil 790" or "Dowsil NS Parking Structure Sealant" by Dow Chemical of Canada ULC
    - .2 "Spectrem 800/900SL" by Tremco Incorporated
    - .3 "Sikasil -728 SL" or "Sikasil -728 NS" by Sika Canada Inc.
    - .4 "301 NS" or "311 NS" by Pecora Corporation
    - .5 Approved equivalent.
- 2.3.4 Single-Component or Multicomponent, Pourable, Traffic-Grade, Urethane Joint Sealant, ASTM C920, Type S or Type M, Grade P, Class 25 or Class 50 as required by joint design, for Use T.
- .1 Exterior joints in horizontal traffic surfaces subject to water immersion as follows:
    - .1 Joints in pedestrian plazas.
    - .2 Joints in swimming pool decks.
    - .3 Other joints as indicated on Drawings and Schedules.
  - .2 Acceptable Products:

- .1 "TH901" or "Vulkem 45 SSL" by Tremco Incorporated
  - .2 "MasterSeal SL1 or MasterSeal SL 2" by Master Builders Solutions"
  - .3 "Urexpan NR-201" by Pecora Corporation
  - .4 "Sikaflex - 1CSL" or "Sikaflex 2C SL " by Sika Canada Inc.
  - .5 Approved equivalent.
- 2.3.5 Single component, nonsag Acrylic latex Type S, ASTM C 920, class 25, Grade NS use NT.
- .1 Exterior expansion joints between tilt-up precast concrete panels
  - .2 Acceptable Products:
    - .1 "Tilt-Seal" by Master Builders Solutions"

## **2.4 Interior Joint Sealants**

- 2.4.1 Single component, nonsag, neutral curing silicone or urethane sealant, ASTM C920, Type S or Type M, Grade NS, Class 50, Class 35 or Class 25 as required for applications and joint design, for Use NT.
- .1 Interior joints in vertical surfaces and horizontal nontraffic surfaces as follows:
    - .1 Control and expansion joints on exposed interior surfaces of exterior walls.
    - .2 Perimeter joints of exterior openings.
    - .3 Tile control and expansion joints.
    - .4 Vertical joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
    - .5 Joints on underside of plant-precast structural concrete beams and planks.
    - .6 Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
    - .7 Other joints as indicated on Drawings and Schedules.
  - .2 Acceptable Products:
    - .1 "Dowsil 791" or "Dowsil 795" or "Dowsil CWS" by Dow Chemical of Canada ULC
    - .2 "Spectrem 2" or "Spectrem 3" or "Dymonic" or "Dymonic FC" by Tremco Incorporated
    - .3 "SilPruf LM SCS2700" by GE Silicones (Momentive Performance Materials)

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- .4 “890NST” or “890FTS” or “864NST” or “PCS” or “DnyaTrol I-XL” or “DynaTrol II” by Pecora Corporation
  - .5 “SikaSil WS-295” by Sika Canada Inc.
  - .6 Approved equivalent.
- 2.4.2 Mildew-Resistant, Single-Component, Nonsag, Silicone Joint Sealant, ASTM C920, Type S, Grade NS, Class 25, for Use NT
- .1 Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces as follows:
    - .1 Joints between plumbing fixtures and adjoining walls, floors, and counters.
    - .2 Tile control and expansion joints.
    - .3 Other joints as indicated on Drawings and Schedules.
  - .2 Acceptable Products: Mildew-Resistant, Single-Component, Acid-Curing or Neutral Curing Silicone Joint Sealant, ASTM C920, Type S, Grade NS, Class 25, for Use NT.
    - .1 “Dowsil 786 Mildew Resistant” or “Dowsil Tub/Ceramic/Tile” by Dow Corning Corporation
    - .2 “Silicones; Sanitary SCS1700” by GE Silicones (Momentive Performance Materials)
    - .3 “Tremsil 200 Sanitary” by Tremco Incorporated
    - .4 “Sikasil GP/GP HT” by Sika Canada Inc.
    - .5 “898 NST” by Pecora Corporation
- 2.4.3 Nonsag, paintable, nonstaining latex complying with ASTM C834 or butyl rubber sealant complying with ASTM C1311.
- .1 Surface Burning Characteristics: Flame spread and smoke developed indexes not greater than 25 and 450, respectively.
  - .2 Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces as follows:
    - .1 Acoustical joints at top and bottom of gypsum board partitions; at top of masonry walls and through non fire-rated penetrations in gypsum and masonry walls.
    - .2 Other joints as indicated on Drawings and Schedules.
  - .3 Acceptable Products:
    - .1 “AC-20 FTR” or “AIS-919” by Pecora Corporation
    - .2 “SHEETROCK Acoustical Sealant” by CGC Inc.
    - .3 “QuietZone Acoustic Sealant” by Owens-Corning Canada Inc.
    - .4 “Tremco Acoustical Sealant” by Tremco Ltd.
    - .5 “QuietSeal” or “QuietSeal 350” by Serious Materials.

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- .6 "CP506 – Smoke and Acoustic Sealant" by Hilti
  - .7 "RCS20" by GE Silicones (Momentive Performance Materials)
  - .8 "MasterSeal NP520" by Master Builders Solutions
- 2.4.4 Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.
- .1 Interior non-acoustical joints in vertical surfaces and horizontal nontraffic surfaces as follows:
    - .1 Non-acoustical and non-moving joints between interior painted surfaces and adjacent materials.
  - .2 Acceptable Products:
    - .1 "MasterSeal NP520 by Master Builders Solutions"
    - .2 "AC-20+" by Pecora Corporation
    - .3 "Tremflex 834" by Tremco Incorporated
- 2.4.5 Single-Component or Multicomponent, Traffic-Grade, Silicone or Urethane Joint Sealant, ASTM C920, Type S or Type M, Class 25 or Class 50 as required by joint design, for Use T
- .1 Interior traffic joints as follows:
    - .1 Isolation joints in cast-in-place concrete slabs. Refer to Section 03 35 10 for filling of contraction joints.
    - .2 Acceptable Products:
      - .1 "Dowsil 790" by Dow Corning Corporation
      - .2 "301 NS" or "311 NS" "300 SL" or "310 SL" by Pecora Corporation
      - .3 "Spectrem 800/900SL" by Tremco Incorporated
      - .4 "Sikaflex - 1CSL or Sikaflex 2C SL" by Sika Canada Inc.
      - .5 "MasterSeal SL1" or "MasterSeal SL2" by Master Builders Solutions
- 2.4.6 Single-Component or Multicomponent, Traffic-Grade, Silicone or Urethane Joint Sealant, ASTM C920, Type S or Type M, Class 25 or Class 50 as required by joint design, for Use T
- .1 Interior traffic joints as follows:
    - .1 Control and expansion joints in stone flooring.
    - .2 Control and expansion joints in tile flooring.
    - .3 Other joints as indicated on Drawings and Schedules.
  - .2 Acceptable Products: As recommended by flooring manufacturer and conforming to TTMAC guidelines.
- 2.4.7 Single-Component Silicone complying with ASTM C920, Grade NS, Class 25 or butyl rubber sealant complying with ASTM C1311.

- .1 Interior traffic joints as follows:
    - .1 Concealed sealants for bedding thresholds and sills.
  - .2 Acceptable Products:
    - .1 "Dowsil 758" by Dow Corning Corporation
    - .2 "Tremco Butyl Sealant" by Tremco Incorporated
    - .3 "BC-158" or "BA-98" by Pecora Corporation
    - .4 "MasterSeal NP1" by Master Builders Solutions
- 2.4.8 Silicone glazing sealant, ASTM C920, Type S, Grade NS, Class 25, Use NT.
- .1 Glazing applications as follows:
    - .1 Non-structural sealing for butt-glazing in interior applications and other non-moving glazing joints.
  - .2 Acceptable Products:
    - .1 "Dowsil 799" or "Dowsil Glazing" by Dow Chemical of Canada ULC
    - .2 "UltraGlaze SSG4000" or "UltraGlaze SSG4000AC" by GE Silicones (Momentive Performance Materials)
    - .3 "Tremsil 200" by Tremco Incorporated
    - .4 "Sikasil - N Plus" by Sika Canada Inc.

## **2.5 Joint Sealant Backing**

- 2.5.1 General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated on Drawings and Schedules by sealant manufacturer based on field experience and laboratory testing.
- 2.5.2 Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin) or Type B (bicellular material with a surface skin) or Type O (open-cell) as approved in writing by joint-sealant manufacturer for joint application indicated on Drawings and Schedules, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- 2.5.3 Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

## **2.6 Miscellaneous Materials**

- 2.6.1 Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated



on Drawings and Schedules, as determined from preconstruction joint-sealant-substrate tests and field tests.

- 2.6.2 Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- 2.6.3 Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

### **3 . EXECUTION**

#### **3.1 Examination**

- 3.1.1 Examine joints indicated on Drawings and Schedules to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- 3.1.2 Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 Preparation**

- 3.2.1 Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - .1 Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - .2 Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include, but are not limited to the following:
    - .1 Concrete.
    - .2 Masonry.
  - .3 Remove laitance and form-release agents from concrete.

- .4 Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include, include but are not limited to the following:
  - .1 Metal.
  - .2 Glass.
  - .3 Porcelain enamel.
  - .4 Glazed surfaces of ceramic tile.
- 3.2.2 Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated on Drawings and Schedules by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- 3.2.3 Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### **3.3 Installation Of Joint Sealants**

- 3.3.1 General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated on Drawings and Schedules, unless more stringent requirements apply or are indicated.
- 3.3.2 Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated on Drawings and Schedules.
- 3.3.3 Install sealant backings as recommended by joint sealant manufacturer to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - .1 Do not leave gaps between ends of sealant backings.
  - .2 Do not stretch, twist, puncture, or tear sealant backings.
  - .3 Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- 3.3.4 Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints to prevent three-sided adhesion.

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- 3.3.5 Install sealants using proven techniques that comply with the following and at the same time backings are installed:
- .1 Place sealants so they directly contact and fully wet joint substrates.
  - .2 Completely fill recesses in each joint configuration.
  - .3 Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- 3.3.6 Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated on Drawings and Schedules; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
- .1 Remove excess sealant from surfaces adjacent to joints.
  - .2 Use tooling agents that are approved in writing by sealant manufacturer and that do not discolour sealants or adjacent surfaces.
  - .3 Provide concave joint profile per Figure 8A in ASTM C1193, unless otherwise indicated on Drawings and Schedules.
  - .4 Provide flush joint profile where indicated on Drawings and Schedules per Figure 8B in ASTM C1193.
  - .5 Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C1193.
    - .1 Use masking tape to protect surfaces adjacent to recessed tooled joints.
- 3.3.7 Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated on Drawings and Schedules, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written recommendations.

### **3.4 Field Quality Control**

- 3.4.1 Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
- .1 Extent of Testing: Test completed and cured sealant joints as follows:
    - .1 Perform 5 tests for the first 300 m (1000 feet) of joint length for each kind of sealant and joint substrate.
    - .2 Perform 1 test for each 300 m (1000 feet) of joint length thereafter or 1 test per each floor per elevation.

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- .2 Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
    - .1 For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
  - .3 Inspect tested joints and report on the following:
    - .1 Whether sealants filled joint cavities and are free of voids.
    - .2 Whether sealant dimensions and configurations comply with specified requirements.
    - .3 Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
  - .4 Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
  - .5 Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- 3.4.2 Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other requirements indicated on Drawings and Schedules will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with requirements indicated on Drawings and Schedules.

### **3.5     Cleaning**

- 3.5.1 Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

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**3.6     Protection**

- 3.6.1 Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Performance of the Work. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Steel Doors And Frames work specified herein. This includes, but is not necessarily limited, to:
- .1 Interior door and frames
  - .2 Exterior hollow-metal doors and frames
  - .3 Hollow-metal panels
  - .4 Frame anchors
  - .5 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.
- .1 Related requirements provided below are for convenience purposes only.
    - .1 Section 08 70 10, Finish Hardware for door hardware for hollow-metal doors.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Definitions**

- 1.4.1 Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.
- 1.4.2 Performance Levels and Duty-rating: Conform to NAMM/HMMA 805 as modified in this Section:
- .1 Standard Duty Assemblies:
    - .1 Door Frame: Minimum 1.06 mm (18 ga - 0.042 inch)
    - .2 Door Face: Minimum 1.06 mm (18 ga - 0.042 inch)
  - .2 Medium Duty Assemblies:

- .1 Door Frame: Minimum 1.34 mm (16 ga - 0.053 inch)
- .2 Door Face: Minimum 1.06 mm (18 ga - 0.042 inch)
- .3 Heavy Duty Assemblies:
  - .1 Door Frame: Minimum 1.34 mm (16 ga - 0.053 inch)
  - .2 Door Face: Minimum 1.34 mm (16 ga - 0.053 inch)

## **1.5 Administrative Requirements**

1.5.1 Pre-installation Meetings: Schedule, and conduct pre-installation meeting at Project Site, in order to coordinate work of this Section, with work of related Subcontractors.

- .1 Ensure attendance of Subcontractor performing work of this Section and representatives of manufacturers and fabricators involved in, or affected by, installation and coordination with other materials and installations that have preceded or will follow. Advise Consultant and Owner in advance of scheduled meeting dates.
- .2 Agenda: Review progress of other construction activities and preparations for the particular activity under consideration.
- .3 Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
- .4 Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.

1.5.2 Coordination

- .1 Coordinate anchorage installation for Pressed Steel Frames. Supply setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

## **1.6 Action Submittals**

1.6.1 Product Data: Submit product data in accordance with Division 01 for the following:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for the Steel Doors And Frames work and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.

1.6.2 Shop Drawings: Submit Shop Drawings in accordance with Division 01. Include the following:

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- .1 Indicate each type of door, frame, steel, construction and core clearly demonstrating the following:
    - .1 Elevations of each door type.
    - .2 Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
    - .3 Frame details for each frame type, including dimensioned profiles and metal thicknesses.
    - .4 Locations of reinforcement and preparations for hardware.
    - .5 Details of each different wall opening condition.
    - .6 Details of anchorages, joints, field splices, and connections.
    - .7 Details of accessories.
    - .8 Details of moldings, removable stops, and glazing.
    - .9 Details of conduit and preparations for power, signal, and control systems.
  - .2 Indicate material thickness, mortises, reinforcements, anchorages, locations of exposed fasteners, openings (glazed, paneled or louvered) and arrangement of standard hardware.
  - .3 Include schedule identifying each unit, with door marks and numbers relating to Consultant's numbering on Drawings and Door Schedule.
- 1.6.3 Samples:
- .1 Submit samples for each type of exposed finish required, prepared on Samples of not less than 75 by 127 mm (3 by 5 inches).
  - .2 When requested by Consultant, submit fabrication Samples approximately 203 by 254 mm (8 by 10 inches) to demonstrate compliance with requirements for quality of materials and construction:
    - .1 Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
    - .2 Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.
- 1.6.4 Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.



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**1.7     Informational Submittals**

- 1.7.1 Product Test Reports: Submit product test reports in accordance with Division 01 for each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency. As a minimum, submit the following test reports:
- .1 Confirmation that insulated doors supplied in exterior openings meet specified thermal resistance rating.
  - .2 Confirmation that acoustic door and frame assemblies provide the STC and sound TL values specified within the critical frequency range, as determined and scheduled by the Consultant.
  - .3 Ensure reports include name of testing authority, date of test, location of test facility, descriptions of test specimens, procedures used in testing and indicate compliance with acceptance criteria of test.

**1.8     Quality Assurance**

- 1.8.1 Manufacturers: Execute work in this Section by a manufacturer who is a member of CSDMA and NAAMM.
- .1 Ensure product is manufactured by a firm experienced in design and production of standard and custom commercial steel door and frame assemblies, integration of builders' or electronic hardware and glazing assemblies, and other items affecting work.
- 1.8.2 Supplier Qualifications: Ensure Product Supplier has Architectural Hardware Consultant (AHC) or person of equivalent experience, available at reasonable times to consult with Consultant, Contractor and Owner.
- 1.8.3 Installer Qualifications:
- .1 Provide work of this Section executed by competent installers with minimum 5 years' experience in the application of Products, systems and assemblies specified and with approval and training of Product manufacturers.
  - .2 Ensure retained installers are familiar with Product manufacturers specified herein and with ANSI/NFPA 80 requirements for installation of labeled fire rated steel doors, frames and hardware.
- 1.8.4 Welding:
- .1 Provide welding in accordance with CSA W59-M performed by a fabricator and mechanics fully approved by the Canadian Welding Bureau as specified herein.

- .2 Ensure fabricator is fully certified by Canadian Welding Bureau for fusion welding of steel structures to CSA W47.1 and for fusion welding of aluminum to CSA W47.2.
- 1.8.5 Single Source Responsibility: Ensure primary materials provided in this Section are obtained from 1 source by a single manufacturer and secondary materials are obtained from sources recommended by primary materials manufacturers.

## **1.9 Delivery, Storage, And Handling**

### **1.9.1 Delivery and Acceptance Requirements:**

- .1 Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
- .2 Provide additional protection to prevent damage to factory-finished units.
- .3 Deliver welded frames with two temporary shipping spreader bars across bottom of frames, tack welded to jambs and mullions. Temporary spreader bars are intended for shipping and handling purposes only, and must not be used for installation purposes.

### **1.9.2 Storage and Handling Requirements:**

- .1 Provide site storage and protection of materials in accordance with NAAMM-HMMA 840. Store items in dry, secure location on planks or dunnage.
- .2 Store Door and frame Products in vertical position, spaced with blocking. Cover materials to protect them from damage but in such a manner as to permit air circulation.
- .3 Immediately Make Good any damage acquired during shipping or handling. Clean scratches and touch up with rust-inhibitive primer. Replace damaged work which cannot be repaired, restored or cleaned.
- .4 For welded frames, weld in two temporary jamb spreaders per door opening to maintain proper alignment during shipment and handling. Do not use temporary jamb spreaders for installation.

## **1.10 Field Conditions**

- 1.10.1 Verify actual opening sizes and field conditions by field measurement before fabrication. Submittal drawings must reflect measurements and conditions provided, and product manufactured accordingly. Coordinate field measurements with fabrication and construction schedules to avoid delays.

- 1.10.2 Verify that substrate conditions, whether existing or otherwise, are as detailed on Drawings, and are acceptable for product installation in accordance with manufacturer's instructions.
- 1.10.3 Do not proceed with fabrication without receipt of reviewed Shop Drawings and reviewed construction hardware schedule.

## **1.11 Warranty**

- 1.11.1 Warrant Work of this Section for period of one year from date of Substantial Performance of the Work against defects and deficiencies in accordance with General Conditions of the Contract. Promptly correct defects or deficiencies which become apparent within warranty period, to satisfaction of Consultant and at no expense to Owner.
- 1.11.2 Extended Rust-perforation Warranty: Standard manufacturer's standard form in which manufacturer agrees to repair finishes or replace doors that show evidence of excessive rusting within specified warranty period.
  - .1 Warranty Period: 5 years from date of Substantial Performance of the Work.

## **2 . PRODUCTS**

### **2.1 Manufacturers**

- 2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.
  - .1 Artek Door Limited; [www.artekdoor.com](http://www.artekdoor.com)
  - .2 Baron Hollow Metal; [www.baronmetal.com](http://www.baronmetal.com)
  - .3 Daybar Industries Limited; [www.daybar.com](http://www.daybar.com)
  - .4 Fleming Door Products-Baron Door Products; an Assa Abloy Group company; [www.flemingdoor.com](http://www.flemingdoor.com).
  - .5 Gensteel Doors; [www.gensteeldoors.com](http://www.gensteeldoors.com)
  - .6 LMT Group inc.
  - .7 Trillium Steel Doors Ltd.
- 2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

### **2.2 Regulatory Requirements**

- 2.2.1 Labelling requirements:
  - .1 Provide label of recognized testing agency having factory inspection service, and constructed as listed or classified for

labeling in accordance with NFPA 80, listing authority's policies and label materials.

- .2 Listing must identify manufacturer.
- .3 Construct fire-rated doors and frames as listed for labeling in "Follow-Up Service Procedures/Factory Inspection Manuals" issued by listing agency.

2.2.2 Fire-Rated Door Assemblies:

- .1 Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated on Drawings and Schedules, based on testing according to CAN4-S104 or equivalent to NFPA 252 or UL 10C.

2.2.3 Fire-Rated, Frame Assemblies:

- .1 Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings and Schedules, based on testing according to CAN4-S104 (Frames, transom and sidelight assemblies) and CAN4-S106 (window assemblies) or equivalent to NFPA 257 or UL 9.

2.2.4 Smoke- and Draft-Control Assemblies:

- .1 Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

2.2.5 Temperature Rise Rated Assemblies: Provide fire and temperature rise rated steel doors for those openings as determined and scheduled by Consultant.

- .1 As a minimum, Provide fire and temperature rise rated steel doors and frames at following locations and as indicated on Drawings and schedules:
  - .1 between dead end corridor and adjacent occupied spaces;
  - .2 between exit enclosures (stairs) and remainder of floor areas;
  - .3 in firewalls and other specific locations noted on Drawings or Schedules.

**2.3 Design And Performance Requirements**

- 2.3.1 Unless otherwise indicated, construct doors to be minimum 44.5 mm (1-3/4 inches) thick.
- 2.3.2 Construct doors to meet requirements of NAAMM-HMMA 861 and CSDMA specifications. Ensure door and frame Products are

fabricated in strict accordance with reviewed Shop Drawings. Ensure steel is free of scale, pitting, coil breaks, surface blemishes, buckles, waves and other defects.

2.3.3 Facilitate installation of electrical components complete with arrangement so conduits and wiring can be readily removed and replaced.

2.3.4 Ensure exterior door assemblies can meet the following performance requirements as a minimum:

- .1 Thermal resistance (R-Value)
  - .1 Nominal: Not less than RSI 1.94 K x sq. m/W (R11 deg F x h x sq. ft./Btu) in accordance with ASTM C518.
  - .2 Actual: Not less than RSI 0.6 K x sq. m/W (R3.4 deg F x h x sq. ft./Btu) in accordance with ASTM C1363.
- .2 Thermal transmittance (U value):
  - .1 Nominal: Not more than 0.5 W/(sq.m· K) (0.09 BTU/(sq.ft · deg F) in accordance with ASTM C518.
  - .2 Actual: Not more than 3.45 W/(sq.m· K) (0.29 BTU/(sq.ft · deg F) in accordance with ASTM C1363.
- .3 Air Infiltration: Maximum air leakage of 0.20 L/s per sq. m (0.04 cfm/sq. ft.) at a static-air-pressure differential of 75 Pa (1.57 lbf/sq. ft.).

## **2.4 Materials**

2.4.1 Metallic-Coated Steel Sheet: ASTM A653/A 653M, Commercial Steel (CS), Type B.

- .1 Interior doors and frames unless indicated otherwise: Comply with A 653/A 653M, Designation ZF 120 (A40)
- .2 Exterior doors and frames: Comply with ASTM A653, Designation Z275 (G90).

2.4.2 Frame Anchors: ASTM A879/A 879M, Commercial Steel (CS), 12G (04Z) coating designation; mill phosphatized.

- .1 For anchors built into exterior walls, steel sheet complying with ASTM A1008/A 1008M or ASTM A1011/A 1011M, hot-dip galvanized according to ASTM A153/A 153M, Class B.

2.4.3 Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A 153M.

2.4.4 Grout: ASTM C476, except with a maximum slump of 102 mm (4 inches), as measured according to ASTM C143/C 143M.

2.4.5 Mineral-Fiber Insulation: CAN/ULC S702 or equivalent to ASTM C665 (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread

and smoke-developed indexes of 25 and 50, respectively; passing CAN/ULC-S114 or equivalent to ASTM E136 for combustion characteristics.

- 2.4.6 Glazing: Comply with requirements in Section 08 80 05, General Requirements for Glass and Glazing.
- 2.4.7 Bituminous Coating: Cold-applied asphalt mastic, compounded for 0.4-mm (15-mil) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

## **2.5 Components**

### **2.5.1 Door Core Materials:**

- .1 Honeycomb: Structural small cell 25.4 mm (1 inch) maximum kraft paper 'honeycomb'. Weight: 36.3 kg (80 lb.) per ream minimum, density: 16.5 kg/m<sup>3</sup> (1.03 pcf) minimum, sanded to required thickness.
- .2 Polystyrene: Rigid extruded, fire retardant, closed cell board, Type 1 with a minimum density of 16 kg/m<sup>3</sup> (1.0 lbs/cu ft) and minimum R-value of RSI 1.05 (R6.0).
- .3 Polyurethane: CAN/ULC-S702, Rigid, polyurethane, board with a density of 32 kg/m<sup>3</sup> (2.0 lbs/cu ft) and minimum thermal resistance rating of RSI 1.92 (R11)
- .4 Steel stiffened core: Continuous vertically formed steel sections, full thickness of interior space between door faces.
  - .1 Stiffeners: Minimum thickness 0.6 mm (22 ga. - 0.026 in) spaced 152 mm (6 in) apart and securely fastened to both face sheets by spot welded spaced a maximum of 127 mm (5 in) o. c. vertically.
  - .2 Fill spaces between stiffeners with fiberglass core (interior locations) or polyurethane core (exterior locations) as specified herein.
- .5 Fire Door Cores: As required to provide fire-protection and temperature-rise ratings indicated on Drawings and Schedules.
  - .1 Temperature Rise Rated (TRR) Core: Ensure core composition provides fire protection rating and limits temperature rise on unexposed side of door to 121 deg C (250 deg F) above ambient temperature after 30 minutes and 250 deg C (421 deg F) after 60 minutes, as determined by OBC requirements in accordance with testing per CAN4-S104-M or equivalent to NFPA 252.

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**2.6     Interior Doors And Frames**

2.6.1 Construct interior doors and frames to comply with the standards indicated in this Section for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

2.6.2 Standard-Duty Doors and Frames:

.1 Physical Performance: Level C according to ANSI/SDI A250.4.

.2 Doors:

.1 Materials: Metallic-coated steel sheet, minimum 1.06 mm (18 ga - 0.042 inch); galvanized as specified herein.

.2 Edge Construction: Following constructions are acceptable:

.1 Full Flush; Mechanically interlocked, adhesive assisted and tack welded at top and bottom of door, 150 mm (6") on centre and above and below each edge cutout, filled with metal filler and ground smooth with no visible seams.

.2 Seamless; continuously welded and ground smooth with no visible seams.

.3 Core: Kraft-paper honeycomb.

.4 Basis-of-Design: "D-Series" by Fleming or approved equivalent.

.3 Frames:

.1 Materials: Metallic-coated steel sheet, minimum 1.06 mm (18 ga - 0.042 inch); galvanized as specified herein.

.2 Construction: Knocked down unless indicated otherwise.

.3 Basis-of-Design:

.1 "M Series" by Fleming or approved equivalent for frames occurring in masonry construction.

.2 "DW Series" by Fleming or approved equivalent for frames occurring in gypsum board construction.

.3 "EXP Series" by Fleming or approved equivalent for frames occurring in existing partitions.

.4 Exposed Finish: Factory-primed for site finishing.

.5 Locations: Service Closets (mechanical, plumbing, electrical etc.)

2.6.3 Heavy-Duty Doors and Frames:

.1 Physical Performance: Level A according to ANSI/SDI A250.4.

.2 Doors:

.1 Materials: Metallic-coated steel sheet, minimum 1.34 mm (16 ga - 0.053 inch); galvanized as specified herein.

- .2 Edge Construction: Seamless; continuously welded and ground smooth with no visible seams.
- .3 Core: Vertical steel stiffened
- .4 Basis-of-Design: "H-Series" by Fleming or approved equivalent.
- .3 Frames:
  - .1 Materials: Metallic-coated steel sheet, minimum 1.34 mm (16 ga - 0.053 inch); galvanized as specified herein.
  - .2 Construction: Face welded or full profile welded unless indicated otherwise.
  - .3 Basis-of-Design:
    - .1 "M Series" by Fleming or approved equivalent for frames occurring in masonry construction.
    - .2 "DW Series" by Fleming or approved equivalent for frames occurring in gypsum board construction.
    - .3 "EXP Series" by Fleming or approved equivalent for frames occurring in existing partitions.
  - .4 Exposed Finish: Factory-primed for site finishing.
  - .5 Locations: typical locations unless otherwise indicated.

## **2.7 Exterior Hollow-Metal Doors And Frames**

- 2.7.1 Construct exterior doors and frames to comply with the standards indicated in this Section for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- 2.7.2 Heavy-Duty Doors and Frames:
  - .1 Physical Performance: Level A according to ANSI/SDI A250.4.
  - .2 Doors:
    - .1 Materials: Metallic-coated steel sheet, minimum 1.34 mm (16 ga - 0.053 inch); galvanized as specified herein.
    - .2 Edge Construction: Seamless; continuously welded and ground smooth with no visible seams.
    - .3 Core: Polyurethane insulated, vertical steel stiffened.
    - .4 Basis-of-Design: "TRIO E-Series" by Fleming or approved equivalent.
  - .3 Frames:
    - .1 Materials: Metallic-coated steel sheet, minimum 1.34 mm (16 ga - 0.053 inch); galvanized as specified herein.
    - .2 Construction: Thermally-broken unless indicated otherwise.



- .3 Basis-of-Design: "TB Series" by Fleming or approved equivalent for frames occurring in masonry construction.
- .4 Exposed Finish: Factory-primed for site finishing.
- .5 Locations: Exterior openings indicated to receive hollow metal doors and pressed steel frames unless indicated otherwise

## **2.8 Hollow-Metal Panels**

- 2.8.1 Provide hollow-metal panels of same materials, construction, and finish as adjacent door assemblies.

## **2.9 Fabrication**

- 2.9.1 Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
  - .1 Provide factory-preparation and reinforcements for doors and frames including mortising, blanking, drilling and tapping for templated hardware only, in accordance with the reviewed hardware schedule and templates provided by hardware supplier.
  - .2 Reinforce doors and frames in factory only where required, for surface-mounted hardware, anchor hinges, thrust pivots, pivot reinforced hinges, or non-templated hardware. Perform drilling and tapping on site, at time of installation.
  - .3 Prior to shipment, mark each door and frame with identification number as shown on approved Shop Drawings.
- 2.9.2 Hollow-Metal Doors:
  - .1 Holes 12.7 mm (0.5") diameter and larger must be factory-prepared, except mounting and through-bolt holes, which are made on site, at time of hardware installation. Holes less than 12.7 mm (0.5") diameter will be factory-prepared only when required for device (for knob, lever, cylinder, thumb or turn pieces) or when holes overlap function holes.
  - .2 Vertical Edges for Single-Acting Doors: Bevel edges 3 mm in 50 mm (1/8 inch in 2 inches) unless otherwise required to suit finish hardware or door swings.
  - .3 Top Edge Closures:
    - .1 Exterior Locations: Sealed, flush PVC closures.
    - .2 Interior locations (hospitals): Sealed, flush steel closures, continuously welded.

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- .3 Interior locations (security locations): Non-sealed, flush steel closures.
  - .4 Interior locations (commercial buildings): Inverted steel closures.
  - .4 Bottom Edge Closures: Close bottom edges of door with end closures or channels of same material as face sheets.
    - .1 Exterior Locations: Sealed, flush PVC closures. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
    - .2 Interior locations (hospitals): Sealed, flush steel closures, continuously welded.
    - .3 Interior locations (security locations): Non-sealed, flush steel closures.
    - .4 Interior locations (commercial buildings): Inverted steel closures.
  - .5 Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated on Drawings and Schedules. Extend minimum 19 mm (3/4 inch) beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- 2.9.3 Pressed Steel Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
- .1 Protect mortised cutouts in frames with steel guard boxes.
  - .2 Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
  - .3 Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  - .4 Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
  - .5 Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
  - .6 Jamb Anchors: Provide anchorage appropriate to floor, wall and frame construction. Locate each anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite strike jamb.
    - .1 Provide number and spacing of anchors as follows:

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- .1 Two anchors per jamb up to 1520 mm (60 inches) high.
  - .2 Provide additional anchor for each additional 760 mm (30 inches) of height or fraction thereof up to 3050 mm (120 inches) high.
  - .3 Provide four anchors per jamb plus one additional anchor per jamb for each 610 mm (24 inches) or fraction thereof above 3050 mm (120 inches) high.
  - .2 Frames in previously placed concrete, masonry or structural steel: Locate anchors not more than 150 mm (6 inches) from the top and bottom of each jamb, and intermediate anchors at 660 mm (26 inches) o.c. maximum.
  - .3 Frames in stud-Wall Type: Locate anchors not more than 457 mm (18 inches) from top and bottom of frame, and intermediate anchors at 813 mm (32 inches) o.c. maximum.
  - .4 Where frame product is installed prior to adjacent partition, securely attach floor anchor to the inside of each jamb profile.
    - .1 Provide each floor anchor with two (2) holes for securing to floor. For conditions that do not permit the use of floor anchors, provide additional wall anchor, located within 150 mm (6 inches) of base of jamb.
  - .7 Door Silencers: Except on weather-stripped and gasketed frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
    - .1 Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - .2 Double-Door Frames: Drill stop in head jamb to receive two door silencers.
    - .3 Exterior Door Frames: Thermally broken.
  - .8 Thermally-broken Frames (exterior locations)
    - .1 Fabricate thermally broken door frames in accordance with Shop Drawings. Fabricate thermally broken exterior door frames with two piece steel core sections separated with closed cell PVC thermal breaks to separate interior and exterior frame sections.
    - .2 Provide wall and floor anchors suitable for installation conditions. Anchoring devices must not permit thermal conductivity from exterior frames to interior frame sections.

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- .3 Ensure welds do not cause thermal transfers between interior and exterior surfaces of frame sections. Separate interior and exterior sections of thermally broken frames by continuous thermal break.
  - .4 Do not assemble thermally broken sections by means of screws, grommets or other fasteners.
  - .5 Insulate closed sections such as mullions or center rails in shop with specified insulation. Install Insulation of open sections such as jambs, heads and sills.
  - .6 Incorporate head drips of same gauge material as frame and plug weld at 150 mm (6") on center. Fill and sand smooth.
  - .9 Welded Type Frames (interior locations as noted herein):
    - .1 Frame products must be accurately mitered or mechanically jointed.
    - .2 Full Profile welded: punch-mitered - continuously welded on profile faces, rabbets, returns and soffit intersections, or saw-mitered - continuously welded on the profile faces, rabbets, returns, stops and soffit intersections.
      - .1 Punch or saw-mitered, at the manufacturer's discretion.
      - .2 All profile welded frame product exposed faces must be filled and ground to a smooth, uniform, seamless surface.
    - .3 Face welded: continuously welded on the profile faces, with exposed faces filled and ground to a smooth, uniform, seamless surface.
    - .4 Joints at mullions, sills and center rails:
      - .1 Must be coped accurately, butted and tightly fitted.
      - .2 At intersecting flush profile faces, be securely welded, filled and ground to a smooth, uniform, seamless surface.
      - .3 At intersecting recessed profile faces, be securely welded to concealed reinforcements, with exposed hairline face seams.
      - .4 At all other intersecting profile elements, have exposed hairline face seams.
    - .5 Glazing stops must be formed steel channels, minimum 16 mm (0.625 inch) height, accurately fitted, butted at corners and fastened to frame sections with counter-sunk oval head sheet metal screws.
  - .10 Knocked Down Type Frames (interior locations as noted herein):

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- .1 Ship knocked-down type frames unassembled.
  - .2 Provide frames with mechanical joints which inter-lock securely and provide functionally satisfactory performance when assembled and installed in accordance with the manufacturer's instructions.
- 2.9.4 Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, CSDMA Specifications, Door Hardware Schedule, and templates. Refer to Section 08 70 10 for additional requirements:
- .1 Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
  - .2 Comply with applicable requirements in BHMA A156.115 and CSDMA Specifications for preparation of hollow-metal work for hardware.
    - .1 Lock and Strike Reinforcements: 2.36 mm (12 ga - 0.093 inch) – high frequency types
    - .2 Hinge Reinforcements: 3.12 mm (10 ga - 0.123 inch) – high frequency types
    - .3 Flush Bolt Reinforcements: 2.36 mm (12 ga - 0.093 inch) – high frequency types
    - .4 Reinforcements for Surface Applied Hardware: 1.34 mm (16 ga - 0.053 inch)
    - .5 Top and Bottom Channels: 1.06 mm (18 ga - 0.042 inch)
    - .6 Steel Top Caps: 0.81 mm (20 ga - 0.032 inch)
    - .7 Mortar Guard Boxes: 0.66 mm (22 ga - 0.026 inch)
    - .8 Floor Anchors: 1.34 mm (16 ga - 0.053 inch)
    - .9 Wall Anchors:
      - .1 Masonry Strap Type: 1.06 mm (18 ga - 0.042 inch)
      - .2 Masonry Wire Type: 4.0 mm (0.156 inch) dia.
      - .3 Masonry Stirrup-Strap Type: 1.34 mm (16 ga - 0.053 inch)
      - .4 Stud Type: Designed to engage stud, welded to back of frames; not less than 1.0 mm (18 ga - 0.042 inch) thick.
      - .5 Existing Masonry /Concrete Wall Type: not less than 1.0 mm (18 ga - 0.042 inch) thick.
  - .3 Where electrified hardware is specified on Hardware Schedule, Provide CSA-approved system consisting of CSA-approved conduit, junction boxes and wire harnesses complete with modular plugs for coordinated connection directly to electrified hardware.

- 2.9.5 Stops and Moldings for Glazing: Provide accurately fitted stops and moldings around glazed lites and louvers where indicated on Drawings and Schedules. Form corners of stops and moldings with butted hairline joints.
- .1 Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
  - .2 Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
  - .3 Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
  - .4 Provide loose stops and moldings on inside of hollow-metal work.
  - .5 Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated on Drawings and Schedules.
  - .6 Glass Trim (Screw Fixed or Snap-In Types): 0.81 mm (20 ga - 0.032 inch)
    - .1 For glazing up to 8 mm (5/16 inch) thick: steel glazing trim and snap-in glazing stops as specified herein.
    - .2 For glazing thicker than 8 mm (5/16 inch): steel glazing trim and screwed-in glazing stops as specified herein. Screws must be #6 x 1-1/4" oval head self-drilling type at 300 mm (12 inch) o.c. maximum.

## **2.10 Steel Finishes**

- 2.10.1 Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
- .1 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.
- 2.10.2 Factory Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, complying with SDI A250.3.
- .1 Colour and Gloss: Match Consultant's sample.

## **3 . EXECUTION**

### **3.1 Examination**

- 3.1.1 Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

- 3.1.2 Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- 3.1.3 Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- 3.1.4 Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2     Preparation**

- 3.2.1 Remove welded-in temporary shipping bars installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- 3.2.2 Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

### **3.3     Installation**

- 3.3.1 General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- 3.3.2 Pressed Steel Frames: Install Pressed Steel Frames of size and profile indicated on Drawings and Schedules. Comply with NAAMM-HMMA 840 and CSDMA Specifications as required by standards specified.
  - .1 Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
  - .1 At fire-rated openings, install frames according to NFPA 80.
  - .2 Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
  - .3 Install frames with removable stops located on secure side of opening.
  - .4 Install door silencers in frames before grouting.
  - .5 Remove temporary braces necessary for installation only after frames have been properly set and secured.
  - .6 Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.

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- .7 Field apply bituminous coating to backs of frames that will be filled with grout agents.
  - .2 Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with anchors.
  - .3 Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
  - .4 Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
  - .5 Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
  - .6 In-Place Concrete or Masonry Construction: Secure frames in place with anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
  - .7 In-Place Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
  - .8 Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
    - .1 Squareness: Plus or minus 1.6 mm (1/16 inch), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - .2 Alignment: Plus or minus 1.6 mm (1/16 inch), measured at jambs on a horizontal line parallel to plane of wall.
    - .3 Twist: Plus or minus 1.6 mm (1/16 inch), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - .4 Plumbness: Plus or minus 1.6 mm (1/16 inch), measured at jambs at floor.
- 3.3.3 Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
- .1 Non-Fire-Rated Steel Doors:
    - .1 Between Door and Frame Jambs and Head: 3.2 mm (1/8 inch) plus or minus 1.5 mm (1/16 inch).
    - .2 Between Edges of Pairs of Doors: 3.2 mm (1/8 inch) plus or minus 1.5 mm (1/16 inch).
    - .3 At Bottom of Door: Provide floor clearance for functional operation of doors of not less than 3.2 mm (1/8 inch) plus or minus 1.5 mm (1/16 inch), unless greater undercuts are indicated on Door Schedule or required for mechanical air flow.
  - .2 Fire-Rated Doors: Install doors with clearances according to NFPA 80.



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- .3 Smoke-Control Doors: Install doors and gaskets according to NFPA 105.
  - 3.3.4 Glazing: Comply with requirements in Section 08 80 05, General Requirements for Glass and Glazing and with hollow-metal manufacturer's written instructions.
    - .1 Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 230 mm (9 inches) o.c. and not more than 51 mm (2 inches) o.c. from each corner.
  - 3.4 Adjusting And Cleaning**
    - 3.4.1 Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
    - 3.4.2 Remove grout and other bonding material from hollow-metal work immediately after installation.
    - 3.4.3 Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

## **1 . GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Design-Build Contract and Subcontracts, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the glazed interior aluminum doors and frames work specified herein. This includes, but is not necessarily limited, to:
- .1 Interior aluminum door and sidelite frames
  - .2 Interior aluminum swing doors,
  - .3 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Administrative Requirements**

- 1.4.1 Pre-installation Meetings: Schedule, and conduct pre-installation meeting at Project Site, in order to coordinate work of this Section, with work of related Subcontractors.
- .1 Ensure attendance of Subcontractor performing work of this Section and representatives of manufacturers and fabricators involved in, or affected by, installation and coordination with other materials and installations that have preceded or will follow. Advise Consultant and Owner in advance of scheduled meeting dates.
  - .2 Agenda: Review progress of other construction activities and preparations for the particular activity under consideration.
  - .3 Record significant discussions, agreements, and disagreements, including required corrective measures and actions.

- .4 Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.

1.4.2 Scheduling:

- .1 Ensure Product lead times does not exceed five weeks from taping of gypsum board around openings to avoid project delays and cost overruns.

**1.5 Action Submittals**

1.5.1 Product Data: Submit in accordance with Division 01 for the following:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for the glazed interior aluminum doors and frames work and include product characteristics, performance criteria, physical size, finish and limitations.

1.5.2 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:

- .1 Include details for each frame type, including dimensioned profiles and metal thicknesses.
- .2 Include locations of reinforcements and preparations for hardware.
- .3 Include details of anchorages, joints, field splices, connections, and accessories.
- .4 Include details of moldings, removable stops, and glazing.

1.5.3 Delegated Design Submittals:

- .1 Engineering design completion of office fronts and screens work is delegated to Contractor based on structural design criteria indicated in Contract Documents.
- .2 Submit Shop Drawings for work of this Section that bear the stamp of a Professional Engineer registered in Province of the Work for the following:
  - .1 Systems restrained at top and bottom only.
  - .2 Systems exceeding 3m in height or manufacturer's standard heights.
  - .3 Systems acting as guards.
  - .4 As required by Contract Documents.
- .3 Submit copy of structural calculations upon request by Consultant.

1.5.4 Product Disclosure and Transparency:

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- .1 Environmental Product Declarations (EPD): When available, submit Product-specific Type III EPD or industry-wide (generic) EPD conforming to ISO 14025 or other recognized environmental product declaration framework.
  - .2 Material Ingredient Reporting: When available, submit documentation demonstrating chemical inventory of materials to at least 0.1% (1000ppm) and conforming to one of the following:
    - .1 Health Product Declaration open Standard,
    - .2 Cradle to Cradle v2 Basic level or Cradle to Cradle v3 Bronze level,
    - .3 International Living Future Institute Declare
    - .4 Other approved framework.
  - .3 When multiple Products are specified, give preference to Products with compliant documentation.
  - .4 Shop Drawings: Submit in accordance with Division 01 for interior aluminum doors and frames work. Include plans, elevations, sections, full-size details, anchorage, locations of accessory items and attachments to other work. Indicate field measurements on Shop Drawings.
- 1.5.5 Samples (for verification purposes): Submit Samples in accordance with Division 01 for units with factory-applied colour finishes. Submit two samples of each finish product specified, in minimum 76 mm by 127 mm (3 inches by 5 inches) sizes representing actual product colour.
- 1.5.6 Warranties: Submit sample of extended warranties specified in this Section for Consultant's review.
- 1.6 Closeout Submittals**
- 1.6.1 Maintenance Data: Submit operation and maintenance data for each type of glazed interior aluminum door and frame to include in maintenance manuals. Include warranty certificates.
- 1.7 Quality Assurance**
- 1.7.1 Installer Qualifications: Installation must be performed by an installer who has been trained or otherwise authorized by manufacturer.
- 1.7.2 Manufacturer Qualifications: Provide Products from a manufacturer with minimum 20 years of experience and capable of providing glazed interior aluminum doors and frames that meet or exceed performance requirements indicated.

- 1.7.3 Mock-ups: Build mock-ups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
- .1 Build mockup of typical wall area as directed by Consultant on site.
  - .2 Subject to compliance with requirements, reviewed mock-ups may become part of the completed Work if undisturbed at time of Substantial Performance of the Work.
- 1.7.4 Source Limitations: Obtain primary components of glazed interior aluminum doors and frames, including framing and accessories, from single manufacturer. Obtain secondary components and accessories from sources acceptable to manufacturer of primary materials.
- 1.7.5 Professional Engineer's Qualifications: For work requiring structural performance, employ Professional Engineer licensed to practice in Province of the Work who carries professional liability insurance and has at least five years' experience providing engineering services of similar kind, scope, and complexity.
- .1 Professional Engineer's Responsibility:
    - .1 production and review of Shop Drawings,
    - .2 design and certification of interior aluminum office fronts and screens, including attachments for building construction, in accordance with applicable codes and regulations,
    - .3 stamping and signing of each Shop Drawing and associated calculations

**1.8 Delivery, Storage And Handling**

- 1.8.1 Deliver, store and handle materials and products in strict compliance with manufacturer's instructions and recommendations. Inspect components for damage upon delivery.
- 1.8.2 Storage: Store products in a secure enclosed area protected from the elements, in manufacturer's packaging until ready for installation.
- 1.8.3 Handling: Handle materials with care and avoid dents, scratches or damage to products. Remove labels, stickers or protection after installation.

**1.9 Project Conditions**

- 1.9.1 Field Measurements: Verify actual locations of openings by field measurements performed by the installer prior to commencement of fabrication. Ensure recorded measurements provided by the

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installer are indicated on Shop Drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

**1.10 Warranty**

1.10.1 Extended Warranty: Provide manufacturer's standard warranty which covers Products specified in this Section that fail in materials or workmanship within specified warranty period.

- .1 Warranty Period: 7 years from date of Substantial Performance of the Work.

**2 . PRODUCTS**

**2.1 Manufacturers**

2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.

- .1 PC350
- .2 Muraflex

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

**2.2 Regulatory Requirements**

2.2.1 Barrier-Free and Accessibility Requirements: Comply with applicable barrier-free provisions in the Ontario Building Code and CSA B651 and requirements of authorities having jurisdiction.

**2.3 Design/Performance Criteria**

2.3.1 Provide office fronts and screen components that precisely match dimensions, profiles, and connections to adjoining work as indicated on the Drawings.

2.3.2 Design Intent: Architectural Drawings and details are diagrammatic and are only intended to show design concept, aesthetics, interfacing requirements, configuration, components and arrangements. They are not intended to identify or solve completely problems of thermal and structural movements, assembly framing, engineering design, fixings and anchorages.

2.3.3 Deflection Limits: Limit deflection to 1/175 of clear span or 19 mm (3/4 inch), whichever is smaller.

- 2.3.4 Ensure aluminum systems are designed to withstand movements of supporting structure. Such movements may include, but are not limited to:
- .1 Story drift
  - .2 Twist
  - .3 Column shortening
  - .4 Long-term creep
  - .5 Deflection due to uniformly distributed and concentrated live loads.
- 2.3.5 Ceiling Heights: System to be designed to accommodate ceiling heights ranging from 2083 mm (82 in) to 3658 mm (144 in) without need for additional engineering.
- 2.3.6 Horizontal Widths: System to be designed to horizontal widths to be cut on-site, up to maximum of 3658 mm (144 in).
- 2.3.7 System Support: Ensure systems are self-supporting without need for additional structural supports or blocking.
- 2.3.8 On-Site Assembly: Systems to be stick-built on site and be cut and assembled to accommodate variations within openings.
- 2.3.9 System must allow for the following adjustments:
- .1 Ceiling adjustment range:  $\pm 19$  mm (3/4 in).
  - .2 Wall Start (Flush Wall) adjustment range:  $\pm 12$  mm (1/2 in).
  - .3 Traditional Wrap-Around adjustment range:  $\pm 16$  mm (5/8 in).
  - .4 Floor level adjustments:  $\pm 25$  mm (1 in).
- 2.3.10 Minimum Glass Thickness:
- .1 Applicability: Thicknesses specified below apply to interior glazing systems with fully tempered glass that is supported at the top and bottom only (i.e. not supported on four sides). Use engineering analysis to determine thicknesses for other glass types.
  - .2 Engineering Adjustments: Increase thickness as necessary based on final engineering calculations.

Unsupported Span	Open Joints	Linked Joints with silicone or permanent fastener
Up to 5 ft. (1.5 m)	10 mm (3/8")	10 mm (3/8")
5 ft. to 6 ft. (1.5 - 1.8 m)	10 mm (3/8")	10 mm (3/8")
6 ft. to 7 ft. (1.8 - 2.1 m)	12 mm (1/2")	10 mm (3/8")
7 ft. to 8 ft. (2.1 - 2.4 m)	12 mm (1/2")	12 mm (1/2")
8 ft. to 9 ft. (2.4 - 2.7 m)	16 mm (5/8")	12 mm (1/2")
9 ft. to 10 ft. (2.7 - 3 m)	16 mm (5/8")	12 mm (1/2")
Over 3 m	Use engineering analysis	Use engineering analysis

2.3.11 Glass acting as guards:

- .1 Engineering Requirements: Engineer glass, glazing, and framing to withstand minimum guard loads specified in OBC 4.1.5.14.
- .2 Guard Locations: Refer to OBC 3.3.1.17.(1), OBC 3.3.1.18.(6), and OBC 4.1.5.16.

2.3.12 Glass design and engineering: to CAN/CGSB 12.20 or ASTM E1300.

2.3.13 Wiring Accommodations: Ensure system is designed to accommodate electrical wiring, including, but not limited to, room booking device wiring, REX sensors, and similar components, through framing system.

2.3.14 Corrosion Control: Prevent galvanic action and other forms of corrosion by insulating metals and materials from direct contact with incompatible substances.

**2.4 Materials**

2.4.1 Aluminum Components:

- .1 Sheet and Plate: ASTM B209M (ASTM B209).
- .2 Extrusions: ASTM B221M (ASTM B221), Alloy and temper 6063-T5 or as recommended by aluminum frame manufacturer for strength, corrosion resistance, and application of required finish.
- .3 Thickness: not less than 3.2 mm (0.125 inch) on exposed surfaces, and 4.75 mm (0.187 inch) on internal webs.

2.4.2 Steel Members: Hot-dip galvanize all steel items to comply with the following:

- .1 ASTM A653/A653M for sheet steel,
- .2 ASTM A153/A 153M for steel and iron hardware,
- .3 ASTM A123/A 123M or CAN/CSA-G164 for other steel products.

**2.5 Aluminum Door And Sidelite Frames (SC04)**

2.5.1 Door and Glazing Frames: Manufacturer's standard glazing frame system designed for wrap-around installation based on wall thicknesses indicated on Drawings.

2.5.2 Framing Members: manufacturer's standard extruded-aluminum framing members formed from controlled 6063 T5 alloy billets.

- .1 Sheet and Plate: ASTM B209M (ASTM B209).
- .2 Extrusions: ASTM B221M (ASTM B221), Alloy and temper 6063-T5 or as recommended by aluminum frame manufacturer



for strength, corrosion resistance, and application of required finish.

- .3 Thickness: not less than 3.2 mm (0.125 inch) on exposed surfaces, and 4.75 mm (0.187 inch) on internal webs.

2.5.3 Frame and Trim: 44 mm (1 3/4 in).

2.5.4 Hardware: Prepare door framing according to templates provided by hardware supplier; refer to Section 08 70 10.

2.5.5 Reinforcements: Manufacturer's standard high-strength aluminum with non-staining, non-ferrous shims for aligning system components.

2.5.6 Finish: Powder-Coat Finish (AAMA 2603)

2.5.7 Joints: Glass-to-glass butt joint system with silicone sealant.

- .1 Silicone sealant: Single-Component, Nonsag, Silicone Joint Sealant: conforming to ASTM C920, Type S, Grade NS, Class 25.

- .2 Basis-of-Design: Dowsil "795" or Dowsil "791" or Dowsil "CWS "" by Dow Chemical of Canada or approved equivalent by Tremco.

2.5.8 Fabrication Method: Field-fabricated stick system.

2.5.9 Throat Size: to accommodate wall sizes.

2.5.10 Acceptable Products: "Elite Door Frame System, Profile P2" by PC350.

## **2.6 Swing Door Systems**

2.6.1 Provide manufacturer's standard 44.5-mm (1-3/4-inch) thick aluminum swing doors with extruded-aluminum tubular rail and stile members.

2.6.2 Door Design: Manufacturer's standard style.

2.6.3 Door Height: Refer to Door and Frame Schedule on Drawings.

2.6.4 Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.

2.6.5 Framing Members for sidelites, and transom frames: Manufacturer's standard extruded aluminum frames as specified in this Section, reinforced for hinges and strikes as required to support imposed operational loads.

2.6.6 Door Hardware: prepare doors and frames to accept hardware from separate hardware supplier, refer to Section 08 70 10.

2.6.7 Door Hardware Sets: Provide quantity, item, size, finish or colour as required by application. As a minimum, include hinges, closers,

push bars, handles, locking devices, automatic door bottoms, and weatherstripping as applicable and recommended by manufacturer.

2.6.8 Acceptable Door Systems: "Elite Door System" by PC350.

2.6.9 Wood Doors: Refer to Section 08 14 16, Flush Wood Doors.

## **2.7 Glazing**

2.7.1 Conform to minimum requirements in Section 08 80 05, General Requirements for Glass and Glazing.

2.7.2 Minimum Glass Thickness: Unless otherwise specified, Provide fully tempered glass, with appropriate stiffness to account for unsupported span of panels. Increase as required based on final engineering calculations.

2.7.3 Glass acting as guards: Provide glass, glazing, and framing engineered for minimum guard loads specified in OBC 4.1.5.14.

2.7.4 Guard Locations: As specified in OBC 3.3.1.17.(1), OBC 3.3.1.18.(6) and OBC 4.1.5.16.

## **2.8 Accessories**

2.8.1 Fasteners and Accessories: Manufacturer's standard non-corrosive, non-bleeding fasteners compatible with adjacent materials.

2.8.2 Glazing Gaskets: Manufacturer's standard elastomeric glazing gaskets, setting blocks, and shims or spacers.

2.8.3 Glazing Sealants: ASTM C920, Type S, Grade NS, Class 25, Use NT, permanently elastic, non-shrinking, and non-migrating silicone type recommended by manufacturer.

2.8.4 Mineral Wool: CAN/ULC-S702.1/S702.2, Type 1; non-combustible mineral wool tested in accordance with requirements of CAN/ULC-S114.

## **2.9 Fabrication**

2.9.1 Form sections true to detail, free from defects that could impair appearance, strength, or durability.

2.9.2 Ensure frames are tubular extruded shapes with sharp, well-defined corners, matching the overall assembled profiles detailed on Drawings.

2.9.3 Corners of formed work must be mitered and closely fitted. Internally caulk and seal corners of frames and joints exposed to water penetration with a material designed to resist high surface temperatures.

- 2.9.4 Fabricate frames with butt, mitered, or coped corners that are continuously welded with seamless face joints. Provide concealed corner reinforcements and alignment clips for precise connections.
- 2.9.5 Fabricate doors and frames with necessary internal reinforcements, cutouts, recesses, and mortising required for rigid assembly and hardware accommodation. Ensure connections provide adequate strength.
  - .1 Prepare frames to receive mortised and concealed hardware according to the final door hardware schedule and templates provided by hardware supplier.
  - .2 Reinforce frames for surface-applied hardware. Machine jambs, drill, tap, and prepare for hardware installation with concealed reinforcement plates secured within the frame using concealed screws.

**2.10 Finishes, Generally**

- 2.10.1 Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for applying and designating finishes.
- 2.10.2 Complete mechanical finishes of flat sheet metal surfaces before fabrication, where possible.
- 2.10.3 After fabrication, finish all joints, bends, abrasions, and surface blemishes to match the sheet finish.
- 2.10.4 Protect mechanical finishes on exposed surfaces with a strippable, temporary protective covering before shipping.
- 2.10.5 Apply organic and anodic finishes to formed metal after fabrication unless specified otherwise.
- 2.10.6 Finish items after assembly.
- 2.10.7 Appearance Criteria: Acceptable variations in appearance of abutting or adjacent pieces are within one-half of the range of reviewed samples.
  - .1 Noticeable variations in the same piece are not acceptable.
  - .2 Variations in appearance of other components are acceptable if within the range of reviewed samples and assembled to minimize contrast.
- 2.10.8 Finish: Manufacturer's standard baked-enamel or powder-coat finish.
- 2.10.9 Colour and Gloss: White

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### **3 .     EXECUTION**

#### **3.1     Examination**

- 3.1.1 Examine installations areas including, walls, floors, openings, and ceilings, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - .1 Verify that wall thicknesses do not exceed tolerances allowed by throat sizes required for installation.
  - .2 Verify rough opening dimensions, levelness of floors, and operational clearances.
  - .3 Verify that steel studs at openings have been installed inverted in order to accept jambs.
  - .4 Verify that openings have been provided unfinished.
  - .5 Verify that gypsum board provided around openings has been finished to a minimum Level 4 in accordance with ASTM C840 as specified in Section 09 21 16.
- 3.1.2 Do not proceed with installation unless unsatisfactory conditions have been corrected.

#### **3.2     Installation**

- 3.2.1 Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing glazed interior aluminum doors and frames, accessories, and other components.
- 3.2.2 Do not install defective or damaged parts or components. Return such component parts to manufacturer for repair or replacement.
- 3.2.3 Do not cut or trim component parts during installation in a manner that would damage finish, decrease strength or result in visual defects.
- 3.2.4 Use fasteners and anchors suitable for substrate and project conditions. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
- 3.2.5 Pack mineral wool insulation in frames to minimize sound transmission through the frame.
- 3.2.6 Install frames rigid, square, straight, plumb, and level. Fit joints to produce hairline joints free of burrs and distortion. Conceal evidence of drilling, cutting, and fitting.
- 3.2.7 Install gypsum board and extrusions in longest possible lengths, ensuring no component is less than 1220 mm (4 ft). Install components with no visible splices.

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- 3.2.8 Install operating components to produce smooth operation and tight fit at contact points. Install surface-mounted hardware according to manufacturers' written instructions using concealed fasteners.

**3.3 Adjusting, Cleaning, And Protection**

- 3.3.1 Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set self-closing mechanisms on doors such that they close from the 90 deg open position in no less than 4 seconds.
- 3.3.2 Touch-up, repair or replace damaged products.
- 3.3.3 Clean exposed surfaces of frames, hardware, and fittings

END OF SECTION

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## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Flush Wood Doors work specified herein. This includes, but is not necessarily limited, to:
- .1 Veneer-faced doors for transparent finish.
  - .2 Priming and finishing of wood doors.
  - .3 Factory fitting flush wood doors to frames and factory machining for hardware.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only.
- .1 Glazing: Comply with requirements in Section 08 80 05, General Requirements for Glass and Glazing for glass view panels in flush wood doors.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Definitions**

- 1.4.1 Transparent Finish: A stain or a clear finish that allows the natural characteristics and color of the grain of the wood surface to show through the finish

### **1.5 Preinstallation Meetings**

- 1.5.1 Pre-installation Meetings: Schedule, and conduct pre-installation meeting at Project Site, in order to coordinate work of this Section, with work of related Subcontractors.
- .1 Ensure attendance of Subcontractor performing work of this Section and representatives of manufacturers and fabricators involved in, or affected by, installation and coordination with

other materials and installations that have preceded or will follow. Advise Consultant and Owner in advance of scheduled meeting dates.

- .2 Agenda: Review progress of other construction activities and preparations for the particular activity under consideration.
- .3 Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
- .4 Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.

## **1.6     Action Submittals**

1.6.1 Product Data: Submit product data in accordance with Division 01 for the following:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for the Flush Wood Doors work and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Include details of core and edge construction and trim for openings. Include factory-finishing specifications.

1.6.2 Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:

- .1 Door schedule indicating door and frame location, type, size, fire protection rating, and swing.
- .2 Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
- .3 Details of frame for each frame type, including dimensions and profile.
- .4 Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
- .5 Dimensions and locations of blocking for hardware attachment.
- .6 Dimensions and locations of mortises and holes for hardware.
- .7 Clearances and undercuts.
- .8 Requirements for veneer matching.
- .9 Doors to be factory finished and application requirements.

1.6.3 Samples:

- .1 Factory finishes applied to actual door face materials, approximately 200 by 250 mm (8 by 10 inches), for each material and finish.

- .2 Plastic laminate, 150 mm (6 inches) square, for each colour, texture, and pattern selected.
- .3 Corner sections of doors, approximately 200 by 250 mm (8 by 10 inches), with door faces and edges representing actual materials to be used.
  - .1 Provide Samples for each species of veneer and solid lumber required.
  - .2 Provide Samples for each colour, texture, and pattern of plastic laminate required.
  - .3 Finish veneer-faced door Samples with same materials proposed for factory-finished doors.
- .4 Louver blade and frame sections, 150 mm (6 inches) long, for each material and finish specified.
- .5 Frames for light openings, 150 mm (6 inches) long, for each material, type, and finish required.

**1.7 Quality Assurance**

- 1.7.1 Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies shall comply with qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
  - .1 DHI's Certified Fire and Egress Door Assembly Inspector (CFDAI) certification.
- 1.7.2 Source Limitations: Obtain flush wood doors from single manufacturer.

**1.8 Delivery, Storage, And Handling**

- 1.8.1 Comply with requirements of referenced standard and manufacturer's written instructions.
- 1.8.2 Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.
- 1.8.3 Mark each door on top and bottom rail with opening number used on Shop Drawings.

**1.9 Field Conditions**

- 1.9.1 Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature between 16 and 32 deg C (60 and 90 deg F) and relative humidity between 25 and 55 percent during remainder of construction period.



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**1.10 Warranty**

1.10.1 Extended Warranty: Repair or replace doors that fail in materials or workmanship within specified warranty period.

.1 Failures include, but are not limited to, the following:

- .1 Delamination of veneer or facing.
- .2 Warping (bow, cup, or twist) more than 6.4 mm (1/4 inch) in a 1067-by-2134-mm (42-by-84-inch) section.
- .3 Telegraphing of core construction in face veneers exceeding 0.25 mm in a 76.2-mm (0.01 inch in a 3-inch) span.

.2 Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.

.3 Warranty Period for Solid-Core Interior Doors: Life of installation.

**2 . PRODUCTS**

**2.1 Manufacturers**

2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.

- .1 Algoma-Marshfield; A Masonite company.
- .2 Baillargeon; A Masonite company.
- .3 Lambton Doors.
- .4 Marshfield Door Systems, Inc.; A Masonite company.
- .5 Mohawk Doors; a Masonite company.
- .6 VT Industries, Inc.

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

**2.2 Performance Requirements**

2.2.1 Fire-Rated Wood Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings and temperature-rise limits indicated on Drawings, based on testing at positive pressure in accordance with CAN4-S104 or equivalent to NFPA 252 (subject to approval by authorities having jurisdiction).

- .1 Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on

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testing in accordance with UL 1784 and installed in compliance with NFPA 105.

2.2.2 Quality Standard: Comply with WDMA I.S.1-A, "Architectural Wood Flush Doors and as follows in accordance with WDMA I.S.1-A Performance Grade:

- .1 Extra Heavy Duty: unless indicated otherwise
- .2 Standard Duty: Closets (not including janitor's closets) and private washrooms and where indicated on Drawings and Schedules.

**2.3 Interior Wood Veneer-Faced Doors And Transom Panels For Transparent Finish**

2.3.1 Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.3.2 Faces: Grade AA (premium), Single-ply wood veneer not less than 0.508 mm (1/50 inch) thick.

- .1 Species, Cut, and Match: Maple, quarter cut and slip matched.
- .2 Assembly of Veneer Leaves on Door Faces: Balance match.
- .3 Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
- .4 Room Match: Provide door faces of compatible colour and grain within each separate room or area of building.

2.3.3 Exposed Vertical and Top Edges: Applied wood edges of same species as faces and covering edges of crossbands as standard with WDMA.

- .1 Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.
- .2 Fire-Rated Pairs of Doors: Provide formed-steel edges and astragals with intumescent seals. Finish steel edges and astragals with baked enamel same colour as doors.

2.3.4 Core for Non-Fire-Rated Doors:

- .1 ANSI A208.1, Grade LD-1 or Grade LD-2 particleboard (density-range 28 – 32 lbs/cu.ft) or agrifibre doors as specified herein.
- .2 Provide doors with laminated-strand-lumber (LSL) or WDMA I.S. 10 structural-composite-lumber cores instead of particleboard cores for doors scheduled to receive exit devices (non-fire-rated).

2.3.5 Core for Fire-Rated Doors: As required to achieve fire-protection rating indicated on Drawings.

- .1 Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings as needed to eliminate through-bolting hardware.
  - .2 At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
- 2.3.6 Basis-of-Design:
- .1 Non-Fire-rated Doors, unless indicated otherwise: "Model No. 8500-ME" / "Model No. 8500-ME-AF" by Baillargeon Doors or "5-FS8500-EME" by Lambton Door or approved equivalent.
  - .2 Doors scheduled to receive exit devices (non-fire-rated): "Model No. 6000-ME" or 5-UFLSL-ME by Lambton Doors or approved equivalent.
  - .3 Fire-rated Doors: "5045/5060/5090" by Baillargeon Doors or approved equivalent.

**2.4     Solid-Core Three-Ply Flush Wood Doors And Transom Panels For Opaque Finish**

- 2.4.1 Grade: Custom.
- 2.4.2 Construction: Three plies, hot-pressed bonded with MDO faces.
- .1 Apply MDO to standard-thickness, closed-grain, hardwood face veneers or directly to high-density hardboard crossbands.
- 2.4.3 Exposed Vertical and Top Edges: Same species as faces or a compatible species or applied wood edges of same species as faces and covering edges of crossbands as standard with WDMA.
- .1 Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.
  - .2 Fire-Rated Pairs of Doors: Provide formed-steel edges and astragals with intumescent seals. Finish steel edges and astragals with baked enamel same colour as doors.
- 2.4.4 Core for Non-Fire-Rated Doors:
- .1 ANSI A208.1, Grade LD-1 or Grade LD-2 particleboard (density-range 28 – 32 lbs/cu.ft) or agrifibre doors as specified herein.
  - .2 Provide doors with laminated-strand-lumber (LSL) or WDMA I.S. 10 structural-composite-lumber cores instead of particleboard cores for doors scheduled to receive exit devices (non-fire-rated).
- 2.4.5 Core for Fire-Rated Doors: As required to achieve fire-protection rating indicated on Drawings.

- .1 Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings as needed to eliminate through-bolting hardware.
- .2 At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

## **2.5     Fabrication**

- 2.5.1 Factory fit doors to suit frame-opening sizes indicated.
  - .1 Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
  - .2 Comply with NFPA 80 requirements for fire-rated doors.
- 2.5.2 Factory machine doors for hardware that is not surface applied.
  - .1 Locate hardware to comply with DHI-WDHS-3.
  - .2 Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
  - .3 For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
- 2.5.3 Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- 2.5.4 Transom and Side Panels:
  - .1 Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors.
  - .2 Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.
  - .3 Fabricate door and transom panels with full-width, solid-lumber, rabbeted, meeting rails.
  - .4 Provide factory-installed spring bolts for concealed attachment into jambs of metal door frames.
- 2.5.5 Openings: Factory cut and trim openings through doors.
  - .1 Light Openings: Trim openings with moldings of material and profile indicated.
- 2.5.6 Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 08 80 05, General Requirements for Glass and Glazing.
  - .1 Louvers: Factory install louvers in prepared openings.

## **2.6     Factory Finishing**

- 2.6.1 Comply with referenced quality standard for factory finishing.

- 2.6.2 Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
- 2.6.3 Finish faces, all four edges, edges of cutouts, and mortises. Specifically, seal top and bottom edges, hardware preparation areas, mortises and hinges and lock areas.
- 2.6.4 Factory finish doors that are indicated on Drawings to receive transparent finish.
- 2.6.5 Transparent Finish: ANSI/WDMA I.S. 1A Grade: Premium
  - .1 Provide ANSI/WDMA I.S. 1A TR-8 UV Cured Acrylated Polyester/Urethane
  - .2 Staining: Match Consultant's sample.

### **3 . EXECUTION**

#### **3.1 Examination**

- 3.1.1 Examine doors and installed door frames, with Installer present, before hanging doors.
  - .1 Verify that installed frames comply with indicated on Drawings and Schedules requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
  - .2 Reject doors with defects.
- 3.1.2 Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 Installation**

- 3.2.1 Hardware: Refer to Section 08 70 10, Finish Hardware.
- 3.2.2 Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated on Drawings and Schedules.
  - .1 Install fire-rated doors according to NFPA 80.
  - .2 Install smoke- and draft-control doors according to NFPA 105.
- 3.2.3 Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
  - .1 Clearances: Provide 3.2 mm (1/8 inch) at heads, jambs, and between pairs of doors. Provide 3.2 mm (1/8 inch) from bottom of door to top of decorative floor finish or covering

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unless otherwise indicated on Drawings and Schedules. Where threshold is shown or scheduled, provide 6.4 mm (1/4 inch) from bottom of door to top of threshold unless otherwise indicated on Drawings and Schedules.

- .2 Bevel non-fire-rated doors 3-1/2 degrees (1/8 inch in 2 inches) at lock and hinge edges.
  - .3 Do not fit and machine fire-rated doors on site.
- 3.2.4 Factory-Fitted Doors: Align in frames for uniform clearance at each edge. Comply with NFPA 80 for fire-rated doors.
- 3.2.5 Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

### **3.3 Adjusting**

- 3.3.1 Operation: Rehang or replace doors that do not swing or operate freely.
- 3.3.2 Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Access Doors And Frames work specified herein. This includes, but is not necessarily limited, to:
- .1 Access doors and frames for walls and ceilings.
  - .2 Floor access doors and frames.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only.
- .1 Section 07 72 76, Roof Access Hatched for roof hatches.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Action Submittals**

- 1.4.1 Product Data: Submit product data in accordance with Division 01 for each type of product.
- .1 Submit manufacturer's instructions, printed product literature and data sheets for the Access Doors And Frames work and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Include construction details, fire ratings, materials, individual components and profiles, and finishes.
- 1.4.2 Shop Drawings:
- .1 Include plans, elevations, sections, details, and attachments to other work.
  - .2 Detail fabrication and installation of access doors and frames for each type of substrate.

- 1.4.3 Samples: Submit samples in accordance with Division 01 for each door face material, at least 75 by 125 mm (3 by 5 inches) in size, in specified finish.
- 1.4.4 Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

## **1.5 Warranty**

- 1.5.1 Provide warranty covering the Work of this Section in accordance with Supplementary Condition SC49 / GC 12.3 WARRANTY.

## **2 . PRODUCTS**

### **2.1 Manufacturers**

- 2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.
  - .1 Acudor Products, Inc.
  - .2 Babcock-Davis.
  - .3 Cendrex Inc.
  - .4 MIFAB, Inc.
  - .5 Milcor Inc.
  - .6 Nystrom, Inc.
- 2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

### **2.2 Performance Requirements**

- 2.2.1 Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, according to CAN4-S104 or equivalent to NFPA 252 (subject to approval by authorities having jurisdiction) or UL 10B.
- 2.2.2 Door Size: Unless otherwise indicated, size doors as follows:
  - .1 Minimum 305 mm x 305 mm (12 inch x 12 inch) for single valves; 406 mm x 406 mm (16 inch x 16 inch) for groups of valves and 610 mm x 610 mm (24 inch x 24 inch) for body access.

### **2.3 Materials**

- 2.3.1 Steel Plates, Shapes, and Bars: ASTM A36/A36M or equivalent to CSA G40.20/G40.21.



- 2.3.2 Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.
- 2.3.3 Galvanized Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum Z180 (G60) or ZF180 (A60) metallic coating.
- 2.3.4 Stainless Steel Plate, Sheet, and Strip: ASTM A240/A240M or ASTM A666, Type 304. Remove tool and die marks and stretch lines, or blend into finish.
- 2.3.5 Stainless Steel Flat Bars: ASTM A666, Type 304. Remove tool and die marks and stretch lines, or blend into finish.
- 2.3.6 Aluminum Extrusions: ASTM B221M (ASTM B221), Alloy 6063.
- 2.3.7 Aluminum Sheet: ASTM B209M (ASTM B209), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- 2.3.8 Frame Anchors: Same material as door face.
- 2.3.9 Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

**2.4 Flush Access Doors With Exposed Flanges**

- 2.4.1 Description: Face of door flush with frame, with exposed flange and concealed hinge.
- 2.4.2 Locations: Masonry walls.
- 2.4.3 Galvanized Steel Sheet for Door: Nominal 1.63 mm (0.064 inch), 16 gage, factory primed.
- 2.4.4 Frame Material: Same material, thickness, and finish as door.
- 2.4.5 Latch and Lock: Cam latch, screwdriver operated.
- 2.4.6 Acceptable Products:
  - .1 "UF-5000" by Acudor
  - .2 "NT" by Nystrom
  - .3 Approved equivalent.

**2.5 Flush Access Doors With Concealed Flanges (Gypsum Board)**

- 2.5.1 Description: Face of door flush with frame; with concealed flange for gypsum board installation and concealed hinge.
- 2.5.2 Locations: Gypsum board wall and ceiling.
- 2.5.3 Galvanized Steel Sheet for Door: Nominal 1.63 mm (0.064 inch), 16 gage factory primed.
- 2.5.4 Frame Material: Same material and thickness as door.

2.5.5 Latch and Lock: Cam latch, screwdriver operated.

2.5.6 Acceptable Products:

- .1 "DW-5040" by Acudor
- .2 "NW" by Nystrom
- .3 Approved equivalent.

**2.6 Recessed Access Doors (Tile Ready) With Concealed Flanges**

2.6.1 Description: Face of door to fit flush to frame. Provide frame with gypsum board beads for concealed flange installation.

2.6.2 Locations: Tile and stone applications where access doors are required.

2.6.3 Door Size: As noted on Drawings

2.6.4 Galvanized Steel Sheet for Door: Nominal 1.63 mm (0.064 inch), 16 gage

- .1 Finish: Factory finish.

2.6.5 Hardware: Cam latch, screwdriver operated.

2.6.6 Acceptable Products:

- .1 "AT-5020 Recessed Access Door" by Acudor
- .2 "RA" by Nystrom
- .3 Approved equivalent.

**2.7 Exterior Flush Access Doors**

2.7.1 Description: Weatherproof assembly, with face of door fit flush with frame and with exposed frame. Include extruded door gaskets and minimum 50-mm-thick (2-inch-thick) fiberglass insulation.

- .1 Air Infiltration: less than 0.01 cfm/ft<sup>2</sup> – ASTM E283
- .2 Water Penetration: no leakage at 15 psf – ASTM E331

2.7.2 Locations: Exterior walls where indicated.

2.7.3 Stainless Steel Sheet for Door: Nominal 1.59 mm (0.062 inch), 16 gage, ASTM A480/A480M No. 4 finish.

2.7.4 Frame Material: Same material, thickness, and finish as door.

2.7.5 Latch and Lock: Cam latch operated by handle, with keyed lock in handle.

2.7.6 Acceptable Products:

- .1 "ADWT" by Acudor
- .2 "XTA I-H" by Nystrom
- .3 Approved equivalent.

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**2.8      Interior Flush Gypsum Access Doors With Concealed Flanges**

- 2.8.1 Description: Face of concealed-hinge door flush with frame, with concealed flange for gypsum board installation.
- 2.8.2 Locations: Gypsum board walls and ceilings.
- 2.8.3 Door and Frame Material: Unpainted gypsum, with extruded aluminum frames reinforced for hardware and fastenings.
- 2.8.4 Latch and Lock: Cam latch, screwdriver operated.
- 2.8.5 Acceptable Products:
  - .1 "Recessed Access Door #GFRG" by Acudor
  - .2 "Bauco-Plus II" by Bauco Access panel Solutions Inc.
  - .3 "RGB" by Nystrom

**2.9      Fire-Rated, Flush Access Doors With Exposed Flanges**

- 2.9.1 Description: Door face flush with frame, with a core of mineral-fibre insulation enclosed in sheet metal; with exposed flange, self-closing door, and concealed hinge.
- 2.9.2 Locations: Masonry walls.
- 2.9.3 Fire-Resistance Rating: Not less than that of adjacent construction.
- 2.9.4 Galvanized Steel Sheet for Door: Nominal 1.02 mm (0.040 inch), 20 gage, factory primed.
- 2.9.5 Frame Material: Same material, thickness, and finish as door.
- 2.9.6 Latch and Lock: Self-latching door hardware, operated by key.
- 2.9.7 Acceptable Products:
  - .1 "FW-5050" by Acudor
  - .2 "IT" by Nystrom
  - .3 Approved equivalent.

**2.10     Fire-Rated, Flush Access Doors With Concealed Flanges**

- 2.10.1 Description: Door face flush with frame, with a core of mineral-fibre insulation enclosed in sheet metal; with concealed flange for gypsum board installation, self-closing door, and concealed hinge.
- 2.10.2 Locations: Gypsum board Wall and ceiling.
- 2.10.3 Fire-Resistance Rating: Not less than that of adjacent construction.
- 2.10.4 Galvanized Steel Sheet for Door: Nominal 1.02 mm (0.040 inch), 20 gage, factory primed.
- 2.10.5 Frame Material: Same material, thickness, and finish as door.

2.10.6 Latch and Lock: Self-closing, self-latching door hardware, operated by key.

2.10.7 Acceptable Products:

- .1 "FW-5050-DW" by Acudor
- .2 "IW" by Nystrom
- .3 Approved equivalent.

## **2.11 Fabrication**

2.11.1 Provide access door and frame assemblies manufactured as integral units ready for installation.

2.11.2 Metal Surfaces: for metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

2.11.3 Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Supply attachment devices and fasteners of type required to secure access doors to types of supports indicated on Drawings and Schedules.

- .1 For concealed flanges with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
- .2 Provide mounting holes in frames for attachment of units to metal framing.
- .3 Provide mounting holes in frame for attachment of masonry anchors.

2.11.4 Recessed Access Doors: form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling.

2.11.5 Latching Mechanisms: Supply number required to hold doors in flush, smooth plane when closed.

- .1 For cylinder locks, Supply two keys per lock and key all locks alike.
- .2 For recessed panel doors, provide access sleeves for each locking device. Supply plastic grommets and install in holes cut through finish.

## **2.12 Finishes**

2.12.1 Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.12.2 Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.12.3 Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

### **3 . EXECUTION**

#### **3.1 Examination**

- 3.1.1 Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- 3.1.2 Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 Installation**

- 3.2.1 Comply with manufacturer's written instructions for installing access doors and frames.
- 3.2.2 Install doors flush with adjacent finish surfaces or recessed to receive finish material.

#### **3.3 Field Quality Control**

- 3.3.1 Fire-Rated Door Inspections: Inspect each fire-rated access door in accordance with NFPA 80, section 5.2.
  - .1 Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
  - .2 Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
  - .3 Prepare and submit separate inspection report for each fire-rated access door indicating compliance with each item listed in NFPA 80.

#### **3.4 Adjusting**

- 3.4.1 Adjust doors and hardware, after installation, for proper operation.
- 3.4.2 Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the high speed roll-up doors work specified herein. This includes, but is not necessarily limited, to:
  - .1 High-speed roll-up door
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only:
  - .1 Section 08 70 10 – Finish Hardware

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

### **1.4 Preinstallation Meetings**

- 1.4.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.
- 1.4.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
  - .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.

- .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.
- .3 Agenda:
  - .1 Review progress of related construction activities and preparations for particular activity under consideration.
  - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
- .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
- .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

## **1.5 Submittals**

- 1.5.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.5.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for high speed roll-up doors work specified in this Section.
- 1.5.3 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:
  - .1 Include plans, elevations, sections and details as applicable.
  - .2 Indicate field-measured dimensions on Shop Drawings.
- 1.5.4 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
  - .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
  - .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
  - .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.5.5 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:
  - .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze

level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.

- .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.

1.5.6 Low-Emitting Materials: For applicable Products specified or used for activities of this Section (i.e., site-applied coatings, adhesives, and sealants), submit certifications from third-party organizations indicating compliance with following:

- .1 VOC Emissions: California Department of Public Health (CDPH) Standard Method v1.2–2017, using applicable exposure scenario.
- .2 VOC Content: SCAQMD Rule 1113 (for paints and coatings) and SCAQMD Rule 1168 (for adhesives and sealants).

1.5.7 Samples: Submit selection and verification samples for Products requiring colour, texture, or design selection. Submit manufacturer's list of finishes or colour swatches for Consultant's selection.

1.5.8 Welding Certificate: Submit certification for welding firms and welders to verify compliance with welding qualifications specified in this section.

## **1.6 Closeout Submittals**

1.6.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.

1.6.2 Operating and Maintenance Data: Submit care and maintenance instructions for high speed roll-up doors to be included in building operation and maintenance manual.

1.6.3 Warranty Documentation: Submit copy of extended warranties specified in this Section.

## **1.7 Quality Assurance**

1.7.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.

1.7.2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.

1.7.3 Welding Qualifications: Qualify procedures and personnel in accordance with the following:

- .1 Steel: to CSA W47.1 and CSA W59
- .2 Aluminum: to CSA W47.2 and CSA W59.2



.3 Stainless Steel: to CSA W47.1 (Annex K) and CSA W59.

1.7.4 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.

1.7.5 Mock-Ups / First Installation Review: Construct mock-ups to verify selections made under submittals, demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

.1 Location: In-situ (i.e. first installation), as directed on site by Consultant.

.2 Purpose: To set benchmarks for installation and to judge subsequent work. Maintain Mock-ups during construction in undisturbed condition.

.3 Reviewed mock-ups: May become part of the completed work if undisturbed at the time of Substantial Performance of The work, provided they are undisturbed, and comply with requirements outlined in Contract Documents.

#### **1.8 Delivery, Storage And Handling**

1.8.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.

1.8.2 Deliver, store and handle high speed roll-up doors materials in accordance with manufacturer's written instructions.

1.8.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

1.8.4 Store materials in off-ground, in clean, dry, well-ventilated area.

1.8.5 Replace defective or damaged materials with new.

#### **1.9 FIELD CONDITIONS**

1.9.1 Environmental Restrictions: Do not deliver or install high speed roll-up doors until building is enclosed, wet work is complete, and HVAC system is operational and will maintain temperature and relative humidity levels equal to occupancy levels for remainder of construction period.

1.9.2 Field Measurements: Verify actual dimensions of construction contiguous with high speed roll-up doors by field measurements before fabrication.

#### **1.10 WARRANTY**

1.10.1 Extended warranty: Submit for Owner's review and acceptance, manufacturer's extended warranty in which manufacturer commits to repair or replace components of high speed roll-up doors that fail within specified warranty period. Manufacturer's extended warranty

is in addition to, and does not supersede, any other rights that Owner may have under Contract Documents.

- .1 Warranty Period: Not less than 10 years from date of Substantial Performance of The work.

## 2. PRODUCTS

### 2.1 Manufacturers

2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:

- .1 Assa Abloy
- .2 Wayne Dalton
- .3 Approved equivalent

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

### 2.2 High-Speed Door (FIN-01)

2.2.1 Description: High-speed roll-up door for interior heavy-duty operations.

- .1 Lifetime Expectation: 1,000,000 cycles
- .2 Door Curtain:
  - .1 Material: 3-layers of PVC coated polyester with 2 layers of polyester weave.
  - .2 Operating Speed: Opening up to 55 inch/s, Closing at 40 inch/s.
  - .3 Colour: refer to Finish Schedule on Drawings.
- .3 Bottom Bar:
  - .1 Fully padded, break away bottom bar full width of the opening, sufficient to maintain bottom edge of curtain parallel to the door threshold.
  - .2 Finish: Powder coated safety yellow.
- .4 Guides:
  - .1 Description: Fully boated construction with full-height weather seal around entire perimeter of door.
  - .2 Material: Steel
  - .3 Finish: Powder coated safety yellow.
- .5 Door Header:
  - .1 Description: Top roll assembly fabricated of high strength steel barrel supported with powder coated high strength steel brackets at each end with self-aligning bearings.

- .2 Drum Barrel System: Minimum 6.625 inches (168.3 mm) diameter ASTM A 500 Grade B high strength steel pipe.
- .3 Brackets: Minimum 1/4 inch (6 mm) thick ASTM A 36 hot rolled steel with heavy-duty, self-aligning bearings with cast iron housings.
- .4 Springless System: No balancing springs or counterweights permitted.
- .5 Head frame provided with a single brush seal along the top of the door.
- .6 Hood: Top roll assembly enclosed with an external metal hood.
  - .1 Finish: Galvanized steel hood with black polyester top coat.
  - .2 Material: 22 gauge steel with intermediate supports as required.
- .7 Electric Door Operator: Heavy duty, rated up to 60 cycles per hour.
- .8 Basis-of-Design: "Model ADV-Xtreme 884" by Wayne Dalton or approved equivalent.

### 2.3 **Operation**

- 2.3.1 Operation: Electrically operated with power drive system, eliminating the need for ballast in the curtain or tension straps. Motor driven by a frequency inverter for smooth operation and longevity.
- 2.3.2 Control Unit: Direct-side mounted with the following features:
  - .1 Microprocessor based with variable frequency drive controller, capable of variable speed control in both up and down directions.
  - .2 System incorporates a Liquid Crystal Display (LCD) to display the system status.
  - .3 Capable of monitoring and reporting on a variety of operating conditions, including: Current operating status, Current command status, Current error status (if applicable), Hoist interlock status (if applicable), Service reminder status, and 24VDC status.
  - .4 Control system is housed in a NEMA 4X panel with built-in push buttons and main power padlock-able rotary disconnect switch.

## 3. **EXECUTION**

### 3.1 **Examination**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions

which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.

**3.2 Installation**

- 3.2.1 Installation, generally: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.
- 3.2.2 Door Operators: Connect door operators to electrical power distribution system.

**3.3 Adjusting**

- 3.3.1 Adjust hardware, moving parts, door operators, and controls to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.
- 3.3.2 Readjust door operators and controls after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).

**3.4 Protection**

- 3.4.1 Protect high speed roll-up doors from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades.
- 3.4.2 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in writing by affected material's manufacturer. Do not use materials or process that can damage finishes, surfaces, or construction.
- 3.4.3 Promptly replace high speed roll-up doors work damaged during construction that cannot be satisfactorily repaired.

**3.5 Cleaning And Waste Management**

- 3.5.1 Cleaning and Waste Management, generally: in accordance with Section 01 74 00, Cleaning and Waste Management.
- 3.5.2 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
- 3.5.3 Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**Regional Municipality  
of Peel  
Procurement Division**

**Document 2024-346P  
CONSTRUCTION OF THE  
DOCKSTEADER PRPS  
REPORTING STATION**

**Division 08  
08 33 23.13  
High Speed Roll-Up  
Doors**

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END OF SECTION

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the overhead coiling doors work specified herein. This includes, but is not necessarily limited, to:
  - .1 Fire-rated, non-insulated overhead coiling service doors.
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only:
  - .1 Section 05 50 00 - Metal Fabrications
  - .2 Section 09 91 23 - Interior Painting
  - .3 Section 11 13 00 - Loading Dock Equipment.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

### **1.4 Administrative Requirements**

- 1.4.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.
- 1.4.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.

- .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.
- .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.
- .3 Agenda:
  - .1 Review progress of related construction activities and preparations for particular activity under consideration.
  - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
- .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
- .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

**1.5 Submittals**

- 1.5.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.5.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for overhead coiling doors work specified in this Section.
  - .1 Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
  - .2 Include description of automatic-closing device and testing and resetting instructions.
  - .3 For motorized doors: Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
- 1.5.3 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:
  - .1 Include plans, elevations, sections and details as applicable.
  - .2 Indicate field-measured dimensions on Shop Drawings.
  - .3 Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - .4 Include points of attachment and their corresponding static and dynamic loads imposed on structure.

- .5 Show locations of controls, locking devices, detectors, and other accessories.
- .6 Wiring Diagrams: Submit for power, signal, and control wiring.
- 1.5.4 Delegated Design Submittals:
  - .1 Engineering design completion of overhead coiling doors work is delegated to Contractor based on structural design criteria indicated in Contract Documents.
  - .2 Submit Shop Drawings for work of this Section that bear the stamp of a Professional Engineer registered in Province of Ontario.
  - .3 Submit copy of structural calculations upon request by Consultant.
- 1.5.5 Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, section 5.2.3.1.
- 1.5.6 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
  - .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
  - .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
  - .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.5.7 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:
  - .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.
  - .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.5.8 Samples: Submit selection and verification samples for Products requiring colour, texture, or design selection. Submit manufacturer's list of finishes or colour swatches for Consultant's selection.

## **1.6 Closeout Submittals**

- 1.6.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.



- 1.6.2 Operating and Maintenance Data: Submit care and maintenance instructions for overhead coiling doors to be included in building operation and maintenance manual.
- 1.6.3 Warranty Documentation: Submit copy of extended warranties specified in this Section.
- 1.6.4 As-Built Documents: Submit list of fire-rated door numbers and applicable room name and number to which door accesses.

## **1.7 Quality Assurance**

- 1.7.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.
- 1.7.2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.
  - .1 Installer must be trained and approved by the manufacturer.
- 1.7.3 Professional Engineer's Qualifications: Employ Professional Engineer licensed to practice in Province of Ontario who carries professional liability insurance and has at least five years' experience providing engineering services of similar kind, scope, and complexity.
  - .1 Professional Engineer's Responsibility:
    - .1 production and review of Shop Drawings,
    - .2 design and certification of overhead coiling doors, including attachments for building construction, in accordance with applicable codes and regulations,
    - .3 stamping and signing of each Shop Drawing and associated calculations
- 1.7.4 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.
- 1.7.5 Mock-Ups / First Installation Review: Construct mock-ups to verify selections made under submittals, demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - .1 Location: In-situ (i.e. first installation), as directed on site by Consultant.
  - .2 Purpose: To set benchmarks for installation and to judge subsequent work. Maintain Mock-ups during construction in undisturbed condition.

- .3 Reviewed mock-ups: May become part of the completed work if undisturbed at the time of Substantial Performance of The work, provided they are undisturbed, and comply with requirements outlined in Contract Documents.

**1.8 Delivery, Storage And Handling**

- 1.8.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.
- 1.8.2 Deliver, store and handle overhead coiling doors materials in accordance with manufacturer's written instructions.
- 1.8.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.8.4 Store materials in off-ground, in clean, dry, well-ventilated area.
- 1.8.5 Replace defective or damaged materials with new.

**1.9 Field Conditions**

- 1.9.1 Field Measurements: Verify actual dimensions of construction contiguous with overhead coiling doors by field measurements before fabrication.

**1.10 Warranty**

- 1.10.1 Extended warranty: Submit for Owner's review and acceptance, manufacturer's extended warranty in which manufacturer commits to repair or replace components of overhead coiling doors that fail within specified warranty period. Manufacturer's extended warranty is in addition to, and does not supersede, any other rights that Owner may have under Contract Documents.
  - .1 Warranty Period: Not less than 2 years from date of Substantial Performance of The work.

**2 . PRODUCTS**

**2.1 Manufacturers**

- 2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:
  - .1 Assa Abloy.
  - .2 C.H.I. Overhead Doors.
  - .3 Cookson Company.
  - .4 Cornell Iron Works, Inc.
  - .5 Clopay Doors
  - .6 Dynamic Closures Corp.

- .7 McKeon Rolling Steel Door Company, Inc.
- .8 Overhead Door Corporation.
- .9 Raynor.
- .10 Wayne-Dalton Corp.

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

## **2.2 Regulatory Requirements**

2.2.1 Accessibility Standard: Comply with applicable provisions in CSA B651, the Ontario Building Code and the AODA.

## **2.3 Performance / Design Criteria**

2.3.1 Operation Cycles: Provide overhead coiling door components and operators capable of operating for not less than number of cycles indicated on Drawings and Schedules for each door. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

2.3.2 Electrical Components, Devices, and Accessories (motorized doors): Listed and labeled as defined in CSA C22 Series, by a qualified testing agency, and marked for intended location and application.

2.3.3 Seismic Performance: Provide products and systems specified in this Section to withstand the effects of earthquake motions in accordance with OBC 4.1.8.18 and CAN/CSA S832.

- .1 Professional engineer specified in Division 01 and referenced in this Section shall be responsible for designing systems and submitting signed and sealed analysis data and Shop Drawings illustrating seismic-resistant systems.
- .2 Refer to Structural Drawings for seismic sensitivity values.

## **2.4 Fire-Rated, Non-Insulated Overhead Coiling Service Doors**

2.4.1 Fire-Rated Door Assemblies: Must comply with NFPA 80. Ensure doors are listed and labeled by a qualified testing agency for fire ratings specified based on testing to CAN/ULC S104.

.1 Smoke Control: For doors in corridors, smoke barriers, and locations specified on Drawings and Schedules, provide doors tested to UL 1784, and listed and labeled with an "S" for smoke and draft control by a qualified testing agency.

- .1 Maximum air-leakage rate: 15.24 L/s x sq. m (3.0 cfm/sq. ft.) at 25 Pa (0.10 inch wg) under ambient and elevated temperature conditions.
- .2 Required Fire-Rating: Refer to Drawings and Schedules

2.4.2 Door Construction: Interlocking roll-formed slats with endlocks riveted to the ends of alternate slats to maintain slat alignment and prevent wear and design to provide required fire-ratings.

- .1 Slats:
  - .1 Galvanized Steel: galvanized steel to ASTM A653; manufacturer-recommended thickness to meet performance requirements, but not less than 22 ga.
  - .1 Steel Finish: Manufacturer's standard baked enamel coating with powder coated clear topcoat having pencil hardness of 2H or better in accordance with ASTM D3363.
  - .2 Colour: to be selected by Consultant at a later date
- .2 Endlocks: high-strength endlocks on alternate slats, each fastened with two 6.35 mm (1/4 in) rivets.
- .3 Bottom Bar: Manufacturer's standard material matching door construction in all respects.
- .4 Guides: Fabricate guides from minimum 6.35 mm (1/4 inch) galvanized steel angles. Provide removable guide stoppers to prevent excessive travel of curtain and bottom bar. Ensure side guide angles are removable to provide access for curtain installation and future maintenance service.
- .5 Counterbalance Shaft Assembly:
  - .1 Barrel: steel pipe designed to support curtain load with a maximum deflection of 2.5 mm per meter (0.03 inches per foot) of width.
  - .2 Spring Balance: Provide oil-tempered, heat-treated steel helical torsion spring assembly for door balance; ensure maximum operational effort does not exceed 110 N (25 lbs). Provide mechanism for applying and adjusting spring torque.
- .6 Brackets: Fabricated from minimum of 5 mm (3/16 inch) steel plate, with permanently lubricated ball or roller bearings at pivot points to support counterbalance shaft assembly and provide end closures.
- .7 Hood: material to match door curtain. Provide reinforcing at top and bottom edges and minimum 6.35 mm (1/4 inch) intermediate support brackets as required to prevent sagging.
- .8 Weatherstripping / Smoke Seals:
  - .1 Bottom Bar - Motorized Doors: combination smoke seal and sensing edge.
  - .2 Guides and Head: Replaceable, cUL-listed, nylon brush smoke seals applied to fascia side of curtain.

- 
- .9 Finish of exposed door components: to match door curtain slat in every respect unless specified otherwise.
  - 2.4.3 Motorized Door Operation: CSA or UL listed and labeled, size as recommended by manufacturer, capable of driving door at a speed of no less than 203 mm (8 inches) per second nor more than 305 mm (12 inches) per second.
    - .1 Motor Exposure: Interior.
    - .2 Type: Standard Use: Up to 20 cycles per day maximum, and 50,000 cycles for life of door.
    - .3 Horsepower: Variable, to be determined by door manufacturer based on door size and operational requirements, but not less than 1/3 hp.
    - .4 Power Supply: 115 VAC, single phase
    - .5 Control Station: NEMA 1 flush mount, 24 V control station with open, close and stop button.
    - .6 Additional Access Control: Refer to Division 28 and Division 11 for additional requirements regarding access control and interlocking with vehicle detection mechanisms.
    - .7 Emergency Operation:
      - .1 Manual Chain Hoist: For manual override in case of power or operational failure.
      - .2 Battery Backup: For doors intended for use in emergency situations, provide battery backup with programmable logic for minimum 10 operational cycles and extended standby.
    - .8 Obstruction-Detection Device: to UL325, Automatic photoelectric sensor with pneumatic sensor edge on bottom bar.
      - .1 Primary Entrapment Protection Devices: Photo eyes fully monitored, non-contact, infrared beam photo sensor system shall reverse a closing door to full open position when an obstruction is sensed; photo sensors shall be mounted no higher than 152 mm (6 inches) maximum above the floor.
      - .2 Ancillary Entrapment Protection Devices: Pneumatic sensing edge shall reverse a closing door to the full open position when an obstruction is sensed.
      - .3 Sensor Edge Bulb Colour: As selected by Consultant from manufacturer's full range.
    - .9 Limit Switch: Adjustable, linear screw-type cam limit switch for accurate door positioning and synchronization with operator.

.10 Location: Operator must fit within door coil area without protrusion.

2.4.4 Locking: Masterkeyable system. Coordinate with Section 08 70 10.

2.4.5 Basis-of-Design: "FireCurtain UCP" as manufactured by Raynor or approved equivalent.

## **2.5 Accessories**

2.5.1 Door Release Mechanism: internal electrical failsafe release device designed to function with no additional wiring or external components.

- .1 Trigger: automatic closure via connection to central fire alarm.
- .2 Closure Speed: Average of 300 mm (12 in) per second. Auto-closure after alarm trigger delayed by up to 10 seconds.
- .3 Provide internal solenoid brake to permit door to hold in position during use.
- .4 Closure speed to be governed via enclosed, variable rate centrifugal governor; no exposed mechanisms are permitted.
- .5 System to automatically reset failsafe release and operator after clearance of alarm without manual intervention.
- .6 Coordinate with Coordinate with Division 26 and Division 28 for disconnect switch, conduit, and wiring.

## **2.6 General Finish Requirements**

2.6.1 Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.6.2 Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

# **3 . EXECUTION**

## **3.1 Examination**

3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.

3.1.2 Examine locations of electrical connections.

**3.2     Installation**

- 3.2.1 Installation, generally: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.
- 3.2.2 Install overhead coiling doors, hoods, and operators at the mounting locations indicated on Drawings and Schedules for each door.
- 3.2.3 Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- 3.2.4 Fire-Rated Doors: Install according to NFPA 80.
  - .1 Smoke-Control Doors: Install according to NFPA 80 and NFPA 105.
- 3.2.5 Motorized Doors: Install according to UL 325.

**3.3     Startup Service**

- 3.3.1 Engage a factory-authorized service representative to perform startup service.
  - .1 Perform installation and startup checks according to manufacturer's written instructions.
  - .2 Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - .3 Test door release, closing, and alarm operations when activated by smoke detector or building's fire-alarm system. Test manual operation of closed door. Reset door-closing mechanism after successful test.
- 3.3.2 Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, section 5.2. Conduct minimum of two drop tests and resets for all activation methods, in accordance with NFPA 80 Section 5 requirements.
  - .1 Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80.
- 3.3.3 Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- 3.3.4 Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

**3.4     Adjusting**

- 3.4.1 Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- 3.4.2 Lubricate bearings and sliding parts as recommended by manufacturer.
- 3.4.3 Adjust seals to provide weathertight fit around entire perimeter.

**3.5     Demonstration**

- 3.5.1 Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

**3.6     Protection**

- 3.6.1 Protect overhead coiling doors from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades.
- 3.6.2 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in writing by affected material's manufacturer. Do not use materials or process that can damage finishes, surfaces, or construction.
- 3.6.3 Promptly replace overhead coiling doors work damaged during construction that cannot be satisfactorily repaired.

**3.7     Cleaning And Waste Management**

- 3.7.1 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
- 3.7.2 Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**END OF SECTION**



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**1 . GENERAL**

**1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

**1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Sectional Doors work specified herein. This includes, but is not necessarily limited, to:
- .1 electrically operated sectional steel doors
  - .2 Tracks, supports, and accessories.
  - .3 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only.
- .1 Section 05 50 00, Metal Fabrications for miscellaneous steel supports.
  - .2 Section 09 91 13, Exterior Painting for finish painting of factory-primed doors.

**1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

**1.4 Action Submittals**

- 1.4.1 Product Data: Submit product data in accordance with Division 01 for the following:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for the Sectional Doors work and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
  - .3 Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

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- 1.4.2 Shop Drawings: Submit Shop Drawings in accordance with Division 01 for each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.
- .1 Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - .2 Include points of attachment and their corresponding static and dynamic loads imposed on structure.
  - .3 Include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
  - .4 Wiring Diagrams: Submit wiring drawings in accordance with Division 01 for power, signal, and control wiring.
- 1.4.3 Samples: Submit Samples in accordance with Division 01 for manufacturer's finish charts showing full range of colours and textures available for units with factory-applied finishes.
- .1 Include similar Samples of accessories involving colour selection.
- 1.4.4 Professional Engineer's Stamped Shop Drawings and Submittals: Submit Professional Engineer's Stamped Shop Drawings and Submittals in accordance with Division 01 for sectional doors indicated on Drawings and Schedules to comply with performance requirements and design criteria, including analysis data signed and sealed by the Professional Engineer licensed to practice in the Province of Ontario responsible for their preparation.
- .1 Detail fabrication and assembly of seismic restraints.
  - .2 Summary of forces and loads on walls and jams.
- 1.5     Closeout Submittals**
- 1.5.1 Maintenance Data: Submit maintenance data in accordance with Division 01 for sectional doors to include in maintenance manuals.
- 1.6     Quality Assurance**
- 1.6.1 Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.
- 1.6.2 Source Limitations: Obtain sectional doors from single source from single manufacturer.
- .1 Obtain operators and controls from sectional door manufacturer.

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**1.7     Warranty**

1.7.1 Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.

- .1 Failures include, but are not limited to, the following:
  - .1 Structural failures including, but not limited to, excessive deflection.
  - .2 Faulty operation of hardware.
  - .3 Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
  - .4 Delamination of exterior or interior facing materials.
- .2 Warranty Period: Five years from date of Substantial Performance of the Work.

1.7.2 Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.

- .1 Warranty Period: 10 years from date of Substantial Performance of the Work.

**2 .     PRODUCTS**

**2.1     Manufacturers**

2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.

- .1 Assa Abloy
- .2 C.H.I. Overhead Doors.
- .3 Clopay Building Products; a Griffon company.
- .4 Overhead Door Corporation.
- .5 Raynor.
- .6 Richard-Wilcox
- .7 Thermostop
- .8 Wayne-Dalton Corp.

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

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**2.2     Regulatory Requirements**

- 2.2.1 Electrical Components, Devices, and Accessories: Listed and labeled as defined in CSA C22 by a qualified testing agency, and marked for intended location and application.
- 2.2.2 Accessibility Standard: Comply with applicable provisions in CSA B651, the Ontario Building Code.

**2.3     Performance Requirements**

- 2.3.1 Ensure sectional doors meet performance requirements specified without failure due to defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.
  - .1 Fabricate sectional doors to comply with DASMA 102 unless otherwise indicated on Drawings and Schedules.
- 2.3.2 Professional Engineering Design and Certification: Design sectional doors, including comprehensive engineering analysis by a Professional Engineer licensed to practice in the Province of Ontario, in accordance with requirements of Ontario Building Code, and using performance requirements and design criteria indicated in this Section.
- 2.3.3 Structural Performance, Exterior Doors: Exterior sectional door shall withstand the wind loads, the effects of gravity loads, and loads and stresses within limits and under conditions indicated on Drawings and Schedules according to Ontario Building Code.
  - .1 Wind Loads: As indicated on Drawings for geographical location of project, but not less than uniform pressure (velocity pressure) of 960 Pa (20 lbf/sq. ft.), acting inward and outward.
  - .2 Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components. Deflection of door in horizontal position (open) shall not exceed 1/120 of the door width.
  - .3 Operability under Wind Load: Design sectional door to remain operable under design wind load, acting inward and outward.
- 2.3.4 Seismic Performance: Provide products and systems specified in this Section to withstand the effects of earthquake motions in accordance with OBC 4.1.8.18 and CAN/CSA S832.
  - .1 Professional engineer specified in Division 01 and referenced in this Section shall be responsible for designing systems and submitting signed and sealed analysis data and Shop Drawings illustrating seismic-resistant systems.
  - .2 Refer to Structural Drawings for seismic sensitivity values.

- 2.3.5 Air Infiltration: Maximum rate not more than indicated on Drawings and Schedules when tested according to ASTM E283.
  - .1 Air Infiltration: Maximum rate of 0.75 L/s per sq. m (0.15 cfm/sq. ft.) at 75 Pa when tested according to ASTM E283 or DASMA 105.
  - .2 Operation Cycles: Provide sectional door components and operators capable of operating for not less than number of cycles indicated on Drawings and Schedules for each door. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
- 2.3.6 Electrical Components, Devices, and Accessories: Listed and labeled as defined in CSA C22 Series, by a qualified testing agency, and marked for intended location and application.

## **2.4     High Performance Insulated Steel Door Assembly**

- 2.4.1 Generic Locations: Building Envelope.
- 2.4.2 Construct panels with a rigid polyurethane core foamed in place between metal skins. Ensure reinforcement with continuous steel plates for hinge attachment.
- 2.4.3 Provide steel sectional door formed with hinged sections with following characteristics:
  - .1 Door thickness: 100 mm (4 inches) with 16-gauge steel skins.
  - .2 Operation Cycles: Not less than 10,000.
  - .3 Curtain R-Value: Not less than R32
  - .4 Insulation: rigid polyurethane insulation with a minimum density of 41.0 kg/m<sup>3</sup> (2.56 lbs/ft<sup>3</sup>).
  - .5 Track Configuration: Refer to Drawings.
  - .6 Weatherseals: Fitted to bottom and top and around entire perimeter of door.
    - .1 Joint and Seal: tongue-and-groove joint with a true thermal break and double bubble-shaped weather seals. Mark II models may use a single seal.
    - .2 Perimeter Seals: Provide triple-lip flexible PVC perimeter weather seal in aluminum retainer.
    - .3 Bottom Seals: U-shaped PVC double weather seals in an aluminum retainer at the door bottom.
  - .7 Windows (GL4): Approximately 610 mm x 305 mm (24 inch x 12 inch) and spaced apart the approximate distance as indicated on Drawings installed with manufacturer's standard insulated glass.

- .8 Roller-Tire Material: Manufacturer's standard case-hardened steel.
- .9 Locking Device Assembly: inside slide lock, outside center lock with automatic latch
- .10 Counterbalance Type: Torsion spring.
- .11 Electric Door Operator: As specified in this Section.
- .12 Door Finish:
  - .1 Baked-Enamel or Powder-Coated Finish: Colour and gloss as selected by Consultant from manufacturer's full range.
  - .2 Finish of Interior Facing Material: Match finish of exterior section face.
- 2.4.4 Basis-of-Design Products: "Sentinel" by Thermostop or approved equivalent.

## **2.5 Corrosion-Resistant Aluminum Door Assembly**

- 2.5.1 Generic Locations: Car Wash
- 2.5.2 Construct corrosion-resistant panels with a rigid polyurethane core foamed in place between metal skins. Ensure reinforcement with continuous steel plates for hinge attachment.
- 2.5.3 Provide aluminum sectional door formed with hinged sections with following characteristics:
  - .1 Door thickness: 100 mm (4 inches)
  - .2 Operation Cycles: Not less than 10,000.
  - .3 Curtain R-Value: Not less than R32
  - .4 Insulation: rigid polyurethane insulation with a minimum density of 41.0 kg/m<sup>3</sup> (2.56 lbs/ft<sup>3</sup>).
  - .5 Track Configuration: Refer to Drawings.
  - .6 Weatherseals: Fitted to bottom and top and around entire perimeter of door.
    - .1 Joint and Seal: tongue-and-groove joint with a true thermal break and double bubble-shaped weather seals. Mark II models may use a single seal.
    - .2 Perimeter Seals: Provide triple-lip flexible PVC perimeter weather seal in aluminum retainer.
    - .3 Bottom Seals: U-shaped PVC double weather seals in an aluminum retainer at the door bottom.
  - .7 Windows (GL4): Approximately 610 mm x 305 mm (24 inch x 12 inch) and spaced apart the approximate distance as indicated on Drawings installed with manufacturer's standard insulated glass.

- .8 Roller-Tire Material: Manufacturer's standard case-hardened steel.
  - .9 Locking Device Assembly: inside slide lock, outside center lock with automatic latch
  - .10 Counterbalance Type: Torsion spring.
  - .11 Electric Door Operator: As specified in this Section.
  - .12 Door Finish:
    - .1 Baked-Enamel or Powder-Coated Finish: Colour and gloss as selected by Consultant from manufacturer's full range.
    - .2 Finish of Interior Facing Material: Match finish of exterior section face.
- 2.5.4 Basis-of-Design Products: "Alucent" by Thermostop or approved equivalent.

## **2.6 Tracks, Supports, And Accessories**

- 2.6.1 Tracks: Manufacturer's standard, galvanized-steel track system of configuration indicated on Drawings and Schedules, sized for door size and weight, designed for lift type indicated and clearances shown on Drawings, and complying with ASTM A653/A 653M for minimum Z180 (G60) zinc coating. Provide complete track assembly including brackets, bracing, and reinforcement for rigid support of ball-bearing roller guides for required door type and size. Slot vertical sections of track spaced 51 mm (2 inches) apart for door-drop safety device. Slope tracks at proper angle from vertical or design tracks to ensure tight closure at jambs when door unit is closed.
- 2.6.2 Track Reinforcement and Supports: Galvanized-steel track reinforcement and support members, complying with ASTM A36/A 36M or equivalent to CSA G40.20/G40.21 and ASTM A123/A 123M. Secure, reinforce, and support tracks as required for door size and weight to provide strength and rigidity without sag, sway, and vibration during opening and closing of doors.
- 2.6.3 Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and top of sectional door unless otherwise indicated on Drawings and Schedules.
- 2.6.4 Windows: Manufacturer's standard window units of type and size indicated on Drawings and Schedules and in arrangement shown. Set glazing in vinyl, rubber, or neoprene glazing channel for metal-framed doors and elastic glazing compound for wood doors, as required. Provide removable stops of same material as door-section frames.

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**2.7     Hardware**

- 2.7.1 Provide heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-resistant fasteners, to suit door type.
- 2.7.2 Hinges: Heavy-duty, galvanized-steel hinges of not less than 2.01-mm- (0.079-inch-) nominal coated thickness at each end stile and at each intermediate stile, according to manufacturer's written recommendations for door size. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is not possible. Provide double-end hinges where required, for doors over 4.88 m (16 feet) wide unless otherwise recommended by door manufacturer.
- 2.7.3 Rollers: Heavy-duty rollers with steel ball-bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide 76-mm- (3-inch-) diameter roller tires for 76-mm- (3-inch-) wide track and 51-mm- (2-inch-) diameter roller tires for 51-mm- (2-inch-) wide track.
- 2.7.4 Push/Pull Handles: For push-up or emergency-operated doors, provide galvanized-steel lifting handles on each side of door.

**2.8     Locking Devices**

- 2.8.1 Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on single-jamb side, operable from inside only.
- 2.8.2 Locking Device Assembly: Fabricate with cylinder lock, spring-loaded deadbolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
- 2.8.3 Chain Lock Keeper: Suitable for padlock.
- 2.8.4 Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

**2.9     Counterbalance Mechanism**

- 2.9.1 Torsion Spring: Counterbalance mechanism consisting of adjustable-tension torsion springs fabricated from steel-spring wire complying with ASTM A229/A 229M, mounted on torsion shaft made of steel tube or solid steel. Provide springs designed for number of operation cycles indicated on Drawings and Schedules.
- 2.9.2 Cable Drums and Shaft for Doors: Cast-aluminum or gray-iron casting cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at



each end of torsion shaft. Provide one additional midpoint bracket for shafts up to 4.88 m (16 feet) long and two additional brackets at one-third points to support shafts more than 4.88 m (16 feet) long unless closer spacing is recommended by door manufacturer.

- 2.9.3 Cables: Galvanized-steel lifting cables with cable safety factor of at least 7 to 1.
- 2.9.4 Cable Safety Device: Include a spring-loaded steel or spring-loaded bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if either lifting cable breaks.
- 2.9.5 Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.
- 2.9.6 Provide a spring bumper at each horizontal track to cushion door at end of opening operation.

## **2.10 Electric Door Operators**

- 2.10.1 Provide fail safe operator unit that is listed and approved for use on door. Provide electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and "operation cycles" requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
  - .1 Comply with CSA C22 SERIES.
  - .2 Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6
  - .3 Usage Classification: Electric operator and components capable of operating for not less than number of cycles indicated for each door.
  - .4 Operator Location: As shown on Drawings.
  - .5 Emergency Manual Operation: Chain type.
  - .6 Obstruction-Detection Device: Automatic photoelectric sensor with pneumatic sensor edge on bottom bar.
    - .1 Primary Entrapment Protection Devices: NEMA 4 Monitored Photo Sensors, Photo eyes fully monitored, non-contact, photo beam reversing photo sensor system with NEMA 4 watertight enclosure shall reverse a closing door to the full open position when an obstruction is sensed; photo sensors shall be mounted no higher than 6 inches (152 mm) maximum above the floor.

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- .2 Ancillary Entrapment Protection Devices: Pneumatic sensing edge shall reverse a closing door to the full open position when an obstruction is sensed.
  - .3 Sensor Edge Bulb Colour: As selected by Consultant from manufacturer's full range.
  - .7 Remote-Control Station: Where shown on Drawings.
- 2.10.2 Door-Operator Type: Unit consisting of electric motor, gears, pulleys, belts, sprockets, chains, and controls needed to operate door and meet required usage classification. Provide one of the following types:
- .1 Trolley: Trolley operator mounted to ceiling above and to rear of door in raised position and directly connected to door with drawbar.
  - .2 Jackshaft, Center Mounted: Jackshaft operator mounted on the inside front wall above door and connected to torsion shaft with an adjustable coupling or drive chain.
  - .3 Jackshaft, Side Mounted: Jackshaft operator mounted on the inside front wall on right or left side of door and connected to torsion shaft with an adjustable coupling or drive chain.
- 2.10.3 Electric Motors: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements unless otherwise indicated on Drawings and Schedules.
- .1 Motor Type and Controller: Reversible motor and controller (disconnect switch) for motor exposure indicated on Drawings and Schedules.
  - .2 Motor Size: Minimum size as indicated on Drawings and Schedules. If not indicated on Drawings and Schedules, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 203 mm/s (8 in./sec.) and not more than 305 mm/s (12 in./sec.), without exceeding nameplate ratings or service factor.
- 2.10.4 Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- 2.10.5 Remote-Control Station: Momentary-contact, three-button control station with push-button controls labeled "Open," "Close," and "Stop."
- .1 Interior units: full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
- 2.10.6 Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit

switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

- 2.10.7 Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

## **2.11 General Finish Requirements**

- 2.11.1 Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- 2.11.2 Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## **3 . EXECUTION**

### **3.1 Examination**

- 3.1.1 Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- 3.1.2 Examine locations of electrical connections.
- 3.1.3 Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 Installation**

- 3.2.1 Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- 3.2.2 Tracks:
- .1 Fasten vertical track assembly to opening jambs and framing, spaced not more than 610 mm (24 inches) apart.
  - .2 Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.
  - .3 Repair galvanized coating on tracks according to ASTM A780.
- 3.2.3 Power-Operated Doors: Install according to UL 325.

- 3.2.4 Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

**3.3     Startup Services**

- 3.3.1 Engage a factory-authorized service representative to perform startup service.
  - .1 Complete installation and startup checks according to manufacturer's written instructions.
  - .2 Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

**3.4     Adjusting**

- 3.4.1 Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- 3.4.2 Lubricate bearings and sliding parts as recommended by manufacturer.
- 3.4.3 Adjust doors and seals to provide weathertight fit around entire perimeter.
- 3.4.4 Align and adjust motors, pulleys, belts, sprockets, chains, and controls according to manufacturer's written instructions.
- 3.4.5 Touch-up Painting: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A780.

**3.5     Demonstration**

- 3.5.1 Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

END OF SECTION

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Sliding Automatic Entrances work specified herein. This includes, but is not necessarily limited, to:
  - .1 Exterior and interior, sliding, power-operated automatic entrances.
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.
  - .1 Related requirements provided below are for convenience purposes only.
    - .1 Section 05 50 00 - Metal Fabrications.
    - .2 Section 08 44 13 - Glazed Aluminum Curtain Walls.
    - .3 Section 08 80 05 – General Requirements for Glass And Glazing.
    - .4 Division 26, Electrical.
    - .5 Division 28, Electronic Safety and Security.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

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**1.4 Definitions**

- 1.4.1 AAADM: American Association of Automatic Door Manufacturers.
- 1.4.2 Activation Device: A control that, when actuated, sends an electrical signal to the door operator to open the door.
- 1.4.3 Safety Device: A control that, to avoid injury, prevents a door from opening or closing.
- 1.4.4 For automatic door terminology, refer to BHMA A156.10 for definitions of terms.

**1.5 Coordination**

- 1.5.1 Coordinate sizes and locations of recesses in concrete floors for recessed sliding tracks that control automatic entrances. Concrete, reinforcement, and formwork requirements are specified elsewhere.
- 1.5.2 Templates: Distribute for doors, frames, and other work specified to be factory prepared for installing automatic entrances.
- 1.5.3 Coordinate hardware with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish. Coordinate hardware for automatic entrances with hardware required for rest of Project.
- 1.5.4 Electrical System Roughing-in: Coordinate layout and installation of automatic entrances with connections to power supplies and access-control system.
- 1.5.5 System Integration: Integrate sliding automatic entrances with other systems as required for a complete working installation.
  - .1 Provide electrical interface control capability for activation of sliding automatic entrances by security access system on doors with electric locking.
  - .2 Provide electrical interface to deactivate door operators on activation of fire alarm system.
  - .3 Provide electrical interface to allow for remote monitoring of automatic entrance door panel status.

**1.6 Preinstallation Meetings**

- 1.6.1 Pre-installation Meetings: Schedule, and conduct pre-installation meeting at Project Site, in order to coordinate work of this Section, with work of related Subcontractors.
  - .1 Ensure attendance of Subcontractor performing work of this Section and representatives of manufacturers and fabricators involved in, or affected by, installation and coordination with other materials and installations that have preceded or will follow. Advise Consultant and Owner in advance of scheduled meeting dates.

- .2 Agenda: Review progress of other construction activities and preparations for the particular activity under consideration.
- .3 Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
- .4 Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.

## **1.7 Submittals**

1.7.1 General Requirements and Procedures for Submittals: In accordance with Section 01 33 00, Submittal Procedures.

1.7.2 Product Data: Submit product data for the following:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for the Sliding Automatic Entrances work and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for automatic entrances.
- .3 Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.7.3 Product Disclosure and Transparency:

- .1 Environmental Product Declarations (EPD): When available, submit Product-specific Type III EPD or industry-wide (generic) EPD conforming to ISO 14025 or other recognized environmental product declaration framework.
- .2 Material Ingredient Reporting: When available, submit documentation demonstrating chemical inventory of materials to at least 0.1% (1000ppm) and conforming to one of the following:
  - .1 Health Product Declaration open Standard,
  - .2 Cradle to Cradle v2 Basic level or Cradle to Cradle v3 Bronze level,
  - .3 International Living Future Institute Declare
  - .4 Other approved framework.
- .3 When multiple Products are specified, give preference to Products with compliant documentation.

1.7.4 Shop Drawings: Submit for sliding automatic entrances.

- .1 Include plans, elevations, sections, hardware mounting heights, and attachment details.

- .2 Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- .3 Include diagrams for power, signal, and control wiring.
- .4 Indicate locations of activation and safety devices.
- .5 Include hardware schedule and indicate hardware types, functions, quantities, and locations.
- 1.7.5 Samples: Submit for units with factory-applied colour finishes.
  - .1 Include Samples of hardware and accessories involving colour or finish selection.
  - .2 Submit samples in manufacturer's standard sizes for each type of exposed finish required.
- 1.7.6 Sample Warranties: Submit sample warranties for special warranties specified in this section..

**1.8 Closeout Submittals**

- 1.8.1 Operation and Maintenance Data: Submit maintenance data for automatic entrances, safety devices, and control systems to include in operation and maintenance manuals.

**1.9 Quality Assurance**

- 1.9.1 Manufacturer Qualifications: A manufacturer with Company Certificate issued by AAADM indicating that manufacturer has a Certified Inspector on staff.
- 1.9.2 Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation and maintenance of units required for this Project and who employs a Certified Inspector.
  - .1 Certified Inspector Qualifications: Certified by AAADM.
- 1.9.3 Source Limitations for Automatic Entrances: Obtain each type of door, frame, operator and sensor components specified in this Section from a single source, same manufacturer unless otherwise indicated.
- 1.9.4 Emergency Exit door requirements: Comply with requirements of authorities having jurisdiction for automatic entrance doors serving as a required means of egress.

**1.10 Project Conditions**

- 1.10.1 Field Measurements: Verify actual dimensions of openings to receive automatic entrances by field measurements before fabrication and indicate on shop drawings.



**1.11 Warranty**

1.11.1 Extended Warranty: Repair or replace components of automatic entrances that fail in materials or workmanship within specified warranty period.

- .1 Failures include, but are not limited to, the following:
  - .1 Structural failures including, but not limited to, excessive deflection.
  - .2 Faulty operation of operators, controls, and hardware.
  - .3 Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
- .2 Warranty Period: Two years from date of Substantial Performance of the Work.

1.11.2 Extended Warranty for Finishes: Repair or replace components on which finishes fail in materials or workmanship within specified warranty period.

- .1 Deterioration includes, but is not limited to, the following:
  - .1 Colour fading more than 5 Hunter units when tested according to ASTM D2244.
  - .2 Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
  - .3 Cracking, checking, peeling, or failure of paint to adhere to bare metal.
- .2 Warranty Period: 10 years from date of Substantial Performance of the Work.

**2. PRODUCTS**

**2.1 Manufacturers**

2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.

- .1 Assa Abloy
- .2 Horton Automatics
- .3 Stanley Access Technologies
- .4 Record USA

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

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## **2.2     Performance Requirements**

- 2.2.1 Employ the services of a Professional Engineer licensed to practice in the Province of Ontario carrying professional liability insurance, and who is experienced in providing engineering services of similar kind, scope and complexity; to design and certify automatic entrances.
- 2.2.2 Electrical Components, Devices, and Accessories: Listed and labeled as defined in CSA C22 Series, by a qualified testing agency, and marked for intended location and application.
- 2.2.3 Power-Operated Door Standard: BHMA A156.10 and UL 325.
- 2.2.4 Automatic door equipment must accommodate medium to heavy pedestrian traffic.
- 2.2.5 Entrapment Force Requirements:
  - .1 Power Operated Sliding Doors: Not more than 30 lbf (133 N) required to prevent stopped door from closing.
  - .2 Sliding doors provided with a breakaway device shall require no more than 50 lbf (222N) applied 25 mm (1 inch) ( ) from the leading edge of the lock stile for the breakout panel to open.
- 2.2.6 Energy Code Requirements: Sliding automatic entrances that are required to meet construction energy code requirements in those districts that have adopted ASHRAE 90.1-2010/2013 and OBC SB10 shall have been evaluated based on methodology in accordance with the following National Fenestration Rating Council (NFRC) standards:
  - .1 NFRC 100, NFRC 200-, and NFRC 500 and ASTM 283.
- 2.2.7 Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - .1 Temperature Change: 67 deg C (120 deg F), ambient; 100 deg C (180 deg F), material surfaces.
- 2.2.8 Operating Temperature Range: Automatic entrances shall operate within - 29 to + 50 deg C (minus 20 to plus 122 deg F).
- 2.2.9 Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 5 L/s x sq. m (1 cfm/sq. ft.)] of fixed entrance-system area when tested according to ASTM E283 at a minimum static-air-pressure difference of 75 Pa (1.57 lbf/sq. ft.).

## **2.3     Bi-Parting Automatic Sliding Doors**

- 2.3.1 Description: manufacturer's standard automatic entrance door assemblies, including doors, sidelights, framing, headers, carrier assemblies, roller tracks, door operators, activation and safety devices, and accessories required for a complete installation.

- 2.3.2 Framing Members: Manufacturer's standard extruded aluminum reinforced as required to support imposed loads.
- 2.3.3 Stile and Rail Design: to be selected by Consultant during Shop Drawings review.
- 2.3.4 Traffic Pattern: Two-way.
- 2.3.5 Locking: Electrified slide lock - Fail Safe: The slide lock is to unlock the sliding function upon loss of power.; ensure compatibility with security systems and facilitate integration.
- 2.3.6 Emergency Breakaway Capability: Sliding leaves and sidelights.
- 2.3.7 Mounting and Configuration: As noted on Drawings.
- 2.3.8 Finish: Class II, Clear Anodic Finish
- 2.3.9 Basis-of-Design:
  - .1 Exterior of Vestibule (Building Envelope): "Dura-Glide™ GreenStar 3000" by Stanley Access Technologies or approved equivalent.
  - .2 Interior of Vestibule and other Interior Locations: "Dura-Glide™ 3000" by Stanley Access Technologies or approved equivalent.

## **2.4     Telescoping (3 Panels) Automatic Sliding Doors**

- 2.4.1 Description: manufacturer's standard automatic entrance door assemblies, including doors, sidelights, framing, headers, carrier assemblies, roller tracks, door operators, activation and safety devices, and accessories required for a complete installation.
- 2.4.2 Traffic Pattern: Two-way.
- 2.4.3 Locking: Electrified slide lock - Fail Safe: The slide lock is to unlock the sliding function upon loss of power.; ensure compatibility with security systems and facilitate integration.
- 2.4.4 Stile and Rail Design: to be selected by Consultant during Shop Drawings review.
- 2.4.5 Emergency Breakaway Capability: Sliding leaves and sidelights.
- 2.4.6 Mounting and Configuration: As noted on Drawings.
- 2.4.7 Finish: Class II, Clear Anodic Finish
- 2.4.8 Basis-of-Design: "Dura-Glide™ 5300" by Stanley Access Technologies or approved equivalent.

## **2.5     Smoke-Sealed Automatic Entrance**

- 2.5.1 Smoke- and Draft-Control Assemblies: to UL 1784.
- 2.5.2 Provide manufacturer's standard automatic entrances, including doors, sidelites, framing, headers, carrier assemblies, roller tracks,

door operators, controls, and accessories required for a complete installation.

- 2.5.3 Required at door type "D104B" as indicated on Drawings.
- 2.5.4 Configuration: 3-panel telescoping sliding doors with three sliding leaves , transom, sidelites on each side as shown on Drawings.
  - .1 Traffic Pattern: Two way.
  - .2 Emergency Breakaway Capability: Sliding leaves only.
  - .3 Mounting: as shown on Drawings.
- 2.5.5 Controls: Activation and safety devices according to BHMA standards.
  - .1 Activation Device: Motion sensor mounted on each side of door header to detect pedestrians in activating zone and to open door.
- 2.5.6 Finish: Finish framing, door(s), and header with Class I, clear anodic finish.
- 2.5.7 Basis-of-Design: "Dura-Care 7500A Telescoping Automatic ICU Door" by Stanley Access Technologies or approved equivalent.

## **2.6 Entrance Components**

- 2.6.1 Stile and Rail Sliding Panels and Sidelites:
  - .1 Material: Extruded Aluminum, Alloy 6063-T5.
  - .2 Door panels shall have a minimum 3.2 mm (.125 inch) structural wall thickness including adjoining horizontal members and perimeter frames where applicable.
  - .3 Door Construction shall be by means of an integrated corner block with 3/8 inch all-thread through bolt from each stile.
  - .4 Glass stops shall be 15.8 mm (.062 inch) wall thickness and shall provide security function as a standard by means of a fixed non-removable exterior section with glazing to be performed from the interior only.
  - .5 Full breakout sliding entrances shall include two interlocks per moving panel securing the leading stile of the sidelite and the butt stile of the sliding door panel together.
- 2.6.2 Vertical Stiles shall be medium stile 102 mm (4 inch) .
- 2.6.3 Bottom Rails shall be 178 mm (7 inch) .
- 2.6.4 Weather-Stripping: Slide-in type, replaceable pile mohair seals retained by the aluminum extrusions. The following types of weather-stripping are required: complementing weather-stripping on the joining vertical stiles of the sidelite and sliding door panels, complementing weather-stripping on the lead edge of the lock stiles of bi-parting doors, single pile weather-stripping between the carrier

and the header, single pile weather-stripping on the lead edge stile of single slide door panels, dual pile weather-stripping on the pivot stile of breakout sidelite panels, and dual pile weather-stripping on the butt stile of fixed sidelite panels. Bottom rails shall be provided with an adjustable nylon sweep.

- 2.6.5 Door Seals: High pile mohair weather stripping on the lock stile of the sliding doors, integrated mohair weather stripping with vinyl fin on the joining vertical stiles of the sidelite and sliding door panels, and expandable foam inserts in leading stile of sidelite panels at pockets for interlocks. Bottom rails shall be provided with a concealed adjustable nylon sweep.

.1 Smoke sealing capacity to be provided here required at FRR.

- 2.6.6 Headers: Fabricated from minimum 3.2-mm- (0.125-inch-) thick extruded aluminum and extending full width of automatic entrance units to conceal door operators and controls. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.

- 2.6.7 Brackets and Reinforcements: High-strength aluminum with nonstaining, nonferrous shims for aligning system components.

- 2.6.8 Signage: As required by cited BHMA standard.

.1 Provide sign materials with instructions for field application after glazing is installed.

- 2.6.9 Glazing: comply with Section 08 80 05 General Requirements for Glass and Glazing.

.1 Exterior door: Insulating glass units to match curtain wall glazing in all respects.

.2 Interior door: Fully tempered glass as specified in Section 08 81 23, Exterior Glass and Glazing.

## **2.7 Door Operators And Controls**

- 2.7.1 Provide operators and controls, which include activation and safety devices, according to BHMA standards, for condition of exposure, and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated.

- 2.7.2 Door Operators: Provide door operators of size recommended by manufacturer for door size, weight, and movement.

.1 Door Operator Performance: Door operators shall open and close doors and maintain them in fully closed position when subjected to Project's design wind loads.

- 2.7.3 Motion Sensors: Self-contained, K-band-frequency, microwave-scanner units; fully enclosed by their plastic housings; adjustable to

provide detection-field sizes and functions required by BHMA A156.10.

- 2.7.4 Presence Sensors: Self-contained, active-infrared scanner units; adjustable to provide detection-field sizes and functions required by BHMA A156.10. Sensors shall remain active at all times.
- 2.7.5 Photoelectric Beams: Pulsed infrared, sender-receiver assembly for recessed mounting. Beams shall not be active when doors are fully closed.
- 2.7.6 Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

## **2.8     Hardware**

- 2.8.1 Provide units in sizes and types recommended by automatic entrance and hardware manufacturers for entrances and uses indicated. Finish exposed parts to match door finish unless otherwise indicated.
- 2.8.2 Breakaway Device for Power-Operated Doors: Device that allows door to swing out in direction of egress to full 90 degrees from any operating position. Maximum force to open door shall be as stipulated in this Section. Interrupt powered operation of door operator while in breakaway mode.
- 2.8.3 Automatic Locking: Electrically controlled device mounted in header that automatically locks sliding door in closed position, preventing door panels from sliding manually. Provide fail-safe operation if power fails.
  - .1 Power Interruption: Lock shall be disengaged, allowing doors to slide manually.
  - .2 Means of Egress: Standard breakaway feature.
- 2.8.4 Weather Stripping: Replaceable components.
  - .1 Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

## **2.9     Fabrication**

- 2.9.1 Factory fabricate automatic entrance components to designs, sizes, and thicknesses indicated and to comply with indicated standards.
  - .1 Form aluminum shapes before finishing.
  - .2 Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

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- .3 Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws.
    - .1 Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
    - .2 Reinforce members as required to receive fastener threads.
  - .4 Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
- 2.9.2 Framing: Provide automatic entrances as prefabricated assemblies. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to Project site.
- .1 Fabricate tubular and channel frame assemblies with welded or mechanical joints. Provide subframes and reinforcement as required for a complete system to support required loads.
  - .2 Perform fabrication operations in manner that prevents damage to exposed finish surfaces.
  - .3 Form profiles that are sharp, straight, and free of defects or deformations.
  - .4 Provide components with concealed fasteners and anchor and connection devices.
  - .5 Fabricate components with accurately fitted joints, with ends coped or mitered to produce hairline joints free of burrs and distortion.
  - .6 Fabricate exterior components to drain water passing joints, condensation occurring within framing members, and moisture migrating within system to exterior. Provide anchorage and alignment brackets for concealed support of assembly from building structure.
  - .7 Allow for thermal expansion of exterior units.
- 2.9.3 Doors: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.
- 2.9.4 Door Operators: Factory fabricated and installed in headers, including adjusting and testing.
- 2.9.5 Glazing: Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated, according to GANA's "Glazing Manual."

- 2.9.6 Hardware: Factory install hardware to greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project site. Cut, drill, and tap for factory-installed hardware before applying finishes.
- .1 Provide sliding-type weather stripping, mortised into door, at perimeter of doors and breakaway sidelites.
- 2.9.7 Controls: Factory install activation and safety devices in doors and headers as required by BHMA A156.10 for type of door and direction of travel.

**2.10 General Finish Requirements**

- 2.10.1 Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- 2.10.2 Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.
- 2.10.3 Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of Samples reviewed by Consultant and are assembled or installed to minimize contrast.

**3 . EXECUTION**

**3.1 Examination**

- 3.1.1 Examine conditions, with Installer present, for compliance with requirements for installation tolerances, header support, and other conditions affecting performance of automatic entrances.
- 3.1.2 Examine roughing-in for electrical systems to verify actual locations of power connections before automatic entrance installation.
- 3.1.3 Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 Installation**

- 3.2.1 Install automatic entrances according to manufacturer's written instructions and cited BHMA A156.10 for direction of pedestrian travel, including signage, controls, wiring, and connection to the building's power supply.
- .1 Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.



- .2 Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
- .3 Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous coating.
- 3.2.2 Entrances: Install automatic entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.
  - .1 Install surface-mounted hardware using concealed fasteners to greatest extent possible.
  - .2 Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.
  - .3 Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within system to exterior.
  - .4 Level recesses for recessed thresholds using nonshrink grout.
- 3.2.3 Door Operators: Connect door operators to electrical power distribution system.
- 3.2.4 Controls: Install and adjust activation and safety devices according to manufacturer's written instructions and cited BHMA standard for direction of pedestrian travel. Connect control wiring according to Division 26, Electrical.
- 3.2.5 Glazing: Install glazing as specified in Section 08 80 05 General Requirements for Glass and Glazing.
- 3.2.6 Sealants: Comply with requirements specified in Section 07 92 00 - Joint Sealants to provide weathertight installation. Seal perimeter of framing members with sealant.
- 3.2.7 Signage: Apply signage on both sides of each door and breakaway sidelite, as required by cited BHMA standard for direction of pedestrian travel.
- 3.2.8 Wiring within Automatic Entrance Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's written limitations on bending radii. Provide and use lacing bars and distribution spools.

### **3.3 Field Quality Control**

- 3.3.1 Certified Inspector: Contractor must engage a Certified Inspector to test and inspect components, assemblies, and installations, including connections.

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- .1 Test and inspect each automatic entrance, using AAADM inspection forms, to determine compliance of installed systems with applicable BHMA standards.
    - .2 Automatic entrances will be considered defective if they do not pass tests and inspections.
  - 3.3.2 Prepare test and inspection reports.
  - 3.4 Adjusting**
    - 3.4.1 Adjust hardware, moving parts, door operators, and controls to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.
      - .1 Adjust exterior doors for tight closure.
  - 3.5 Cleaning**
    - 3.5.1 Clean glass and metal surfaces promptly after installation. Remove excess glazing and sealant compounds, dirt, and other substances. Repair damaged finish to match original finish.
  - 3.6 Demonstration**
    - 3.6.1 Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain automatic entrances.

END OF SECTION

## **1. GENERAL**

### **1.1 Summary**

1.1.1 Provide labour, materials, Products, equipment and services to complete the glazed aluminum curtain wall work specified herein. This includes, but is not necessarily limited, to:

- .1 curtain wall framing, anchors, glass, glazing, panels, insulation, sealants, windows, doors and other components required for a complete system and its installation, either directly or by reference.
- .2 metal framing for glass, panels and other components indicated on drawings and forming part of the work of this section.
- .3 anchors, brackets and attachments
- .4 air barrier interfaces
- .5 auxiliary materials required for a complete installation.

1.1.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

### **1.2 References**

1.2.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.3 Submittals**

1.3.1 Product Data: Submit product data in accordance with Division 01 for the following:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for the Glazed Aluminum Curtain Walls work and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1.3.2 Shop Drawings: Submit Shop Drawings indicating the following:

- .1 Scaled elevations and sections. Provide full-scale sections when required for clarity.
- .2 Include, as applicable, hardware schedule, sheet metal and glass thicknesses, metal finishes, and other pertinent information necessary for thorough evaluation of work of this Section.

- .3 Provide clear indications of field connections and anchorages, as well as relationships to work of other Sections, as required to coordinate with other building trades.
  - .4 Provide information on fastening and sealing methods and other Product joinery to ensure proper field installation and performance.
  - .5 Air Barrier Interface Detailing: Indicate details of air barrier interface materials, accessories, fastening, seals, and relationship to The Work as necessary to coordinate The Work with other building trades.
    - .1 Air barrier interface details must clearly indicate plane of primary air and water resistance of (a) air barrier system, and (b) the curtain wall framing to which it attaches.
    - .2 Manufacturer's literature must clearly indicate intended plane of primary air and water resistance for curtain wall system.
  - .6 Do not start fabrication or installation of work of this Section until Shop Drawings have been reviewed by Consultant.
- 1.3.3 Curtain Wall Design Completion Delegated to Contractor:
- .1 Submit Shop Drawings for the work of this Section that bear the stamp of a Professional Engineer registered in the Province of Ontario, and as noted in the Owner's supplementary conditions.
  - .2 Professional Engineer's Responsibility:
    - .1 Professional Engineer must be responsible for production and review of Shop Drawings, including full curtain wall design and design of components requiring structural performance in accordance with applicable codes and regulations, as well as stamping and signing of each Shop Drawing and associated calculations.
  - .3 Structural Calculations: Submit, upon request, copies of structural calculations performed by curtain wall Subcontractor's Professional Engineer in connection with design and detailing of curtain system.
- 1.3.4 Samples:
- .1 Submit samples for units with factory-applied colour finishes. Where finishes involve colour and texture variations, include sample sets showing the full range of variations expected.
  - .2 Fabrication Sample: Submit fabrication sample of each vertical-to-horizontal intersection of assemblies, made from 300 mm (12-inch) lengths of full-size components and displaying details of joinery, including concealed welds, anchorage, expansion provisions, glazing and flashing and drainage.
- 1.3.5 Energy Simulation:

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- .1 Performance of Glazing: simulated using WINDOW (latest edition) software by Lawrence Berkley Laboratories (LBL).
  - .2 Performance of Framing: simulated using THERM software by LBL using CAN/CSA A440.2 calculation methods.
  - .3 Simulations must be carried out by a qualified simulator and summary reports must bear seal of a Professional Engineer.
  - .4 Thermal performance of curtain wall framing and spandrel based on relevant framing modules (including effects of frame and glass area) must have a maximum U value as specified in this Section.
  - .5 Alternately test results based on testing in accordance with AAMA 1503.1 may be submitted in lieu of energy simulation to verify performance.
- 1.3.6 Statistical Glass Breakage Analysis: Submit statistical glass breakage analysis substantiating glass breakage risk criteria and conformance with requirements specified in this Section.
  - 1.3.7 Preconstruction Sealant Compatibility and Adhesion Testing: Submit test results of compatibility testing specified in this Section.
  - 1.3.8 Sample Warranties: Submit manufacturer's sample warranties for extended warranties specified in this Section.
  - 1.3.9 Test and Evaluation Reports: Submit certified test reports on performance of curtain wall systems and components demonstrating compliance with requirements of this Section.
  - 1.3.10 Submit for Consultants review, QA checklist used as part of installation process. Make modifications to QA checklist based on Consultant feedback.

#### **1.4 Closeout Submittals**

- 1.4.1 Maintenance Data: Submit maintenance data for glazed aluminum curtain walls to include in maintenance manuals.
- 1.4.2 Maintenance Data for Structural Sealant: For structural-sealant-glazed curtain walls to include in maintenance manuals. Include ASTM C1401 recommendations for post-installation-phase quality-control program.

#### **1.5 Quality Assurance**

- 1.5.1 Installer Qualifications: An entity that employs installers and supervisors who are trained and reviewed by manufacturer. Entity must specialize in erection of glazed aluminum curtain wall components and must have successfully produced work similar in design and extent to that required for the project, in not less than three Projects of similar scope, and whose work has resulted in

construction with a record of successful in-service performance for a period of 10 years.

- .1 Ensure installer has sufficient production capacity, organized quality control and testing procedures, and published written and illustrated installation manuals, to produce and properly Install curtain wall system without causing delay in progress of The Work.
- 1.5.2 Welding: performed by skilled and qualified mechanics licensed in accordance with local building regulations and in conformance with CSA W47.1 for steel and CSA W47.2 for aluminum.
- 1.5.3 Preconstruction Adhesion and Compatibility Testing for Sealants: Submit samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that are near or touch structural or nonstructural sealants of structural glazed system to manufacturer of glazing sealant for testing.
  - .1 Compatibility: Test materials or components using ASTM C1087.
  - .2 Adhesion: Test for adhesion or lack of adhesion of a structural sealant to the surface of another material or component using ASTM C1135.
  - .3 Submit no fewer than pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
  - .4 Schedule sufficient time for testing and analyzing results to prevent delaying The Work.
  - .5 For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
  - .6 Testing will not be required if data based on previous testing of current sealant Products match those submitted.
- 1.5.4 Single-source responsibility: Obtain curtain-wall system components, such as framing, operable windows (as applicable), entrances, sun control devices (as applicable), and other components and accessories, from a single manufacturer or from sources reviewed by primary curtain wall manufacturer.
- 1.5.5 Testing Laboratory Qualifications: ASTM E699-qualified for testing and accredited by AAMA, SCC, IAS, or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025 and specifically qualified to conduct laboratory and field performance tests required in this Section.
  - .1 Performance tests conducted in curtain wall Supplier's laboratories must be performed by accredited laboratory

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personnel and witnessed and validated by a licensed Professional Engineer.

**1.6 Field Visual Mock-Up Of Exterior Curtain Wall System**

- 1.6.1 Construct mock-ups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation. Provide required labour and materials to construct mock-up.
- 1.6.2 Build mock-up on site complete with glass, aluminum framing, adjacent cladding materials, anchors, connections, flashings, sealants, and joint fillers as noted on final Shop Drawings.
- 1.6.3 Alignment and fit of curtain wall systems and components, including visual mockups, installed curtain wall systems, and related trim and accessories, must be assessed in natural light with an unaided eye at a distance of 3 m (10 ft) from the outermost or innermost surface.
- 1.6.4 Use techniques that represent those to be used on The Work. Do not enclose interior side of wall with interior finishes and insulation materials.
- 1.6.5 Review of mock-ups does not constitute approval of deviations from Contract Documents contained in mock-ups unless Consultant specifically accepts such deviations in writing.
- 1.6.6 Reviewed mock-ups may become part of the completed Work if undisturbed at time of Substantial Performance of The Work.
- 1.6.7 Build mock-up of typical wall area as directed on site.

**1.7 Delivery, Storage And Handling**

- 1.7.1 Conform to AAMA CW-10, "Care and Handling of Architectural Aluminum from Shop to Site," for handling of materials.
- 1.7.2 Identify curtain wall system components after fabrication. Ensure packaging protects curtain wall components from damage during transport and hoisting.
- 1.7.3 Materials must not be exposed to damage from moisture, foot traffic, or the operations of other trades. Stack materials such that they do not bend or are subjected to excessive pressure or abrasion.
- 1.7.4 Aluminum, stainless steel, and other metal components susceptible to galvanic action must be stored in a clean, dry location away from uncured concrete and masonry. Cover with water-resistant paper, tarpaulin, or polyethylene sheeting to permit air to circulate within covering.
- 1.7.5 Keep handling on-site to a minimum. Take special precautions to avoid damaging the finishes of materials.

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**1.8 Project Conditions**

- 1.8.1 Field Measurements: Verify dimensions of supporting structure by field measurements before fabrication so that curtain wall work will be accurately designed, fabricated and fitted to the structure. Indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying The Work.
- 1.8.2 Established Dimensions: Where field measurements cannot be made without delaying The Work, establish dimensions and proceed with fabricating curtain wall work without field measurements. Coordinate supporting structure construction to ensure actual dimensions correspond to established dimensions.

**1.9 Warranty**

- 1.9.1 Extended Assembly Warranty: Repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
- .1 Failures include, but are not limited to, the following:
    - .1 Structural failures including, but not limited to, excessive deflection.
    - .2 Noise or vibration created by wind and thermal and structural movements.
    - .3 Deterioration of metals, metal finishes, and other materials beyond normal weathering.
    - .4 Water penetration through fixed glazing and framing areas.
    - .5 Failure of operating components.
  - .2 Warranty Period: 10 years from date of Substantial Performance of The Work.
- 1.9.2 Extended Warranty for Finishes, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.
- .1 Deterioration includes, but is not limited to, the following:
    - .1 Colour fading more than 5 Delta E units when tested in accordance with ASTM D2244.
    - .2 Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
    - .3 Cracking, peeling, or chipping.
  - .2 Warranty Period: 10 years from date of Substantial Performance of The Work.



- 1.9.3 Extended Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period.
- .1 Deterioration of insulating glass is defined as: failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
  - .2 Warranty Period: 10 years from date of Substantial Performance of The Work.
- 1.9.4 Extended Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period.
- .1 Deterioration of laminated glass is defined as: defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
  - .2 Warranty Period: Five years from date of Substantial Performance of The Work.
- 1.9.5 Extended Warranty on Sealants: Manufacturer's standard form in which joint-sealant manufacturer agrees to Supply joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
- .1 Warranty Period: 20 years from date of Substantial Performance of The Work.

## **2 . PRODUCTS**

### **2.1 Manufacturers**

- 2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.
- .1 Alumaticor
  - .2 Flynn Group of Companies
  - .3 Harmon;
  - .4 Kawneer North America; an Alcoa company.

.5 Oldcastle Building Envelope.

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

## **2.2 Description**

2.2.1 Glazed aluminum curtain wall defined in this Section and forming part of the exterior building enclosure is as follows:

### **.1 CW-1 (2SSG):**

- .1 Framing: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
- .2 Construction: Thermally-broken.
- .3 Sightlines: 63.5 mm (2-1/2 inches)
- .4 Back Section: As noted on Drawings.
- .5 Pressure Plate: Aluminum or as required to meet thermal performance requirements.
- .6 Glazing System: 2-sided SSG - Retained mechanically with gaskets on two sides and structural sealant on two sides.
- .7 Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
- .8 Steel Reinforcement: As required by manufacturer.
- .9 Locations: As noted on Drawings
- .10 Basis-of-Design: "Thermawall 2600" by Alumicor or approved equivalent.

### **.2 CW-2 (4SSG):**

- .1 Framing: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
- .2 Construction: Thermally-broken.
- .3 Sightlines: 63.5 mm (2-1/2 inches)
- .4 Back Section: As noted on Drawings.
- .5 Glazing System: 4-sided SSG - Retained with structural sealant on four sides.
- .6 Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
- .7 Steel Reinforcement: As required by manufacturer.
- .8 Locations: As noted on Drawings

- .9 Basis-of-Design: "Thermawall 2600" by Alumicor or approved equivalent.

## **2.3 Design And Performance Requirements**

- 2.3.1 Curtain wall system must meet or exceed requirements specified in AAMA CWM-19 (Curtain Wall Design Manual, 2019).
- 2.3.2 Indicative Design Concept:
- .1 Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies.
  - .2 Information noted on Drawings is to be considered diagrammatic and conveys only aesthetic effects as indicated by governing dimensions, arrangements, alignment, and profiles of components and assemblies in relation to sightlines, each other, and adjacent construction.
  - .3 Do not alter intended aesthetic effects except with Consultant's express permission. Maintain general design concept without changing the size, profiles, or alignment of the components.
  - .4 Variations in details or materials must not have an adverse effect on appearance, durability, or strength of components, nor subject building structure to excessive stress or deflection.
  - .5 Submit detailed explanatory data to Consultant for review if changes are proposed.
- 2.3.3 Demonstration of Compliance: demonstrated by submitting appropriate manufacturer's standard test reports, calculations, and other documentation.
- 2.3.4 Provision For Thermal Movement:
- .1 Curtain wall system must be designed to accommodate expansion and contraction of component materials caused by exterior metal surface temperatures ranging from -35 deg C (-31 deg F) to 85 deg C (185 deg F) without buckling, excessive stress on glass, joint seal failure, excessive stress on structural elements, damaging loads on fasteners, performance reduction, or other detrimental effects.
- 2.3.5 Structural Design:
- .1 Curtain wall system must be designed to withstand specified design wind pressures specified in this Section. Compliance must be demonstrated by calculations performed in accordance with accepted engineering practice as established by OBC, AA, CISC, AISC, and AAMA, as applicable for materials in question.
  - .2 Wind Loads: Design curtain wall systems to withstand wind loads acting perpendicular to plane of wall based on Limit States Design and a 1 in 50-year return period in accordance

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- with requirements of the Ontario Building Code and Cladding Wind Load Study for the geographical location of the Project.
- .3 Air barrier interfaces must be designed to withstand same design wind load as air barrier systems to which they attach.
- 2.3.6 Seismic Performance: Provide products and systems specified in this Section to withstand the effects of earthquake motions in accordance with OBC 4.1.8.18 and CAN/CSA S832.
- .1 Professional engineer specified in Division 01 and referenced in this Section shall be responsible for designing systems and submitting signed and sealed analysis data and Shop Drawings illustrating seismic-resistant systems.
- .2 Refer to Structural Drawings for seismic sensitivity values.
- 2.3.7 Deflection Limitations: Deflection of framing member in direction perpendicular to plane of wall when subject to design loads specified:
- .1 Span of 4.1 m (13'-6") or less: Maximum  $L/175$
- .2 Span over 4.1 m (13'-6"): Maximum  $L/240 + 6 \text{ mm } (1/4")$
- .3 Unsupported cantilevers:  $2L/175$
- .4 At plastered surfaces or gypsum board subjected to bending: Maximum  $L/360$ .
- .5 Dead Loads: Deflection of framing member in direction parallel to plane of wall when subject to design loads specified when carrying its full dead load:
- .1 Not to exceed an amount which will reduce the glass bite below 75% of design dimension, or reduce edge clearance to less than 25% of design dimension, or 3 mm (1/8 inch) whichever is greater.
- .2 Do not permit permanent deformation (set) in metal framing work. Permanent deformation, fastener, weld, or gasket failure, component breakage or disengagement must not occur under wind loading equal to 1.5 times the wind loads (positive or negative). Permanent deformation is defined as deflection without recovery exceeding  $1/1000$  span.
- .6 Minimum clearance of framing member between itself and top of fixed panel, glass or other fixed parts part immediately below: minimum 3 mm (~0.12 in).
- .7 Minimum between framing member and operable window or door: minim 1.5 mm (~0.05 in).
- 2.3.8 Uniform Structural Loads and Testing Requirements: in accordance with ASTM E330 for criteria specified in this Section.

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- .1 When tested at 150% of uniform design wind pressures acting inward and outward, there must be no glass breakage, damage to fasteners or anchors, hardware parts, or actuating mechanisms; no malfunctioning of windows, doors, and operating hardware; and no permanent deformation of main framing members exceeding 0.2% of clear span.
- 2.3.9 Maintenance Equipment Loading:
- .1 Integrated window washing tie backs must be designed to withstand loads generated by window washing stages, but not less than 2.67kN applied in any direction.
  - .2 Anchor points must not require special cut-outs in insulating glass units, or mechanical additions to the curtain wall's interior and exterior surfaces or induce stresses that could damage the exterior and interior seals, break glass, or similar elements.
  - .3 Parapet copings to be designed for window washing loads and incidental man loads.
- 2.3.10 Lateral Drift: curtain wall system and anchorages must be capable of withstanding lateral drift due to wind loads or seismic loads as demonstrated by testing in accordance with AAMA 501.4.
- 2.3.11 Inter-Story Vertical Movement: Curtain wall system and building anchorages must accommodate vertical design displacement at mid-point between columns caused by live loads and caused by deflection of floor slabs due to the weight of occupants, materials, equipment, construction, or other elements supported by structure, as well as column shortening, creep, differential thermal expansion and contraction, seismic movement, or window washing equipment loads. Compliance must be demonstrated by testing in accordance with mandatory provisions of AAMA 501.7.
- 2.3.12 Structural Sufficiency of Guards: Where work of this Section is required to be acting as a guard pursuant to OBC Clause 3.3.1.17, Provide glass, glazing and framing compliant with OBC Clause 4.1.5.14, 4.1.5.16 and OBC Standard SB-13. As a minimum, system must withstand the effects of gravity loads according to the minimum requirements of the Ontario Building Code and CSA A500.
- 2.3.13 Thermal Transmittance:
- .1 Vision areas and framing (triple glazed): fixed light areas of curtain wall, including glass and metal framing, must have an overall thermal transmittance, or U-Factor, not exceeding 0.20<sub>IP</sub> BTU/hr.ft<sup>2</sup>deg F when simulated per NFRC 100 and NFRC 200 using applicable testing, modelling and validation protocols.
  - .2 Alternate Compliance: Simulation per AAMA 507 or tests in accordance with AAMA 1503.

- 2.3.14 Condensation Resistance: No condensation to be allowed based on the design parameters. Condensation analysis to be submitted confirming dew point remains within exterior 'wet' zones of curtain wall design and not being formed on interior surfaces.
- 2.3.15 Air infiltration through curtain wall: must not exceed 0.2 L/s-m<sup>2</sup> (0.04 cfm/ft<sup>2</sup>) of fixed wall area plus permissible allowance specified for operable windows and doors within test area when tested in accordance with ASTM E283 at static air pressure difference of 300 Pa (~6.26 psf).
- 2.3.16 Water Penetration:
- .1 Water Penetration under Static Pressure: There must be no uncontrolled water penetration when curtain wall system is tested per ASTM E331 at 20% of maximum inward and outward acting design wind pressure, but not less than 300 Pa (6.26 psf) or greater than 720 Pa (15.03 psf).
  - .2 Water Penetration under Dynamic Pressure: There must be no uncontrolled water penetration when curtain wall system is tested per AAMA 501.1 at 20% of maximum inward and outward acting design wind pressure, but not less than 300 Pa (6.26 psf) or greater than 720 Pa (15.03 psf).
  - .3 Provisions must be made for water entering system from the exterior to be drained back to exterior.
  - .4 Maximum Water penetration: No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters or water that is drained to exterior.
- 2.3.17 Pressure-Equalized Design: System must be pressure-equalized.
- .1 Provide rain screen at weeps to exterior.
  - .2 Vertical compartmentalization must be provided at a minimum of every two floors.
  - .3 Install pressure-equalized and drained sill starters at base of curtain wall.
- 2.3.18 Sound Transmission:
- .1 Performance tests in accordance with ASTM E90 and ASTM E1425.
  - .2 Classification and Determination of Ratings: based on acoustical performance in accordance with ASTM E413 (STC) and ASTM E1332 (OITC).

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**2.4     Metals**

- 2.4.1 Aluminum Alloys: conform to requirements of Aluminum Association's, "Specifications for Aluminum Structures," and in accordance with following standards:
- .1 Minimum thickness: 1.8 mm (0.070 inch)
  - .2 Sheet and plate: to ASTM B209/B209M.
  - .3 Extruded bars, rods, shapes and tubes: to ASTM B221/B221M.
  - .4 Welding rods and bare electrodes: to CSA W48 and AWS A5.10/5.10M.
  - .5 Structural Profiles: to ASTM B308/B308M.
  - .6 Alloy and Temper: 6063-T5 or 6063-T6 Alloy as recommended by glazed aluminum curtain wall manufacturer for strength, corrosion resistance, and application of required finish.
  - .7 Other alloys may be acceptable, subject to review and acceptance by Consultant.
- 2.4.2 Carbon Steel: conform to requirements of CISC's "Code of Standard Practice for Structural Steel" or CSA S136/ AISI S100 and following standards:
- .1 Structural shapes, plates and bars: ASTM A36/A36M or equivalent to CSA G40.20/G40.21.
  - .2 Commercial sheet and strip, cold rolled, (Grades A, B and C): to ASTM A1008/A1008M.
  - .3 Commercial sheet and strip, hot rolled, (Grades A, B, C and D): to ASTM A1011/A1011M.
  - .4 Other alloys may be acceptable, subject to review and acceptance by Consultant.
- 2.4.3 Stainless Steel: conform to requirements of CSA S136/ AISI S100 and following standards:
- .1 Sheet, strip, and plate, chromium stainless steel: ASTM A176
  - .2 Sheet, strip, plate, and flat bar, annealed or cold-worked austenitic stainless steel: ASTM A666
  - .3 Seamless and welded tubing, ferritic and martensitic stainless steel: ASTM A268/A268M
  - .4 Seamless and welded tubing, austenitic stainless steel: ASTM A269
  - .5 Stainless Steel Grade: Type 304 in interior locations, Type 316L in exterior locations.
  - .6 Other alloys may be acceptable, subject to review and acceptance by Consultant.

2.4.4 Fasteners: Conform to AAMA TIR-A9. Fasteners must be compatible with materials they are attached to. Metal fasteners must be manufactured from stainless steel.

- .1 Exposed fasteners on finished surfaces: Phillips screw heads unless otherwise indicated.
- .2 Colour: Where exposed, fasteners must match colour of adjacent framing members.

## **2.5 Protection Of Metals**

2.5.1 Galvanized coatings on carbon steel anchors and reinforcing concealed after completion of installation, or exposed only to interior:

- .1 Steel sheet, hot-dip zinc-coated (galvanized) or zinc-iron alloy-coated (galvannealed) to ASTM A653/A653M, minimum Z275 (G90) coating.
- .2 Miscellaneous steel Products, zinc hot-dip galvanized coatings to ASTM A123/A123M.

2.5.2 Non-galvanized steel anchors and reinforcing concealed after completion of installation, or exposed only to the interior:

- .1 Manufacturer's standard zinc-rich, corrosion-resistant prime as recommended by SSPC for use in Environmental Zone 1B (exteriors, normally dry), and comply with SSPC-PS Guide No. 12.00.
- .2 Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

2.5.3 Preformed mastic tape: to AAMA 804.1.

2.5.4 Strippable Metal Surface Coverings: Use appropriate covering only for protection during fabrication. To avoid covering melting on aluminum surfaces, remove prior to outdoor exposure.

## **2.6 Glass And Glazing Materials**

2.6.1 Provide glass and glazing materials in accordance with Section 08 80 05.

2.6.2 Glass and glazing materials must meet applicable performance requirements specified in this Section.

2.6.3 Setting blocks used to support glass: In accordance with IGMA TM-3000 or GANA's Glazing Manual unless otherwise specified.

- .1 Materiality: Elastomeric material of 85 +/-5 Shore A durometer hardness. Neoprene blocks are not permitted.
- .2 Place blocks in positions shown on reviewed Shop Drawings. Ensure setting block material is reviewed by glass fabricator to



ensure compatibility with sealants, low-e or reflective coatings, and applied films.

- .3 Setting blocks must uniformly support all lites of glazing and must not obstruct venting or draining of glazing cavity.

2.6.4 Edge blocks necessary for centering the glass and preventing lateral “walking”:

- .1 Materiality: Elastomeric material of 60+/-10 Shore A durometer hardness. Neoprene blocks are not permitted.
- .2 Place blocks in positions shown on reviewed Shop Drawings. Ensure setting block material is reviewed by glass fabricator to ensure compatibility with sealants, low-e or reflective coatings, and applied films.

2.6.5 Glass and glazing materials must be held in proper plane and maintain proper face clearance by means of continuous glazing gaskets, tapes, or wet glazing with spacers. Glazing materials must extend around the entire perimeter of opening and Provide required level of resistance to air and water infiltration. Wet sealants must be compatible with materials with which they are in contact.

2.6.6 Back-bedding tapes, expanded cellular glazing tapes, toe beads, heel beads and cap beads: in accordance with requirements of AAMA 800. Glazing gaskets must be resistant to shrinkage and weathering, and compatible with materials with which they are in contact.

2.6.7 Structural silicone sealant (where used): in accordance with ASTM C1184.

- .1 Only chemically curing silicone sealant specifically formulated, tested and marketed for structural sealant glazing is acceptable for use in structural sealant-glazed applications.
- .2 Structural silicone sealant glazing systems must be designed, tested, applied, installed and inspected in accordance with ASTM C1401.
- .3 Materials and finishes in contact with structural silicone must be tested for compatibility and reviewed by the sealant manufacturer for intended application.
- .4 Gaskets in continuous contact with structural silicone must be extruded silicone or compatible material.

**2.7 Framing**

2.7.1 Provision must be made in glazing pocket of framing for minimum clearances for thickness and type of glass and glazing shown. Ensure clearances are in accordance with GANA Glazing Manual, glass fabricator’s recommendations, or governing OBC

requirements. Glass must be edge blocked if necessary, to prevent contact with metal framing.

- 2.7.2 Unless indicated otherwise, framing must be designed to Provide for glazing and re-glazing from the outside.
- 2.7.3 Framing must accommodate windows and doors and other components shown on Drawings and Schedules.

## **2.8 Flashings**

- 2.8.1 Flashings and other materials used internally or externally: corrosion resistant, non-staining, non-bleeding and compatible with adjoining materials.
- 2.8.2 Materiality: Dead-soft, 0.457-mm- (0.018-inch-) thick stainless steel, ASTM A240/A240M of type recommended by manufacturer.

## **2.9 Air Barrier Interface Components / Silicone Transition Sheet**

- 2.9.1 Material Tag: This item is noted as "AVBM-4" on Drawings and Schedules.
- 2.9.2 Provide engineered transition assemblies for connections between building's air barrier system to curtain wall system, including accessories, fastening devices, perimeter sheets, sealants, adhesive, and tapes, as shown on reviewed Shop Drawings and specified in this Section, as required to maintain air barrier continuity:
  - .1 Acceptable Products: "DOWSIL™ Silicone Transition Strip & System" by Dow Chemical Company of Canada or "Proglaze ETA" by Tremco Commercial Sealants & Waterproofing.

## **2.10 Aluminum Panel Systems**

- 2.10.1 Pressure-Equalized Rain Screen Wall Cladding (PRWC) systems: in accordance with AAMA 508 when tested per ASTM E331.
- 2.10.2 Custom fabricated from minimum 3 mm (1/8 inch) thick, tension-leveled, smooth aluminum sheet, conforming to ASTM B209M (ASTM B209). Provide concealed anchorage devices and reinforcements as required to erect metal panels and copings to exterior wall framing systems and as required to maintain the specified flatness tolerances.
- 2.10.3 Edge Construction and Profiles: as required to secure metal panels and copings to exterior wall framing systems and provide air, vapour and water tight seal complying with the performance requirements specified in this Section. Corners to be welded and ground smooth prior to final finishing.

- 2.10.4 Flatness Tolerances: Oil canning is not permitted. Ensure anchorage devices, cover stiffeners (if any), and reinforcements are not visible in the finished (exposed) faces of panels and copings.
- .1 Panel Bow: Not to exceed 0.8% of panel overall dimension in width or length.
  - .2 Length & Width: +0 mm, -3.2 mm (1/8 inch).
  - .3 Squareness: 1.3 mm per linear m (0.02 inch per ft) .
- 2.10.5 Finishing: After forming metal panels and copings but before finishing, remove abrasions, scratches, die markings, and dents.
- 2.10.6 Apply sound deadening (dielectric separator) on the back side of metal panels.
- 2.10.7 Finish: To match adjacent curtain wall members.

## **2.11 Venting Windows**

- 2.11.1 Manufacturer's standard units, complying with AAMA/WDMA/CSA 101/I.S.2/A440, with self-flashing mounting fins, and as follows:
- .1 Window Type: As indicated on Drawings
  - .2 Minimum Performance Class: AW
  - .3 Minimum Performance Grade: 60.
  - .4 Hardware: Manufacturer's standard; of aluminum, stainless steel, die-cast steel, malleable iron, or bronze.
  - .5 Limit Devices: Concealed friction adjustor and adjustable stay bar limit devices designed to restrict sash opening.
    - .1 Limit clear opening to 100 mm (4 inches) for ventilation; with custodial key release.
  - .6 Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.
  - .7 Motorized Window Operators: Refer to Section 08 75 16 – Window Operators.
  - .8 Insect Screens: Provide removable insect screen on each operable exterior sash, with screen frame finished to match window unit, complying with SMA 1004 or SMA 1201, and as follows:
    - .1 Fabric: Manufacturer's standard aluminum wire fabric or glass-fibre mesh fabric.
  - .9 Glazing: Same as adjacent glazed aluminum curtain-wall glazing.
  - .10 Finish: Match adjacent glazed aluminum curtain-wall finish.
  - .11 Basis-of-Design: "Unit Vent 1350" by Alumicor or approved equivalent.

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**2.12     Sun Control Devices**

2.12.1 Refer to Section 10 71 13.

**2.13     Entrance Door Systems**

2.13.1 Thermally Enhanced Doors (Doors forming part of the building envelope): Provide manufacturer's standard thermally enhanced glazed entrance doors for manual-swing operation.

- .1 Door Construction: 57.2-mm (2-1/4-inch) overall thickness, with minimum 3.2-mm- (0.125-inch-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
- .2 Glazing Stops and Gaskets: snap-on, extruded-aluminum stops and preformed gaskets. Provide nonremovable glazing stops on outside of door.
- .3 Door Hardware Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door to comply with requirements in this Section. Refer to Section 08 70 10 for additional requirements.
- .4 Basis-of-Design: "Phantom Door" by Alumicor or approved equivalent.

**2.14     Accessories**

2.14.1 Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

- .1 Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
- .2 Reinforce members as required to receive fastener threads.

2.14.2 Thermal Separators and Thermal Barriers: as required to meet thermal requirements specified in this Section. Provide continuous low-conductance thermal separation. Design structural thermal barriers in accordance with and in compliance with AAMA TIR-A8 requirements.

2.14.3 Framing anchors: must Provide for three-way adjustment to accommodate fabrication and construction tolerances and be structurally adequate to carry loads of curtain wall units as well as applicable wind, maintenance and other design loads. Anchors must allow for thermal movement, and meet the structural requirements specified in this Section.

- .1 Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with

ASTM A 123/A 123M or equivalent to CAN/CSA-G164 or ASTM A153/A153M requirements.

- .2 Provide insulation between steel material and aluminum material to prevent galvanic action.
- .3 Basis-of-Design Products: "HTA Anchor Channels" by Halfen or "HAC" by Hilti Canada or approved equivalent.

2.14.4 Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 0.762-mm (30-mil) thickness per coat.

## **2.15 Fabrication**

- 2.15.1 All parts of the curtain wall system must be of the materials, design, sizes and thicknesses, subject to commercial tolerances, shown or called for on reviewed Shop Drawings, cited in references, and specified herein.
- 2.15.2 Methods of fabrication and assembly, however, unless otherwise specifically stated, are at manufacturer's discretion.
- 2.15.3 For purposes of this Section, "unit" is defined as curtain wall system assembly one lite wide by one storey high, whether assembled and glazed in factory or field. Allowable tolerances for multi-span wall systems or larger bays of curtain wall must be increased accordingly.
- 2.15.4 In the absence of a reviewed visual mockup, documentation of which must include defined limits of cumulative tolerances, acceptable variation from nominal position, fit and alignment shall be determined by adding allowable variations cited in referenced standards for all components, substrates and assemblies (i.e. "built-up" tolerances).
- 2.15.5 Joints in Metal Work: exposed work must be carefully matched to produce continuity of line and design, with all joints, unless otherwise shown or specified, being accurately fitted and rigidly secured.
- 2.15.6 Shop Assembly: As far as practicable, all fitting and assembly work must be done in the factory.
- 2.15.7 Welding: in accordance with CSA recommendations and must be done with electrodes and by methods recommended by Suppliers of the metals being welded. Type, size and spacing of welds must be as shown on reviewed Shop Drawings.
  - .1 Welds behind finished surfaces: done as to minimize distortion and discoloration on finished side.
  - .2 Weld spatter and welding oxides on finished surfaces must be removed by de-scaling and grinding.
  - .3 Protect glass and finished aluminum surfaces from weld spatter.

2.15.8 Sealing / Sealant Materials in Fabrication: must be used in accordance with recommendations of manufacturer of material and joints to be sealed and in accordance with design and tolerances shown on reviewed Shop Drawings.

**2.16 Component Tolerances**

2.16.1 Provide component dimensions and tolerances as indicated below.

2.16.2 Dimensional Tolerances of Extruded Aluminum Profiles: must be within limits established by AA "Standards and Data," or as defined in manufacturers' quality assurance documents, whichever is more stringent.

2.16.3 Cutting and Machining: must be within limits defined in manufacturers' quality assurance documents and installation manuals.

2.16.4 Assembly and Glazing: must be within the limits defined in manufacturers' quality assurance documents, installation manuals, and the GANA Glazing Manual, whichever is more stringent.

2.16.5 Overall Curtain Wall System Tolerances (excluding installation and substrates):

- .1 Factory assembled framing and trim:
  - .1 Overall Size: For singular rectangular curtain wall units or assembled framing, overall size of any unit or daylight opening, within a framing system must not deviate from dimensions indicated on Drawings by more than the following:
    - .1  $\pm 1.5$  mm (1/16 in) for all dimensions 1830 mm (72 in) and under;
    - .2  $\pm 3.0$  mm (1/8 in) for all dimensions between 1830 mm (72 in) and 3660 mm (144 in); and
    - .3  $\pm 4.5$  mm (3/16 in) for all dimensions greater than 3660 mm (144 in).
  - .2 These requirements do not apply to diagonal measurements.
  - .3 Measurement is must be taken an ambient temperature of 21 deg C +/- 10 deg C (~70 deg F +/- 18deg F) with system fully installed and glazed, in non-displaced openings.
- .2 For singular non-rectangular specimens: overall size must not deviate from dimensions indicated on the Drawings by more than  $\pm 6.0$  mm (~0.25 in).
- .3 Alignment of Framing and Trim Members:

- .1 Maximum offset from true alignment between two identical exposed members, abutting end to end in line within an assembly: 1.5 mm (~0.06 in).
- .2 Maximum variation from co-planar alignment between two exposed members at corner joinery within an assembly: 2 degrees.
- .3 Maximum variation in nominal joint width between exposed members within an assembly 1.5 mm (~0.06 in) not including purposeful gaps for drainage, expansion, and movement accommodation, or variation due to installation tolerances.

## **2.17 Aluminum Finishes**

2.17.1 Finish of Exposed Aluminum Components: in accordance with the appropriate AAMA voluntary guide specification as follows:

- .1 Building Exterior: AA M10 C21 or C22 A41; AAMA 611 Class I Clear Anodizing.
- .2 Building Interior: AA M10 C21 or C22 A31; AAMA 611 Class II Clear Anodizing.
- .3 Finishes on exposed metal parts of windows and doors specified in this Section or adjacent to work of this Section, excluding hardware, must be same finish as that specified for the curtain wall framing.

2.17.2 Finish of Unexposed Aluminum Components: provided with pre-treatment, flash anodize or organic paint finish to improve sealant adhesion.

2.17.3 Dissimilar Material Protection: Where aluminum or carbon steel surfaces are to be in contact with each other or in contact with dissimilar materials such as masonry or concrete, and where hot dip galvanizing of carbon steel is incompatible with component parts because of galvanic action or component fabrication tolerances provide one of the following:

- .1 Bituminous Paint: Cold-applied, non-sagging, asphalt-mastic paint complying with SSPC-Paint 12 requirements, except containing no asbestos. Apply in two coats for an overall minimum dry film thickness of 25 mils.
- .2 Zinc Rich Primer: Organic zinc-rich primer, complying with SSPC-Paint 20.

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### **3 . EXECUTION**

#### **3.1 Examination**

- 3.1.1 Examine areas, with Subcontractor present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- 3.1.2 Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.1.3 Examination of Lines, Elevations and Structure:
  - .1 Obtain building perimeter offset line for each floor, and ensure it is plumb with lines on floors above and below.
  - .2 Before beginning installation, visually inspect entire extent of structure affecting installation for work of this Section.
  - .3 If errors in location of offset lines or benchmarks are discovered, or conditions in structure that will prevent proper execution of work of this Section, report conditions to in writing to Consultant promptly.
  - .4 Stop installation until errors and unsatisfactory conditions have been corrected.
- 3.1.4 Air Barrier Systems Adjacent to Curtain Wall:
  - .1 Ensure that air barriers adjacent to curtain wall are undamaged, and satisfactory to receive accessories, fastening devices, perimeter sheets, sealants, adhesive and tapes, as detailed on Drawings and specified herein.
- 3.1.5 Commencement of work implies acceptance of in-place conditions.

#### **3.2 Installation**

- 3.2.1 Comply with manufacturer's written instructions.
- 3.2.2 Do not install defective components. Fit joints to produce hairline, burr- and distortion-free joints.
- 3.2.3 Curtain wall framing and preassembled framed units: erected plumb and true, in proper alignment and relation to established lines and grades, as specified herein and shown on the reviewed shop and erection Drawings. Solidly anchor non-moving joints.
- 3.2.4 Do not install damaged components. Fit joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints.
- 3.2.5 Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
- 3.2.6 Seal joints watertight unless otherwise indicated.



**3.2.7 Metal Protection:**

- .1 Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
- .2 Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

**3.2.8 Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.**

**3.2.9 Anchorage of curtain wall to building structure: in accordance with the reviewed Shop Drawings and reviewed engineering calculations. Anchors must meet requirements specified in this Section.**

**3.2.10 Field Welding: Welds and adjacent metal areas must be thoroughly cleaned and finished or protected as specified in this Section.**

- .1 Weld components in concealed locations to minimize distortion or discoloration of finish.
- .2 Take special care to prevent fires and to protect glass and other finished surfaces from damage by weld spatter.

**3.2.11 Use of Sealant Materials in Installation: conform to requirements of Section 07 92 00.**

- .1 Materials specified must be used in strict accordance with manufacturer's printed instructions and applied only by mechanics specially trained or experienced in their use.
- .2 Before applying sealant, all mortar, dirt, dust, moisture and other foreign matter must be completely removed from surfaces it will contact.
- .3 Adjoining surfaces must be left with clean and neat appearance. Sealing compounds must be tooled to fill the joint and Provide finished surfaces.

**3.2.12 Field Glazing: Unless otherwise specified, conform to recommendations of GANA Glazing Manual.**

- .1 Glazing materials other than glass: in accordance with recommendations of the material manufacturers.
- .2 Tapes must not be applied to either side of glass to indicate that an opening has been glazed.

**3.2.13 Windows, Doors and Operable Components: securely anchored in place to a straight, plumb and level condition, without distortion, in accordance with reviewed Shop Drawings. Weather stripping**

contact and hardware movement must be checked, and final adjustment made for proper operation and performance of units

### **3.3 Installation Of Structural Glazing**

- 3.3.1 Prepare surfaces that will contact structural sealant in accordance with sealant manufacturer's written instructions, to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
- 3.3.2 Set glazing into framing in accordance with sealant manufacturer's and framing manufacturer's written instructions and standard practice. Use a spacer or backer as recommended by manufacturer.
- 3.3.3 Set glazing with proper orientation, so that coatings face exterior or interior as specified.
- 3.3.4 Hold glazing in place using temporary retainers of type and spacing recommended by manufacturer, until structural sealant joint has cured.
- 3.3.5 Apply structural sealant to completely fill cavity, in accordance with sealant manufacturer's and framing manufacturer's written instructions and in compliance with local codes.
- 3.3.6 Apply structural sealant at temperatures indicated by sealant manufacturer for type of sealant.
- 3.3.7 Allow structural sealant to cure in accordance with manufacturer's recommendations.
- 3.3.8 Clean and protect glass as indicated in Section 08 80 05, General Requirements for Glass and Glazing.

### **3.4 Installation Of Weatherseal Sealant**

- 3.4.1 After structural sealant has completely cured, remove temporary retainers and insert backer rod between lites of glass, as recommended by sealant manufacturer.
- 3.4.2 Install weatherseal sealant to completely fill cavity, in accordance with sealant manufacturer's written instructions, to produce weatherproof joints.

### **3.5 Tolerances**

- 3.5.1 Variation from nominal position of overall unit as indicated on reviewed Shop Drawings as follows:
  - .1 Level (Horizontal measurement): 3 mm per m, (~0.12 in. per foot), not to exceed 3 mm (~0.12 in) maximum.
  - .2 Plumb (Vertical measurement): 3 mm per m (~0.12 in. per foot), not to exceed 3 mm (~0.12 in) maximum

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- .3 True (In-plane measurement): 3 mm per m (~0.12 in. per foot), not to exceed 3 mm (~0.12 in) maximum
  - .4 Straight/True (Straightness): 1.5 mm per m (~0.06 in. per foot), not to exceed 1.5 mm (~0.06 in) maximum
  - .5 Square (Diagonal measurement): 3 mm (~0.12 in) maximum for units up to 1.9 sqm (~20.5 sqft); 6 mm (~0.24 in.) maximum for units over 1.9 sqm (~20.5 sqft)
  - .6 Maximum variation from plane or location of overall unit, as shown on reviewed Shop Drawings: 3 mm per 3600 mm (~0.12 in. per 11.81 ft) of length or 12 mm (~0.47 in) in any total length.
  - .7 Installation tolerances do not include component or alignment tolerances specified in this Section.
- 3.5.2 Field assembled framing and trim: same deviations as specified in this Section for factory-assembled framing and trim.
- 3.5.3 Panels: installed plumb and true in proper alignment and relation to the curtain wall framing or the established lines and grades as shown on the reviewed Shop Drawings.
- 3.6 Field Quality Control**
- 3.6.1 Inspection and Testing: As specified in Section 01 83 16 and Section 01 91 15.
- 3.6.2
- 3.7 Cleaning**
- 3.7.1 Remove debris caused by, or incidental to, installation promptly.
- 3.7.2 Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
- 3.7.3 Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.
- 3.7.4 On completion of installation, carefully clean metal work.
- 3.7.5 Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Consultant at no cost to Owner.

**END OF SECTION**

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the tubular skylights work specified herein. This includes, but is not necessarily limited, to:
  - .1 Tubular skylights.
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only:
  - .1 Section 07 21 00, Thermal Insulation: insulation materials field installed with tubular skylights.
  - .2 Section 07 62 00, Sheet Metal Flashing and Trim: metal flashings installed at perimeters of assemblies.
  - .3 Section 07 92 00, Joint Sealants: sealants installed at perimeters of tubular skylights.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

### **1.4 Preinstallation Meetings**

- 1.4.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.

- 1.4.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
- .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.
  - .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.
  - .3 Agenda:
    - .1 Review progress of related construction activities and preparations for particular activity under consideration.
    - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
  - .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
  - .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

**1.5 Submittals**

- 1.5.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.5.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for tubular skylights work specified in this Section.
- 1.5.3 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:
- .1 Include plans, elevations, sections and details as applicable.
  - .2 Indicate field-measured dimensions on Shop Drawings.
- 1.5.4 Delegated Design Submittals:
- .1 Engineering design completion of tubular skylights work is delegated to Contractor based on structural design criteria indicated in Contract Documents.
  - .2 Submit Shop Drawings for work of this Section that bear the stamp of a Professional Engineer registered in Province of Ontario.
  - .3 Submit copy of structural calculations upon request by Consultant.

- 1.5.5 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
- .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
  - .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
  - .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.5.6 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:
- .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.
  - .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.5.7 Samples: Submit selection and verification samples for Products requiring colour, texture, or design selection. Submit manufacturer's list of finishes or colour swatches for Consultant's selection.
- 1.5.8 Submit for Consultants review, QA checklist used as part of installation process. Make modifications to QA checklist based on Consultant feedback.

**1.6 Closeout Submittals**

- 1.6.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.
- 1.6.2 Operating and Maintenance Data: Submit care and maintenance instructions for tubular skylights to be included in building operation and maintenance manual.
- 1.6.3 Warranty Documentation: Submit copy of extended warranties specified in this Section.

**1.7 Quality Assurance**

- 1.7.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.
- 1.7.2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and

Schedules, and whose work has resulted in construction with a track record of successful in-service performance.

1.7.3 Professional Engineer's Qualifications: Employ Professional Engineer licensed to practice in Province of Ontario who carries professional liability insurance and has at least five years' experience providing engineering services of similar kind, scope, and complexity.

.1 Professional Engineer's Responsibility:

- .1 production and review of Shop Drawings,
- .2 design and certification of tubular skylights, including attachments for building construction, in accordance with applicable codes and regulations,
- .3 stamping and signing of each Shop Drawing and associated calculations

1.7.4 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.

1.7.5 Mock-Ups / First Installation Review: Construct mock-ups to verify selections made under submittals, demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

- .1 Location: In-situ (i.e. first installation), as directed on site by Consultant.
- .2 Purpose: To set benchmarks for installation and to judge subsequent work. Maintain Mock-ups during construction in undisturbed condition.
- .3 Reviewed mock-ups: May become part of the completed work if undisturbed at the time of Substantial Performance of The work, provided they are undisturbed, and comply with requirements outlined in Contract Documents.

## **1.8 Delivery, Storage And Handling**

- 1.8.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.
- 1.8.2 Deliver, store and handle tubular skylights materials in accordance with manufacturer's written instructions.
- 1.8.3 deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.8.4 Store materials in off-ground, in clean, dry, well-ventilated area.
- 1.8.5 Replace defective or damaged materials with new.

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**1.9     Field Conditions**

1.9.1 Field Measurements: Verify actual dimensions of construction contiguous with tubular skylights by field measurements before fabrication.

**1.10    Warranty**

1.10.1 Extended warranty: Submit for Owner's review and acceptance, manufacturer's extended warranty in which manufacturer commits to repair or replace components of tubular skylights that fail within specified warranty period. Manufacturer's extended warranty is in addition to, and does not supersede, any other rights that Owner may have under Contract Documents.

- .1 Warranty Period: For daylighting device, manufacturer's standard 10 year warranty.
- .2 Warranty Period: For electrical parts, manufacturer's standard 5 year warranty.

**2 .    PRODUCTS**

**2.1     Manufacturers**

2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:

- .1 Kingspan Light+Air
- .2 Solatube
- .3 Velux

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

**2.2     Performance / Design Criteria**

2.2.1 Provide tubular skylights, including anchorage, capable of withstanding, without failure, the effects of the following:

- .1 Structural loads.
- .2 Thermal movements.
- .3 Movements of supporting structure.
- .4 Dimensional tolerances of building frame and other adjacent construction.

2.2.2 Failure includes the following:

- .1 Deflection exceeding specified limits.
- .2 Water leakage.
- .3 Thermal stresses transferred to building structure.



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- .4 Noise or vibration created by wind and thermal and structural movements.
  - .5 Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
  - .6 Loosening or weakening of fasteners, attachments, and other components.
  - .7 Sealant failure.
- 2.2.3 Tubular daylighting systems must be designed to withstand project-specific design loads and their effects within constraints specified in this Section and Ontario Building Code without defects, damage, or failure, including but not limited to the following:
- .1 Dead Loads: Including those transferred from structural elements.
  - .2 Environmental Loads: Such as wind, snow, rain, hydrostatic, and seismic as applicable.
  - .3 Loads from Temperature and Moisture Loads: Including expansion, contraction, deflection, deformation, creep, shrinkage, settlement, and differential movement.
  - .4 Fire Loads: as determined by fire performance testing specified.
- 2.2.4 Seismic Performance: Provide products and systems specified in this Section to withstand the effects of earthquake motions in accordance with OBC 4.1.8.18 and CAN/CSA S832.
- .1 Professional engineer specified in Division 01 and referenced in this Section shall be responsible for designing systems and submitting signed and sealed analysis data and Shop Drawings illustrating seismic-resistant systems.
  - .2 Refer to Structural Drawings for seismic sensitivity values.
- 2.2.5 Building Enclosure Design Principle: Exterior envelope construction for this Project is based on "Rain Screen" design principle, as recommended by National Research Council of Canada. Face sealed assemblies are not permitted.
- .1 Continuity: Maintain integrity and continuity of building enclosure's thermal, air, and vapour control layers at all times by using appropriate insulation, air barriers, vapour retarders to tie work of this Section with adjacent construction.
  - .2 Design for compartments to achieve appropriate pressure equalization in exterior cladding system.
- 2.2.6 Incorporate means of draining moisture to exterior. Drainage system must provide clear, internal paths of drainage of trapped moisture within aluminum plate assemblies to exterior of wall assemblies.

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- 2.2.7 System must discharge water in manner that avoids staining of architectural finishes, formation of puddles or formation of icicles.
- 2.2.8 Skylights must be tested and labeled in accordance with AAMA/WDMA/CSA 101/I.S.2/A440.
- .1 Classification: Class CW-PG80, for 914 mm by 914 mm (36 inches by 36 inches) gateway size.
  - .2 Air Infiltration: maximum of 0.3 L/s/m<sup>2</sup> (0.06 cfm/ft<sup>2</sup>) at 75 Pa when tested according to ASTM E283.
  - .3 Water Resistance: no uncontrolled water leakage at pressure differential of 580 Pa (12.11 psf) or 15% of design pressure per ASTM E331.
  - .4 Uniform Load: No breakage, permanent damage to fasteners, hardware parts, or damage that renders the daylighting system inoperable or causes excessive permanent deflection when tested at a positive load of 11.52 kPa (240.6 psf) or negative load of 7.66 kPa (160 psf), to ASTM E330.
- 2.2.9 Thermal Transmittance: U-Factor, not exceeding 0.47<sub>IP</sub> BTU/hr.ft<sup>2</sup>deg F when simulated per NFRC 100 and NFRC 200 using applicable testing, modelling and validation protocols.
- 2.2.10 Structural Loads:
- .1 Wind Loads: As indicated by structural design data on Drawings.
  - .2 Snow Loads: As indicated by structural design data on Drawings.
  - .3 Concentrated Live Loads: 1112 N (250 lbf) applied to framing members at locations that will produce greatest stress or deflection.
  - .4 Seismic Loads: As indicated by earthquake design data on Drawings.
  - .5 Load Combinations: Calculate according to requirements of applicable code indicated on Drawings.
- 2.2.11 Self-Ignition Temperature: > 343 degrees C (650 degrees F) per ASTM D1929.
- 2.2.12 Smoke Density: Maximum 75 per ASTM D2843.
- 2.2.13 Rate of Burn and Extent of Burn: Minimum CC-2 Classification with less than 62 mm/min (2.5 inches/min) per ASTM D635.
- 2.2.14 Fall Protection Performance: Passes fall protection test: No penetration of dome or curb cap when subjected to 318.2 kg (700 lb)/60 second static load test and 318.2 kg (700 lb)/610 mm (2-foot) impact drop test in accordance with OSHA 29 CFR 1926 Subpart M (Fall Protection) 1926.501(b)(4)(i); 1926.501(i)(2); and 1926.501(b)(4)(ii).

2.2.15 Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

- .1 Temperature Change (Range): 67 deg C (120 deg F), ambient; 100 deg C (180 deg F), material surfaces.

## **2.3     Tubular Skylight**

2.3.1 Description: Transparent roof-mounted skylight dome and self-flashing curb, reflective tube, and ceiling level diffuser assembly, transferring sunlight to interior spaces; complying with ICC AC-16.

2.3.2 Diameter: 740 mm (29 inch)

2.3.3 Dual Dome Glazing: Type DPP.

- .1 Outer Dome Glazing: 3.2 mm (0.125 inch) minimum thickness, vacuum-formed polycarbonate classified as CC1 material; UV inhibiting; (100 percent UVC, 100 percent UVB, and 98.8 percent of the range of UVA transmission).
- .2 Inner Dome Glazing: CC2, 1 mm (0.040 inch) minimum thickness, copolyester (PETG) polyethylene terephthalate with glycol;.

2.3.4 Seals:

- .1 Inner Dome Seal: Adhesive back closed cell foam seal 3.2 mm (0.125 inch) or 4.8 mm (0.188 inch) tall by 9.5 mm (0.375 inch) wide.
- .2 Dome Assembly Seal: Adhesive-backed pile weather-strip, 8.9 mm (0.350 inch) tall by 4.8 mm (0.187 inch) wide.

2.3.5 Transfer Zone:

- .1 Extension Tubes: Aluminum sheet, thickness 0.5 mm (0.018 inch) conforming to ASTM B 209 with Tab-Lock tube joint structural connection system.
- .2 Reflective Tubes:
  - .1 Reflective 610 mm (24 inch) extension tube, Type EXX or Type EL with total length of run as indicated on the Drawings.
  - .2 Belt Alignment Tab aligns Tube Belt on tube in the correct location.
- .3 Interior Finish: Manufacturer's standard Infrared reduction technology designed to produce high visible light transmittance with low infrared (IR) transmission.
  - .1 Color: a\* and b\* (defined by CIE Lab\* color model) not to exceed +/- 2 as determined in accordance with ASTM E308.

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- 2.3.6 Tab-Lock: manufacturer's standard device designed to capture adjoining tube or tube connector using periodic opposing hooks integrated in the tube perimeter with mating retention detents.
- 2.3.7 Tube Belt: Sheet-metal belt 50.8 mm (2 inch) wide by 724 mm (28.5 inch) nominal diameter by 0.5 mm (0.022 inch) thick CS-B AZ-50 ASTM A792 with 2.5 mm (0.10 inch) diameter stainless steel type 302 ASTM A313 torsion spring actuated toggle clamp.
- .1 Designed to retain Tab-Lock tube joint structural connection system; stiffens linear tube assembly; and prevents tube rotation or disengagement under normal use. Includes locking tab to prevent unintentional Tube Belt Latch opening due to handling, service, vibration, or normal operation or use.
- 2.3.8 Bottom Assembly: Amplifier Assembly for Tubes Not Penetrating Ceilings (Open Ceiling): Type A, 914 mm (36 inch) diameter amplifier diffuser assembly attached directly to bottom of tube.
- .1 Amplifier: Conical shaped assembly 602 mm (23.7 inches) tall, 724 mm (28.5 inches) upper diameter, and 914 mm (36 inches) lower diameter.
  - .2 Amplifier collimates incident light. Light reflects off two successively angled facets designed to mix the light to reduce glare and to correct the incident angle by 15 degrees and 25 degrees successively, thereby improving the transmission efficiency through the diffuser lens by reducing retro-reflection due to first surface refraction and concentrating the distribution of light by reducing the cone of illumination relative to the incident angle correction.
  - .3 Assembly comprised of three multifaceted segments to be joined together with 15 - 3 mm (0.125 Inch) rivets.
  - .4 Tube Connect Slots at upper perimeter receive six Tab-Lock Hook features from adjoining tube for mechanical tube engagement.
- 2.3.9 Amplifier Diffuser Belt: Sheet-metal belt 50.8 mm (2 inch) wide by 914 mm (36 inch) nominal diameter by 0.5 mm (0.022 inch) thick CS-B AZ-50 ASTM A792 with 2.5 mm (0.10 inch) diameter stainless steel Type 302 ASTM A313 torsion spring actuated toggle clamp.
- .1 Designed to retain tab-Lock tube joint structural connection system; stiffens linear tube assembly; and prevents tube rotation or disengagement under normal use. Includes locking tab to prevent unintentional Latch opening due to handling, service, vibration, or normal operation or use.
- 2.3.10 Diffuser Lens: Lens: CC2, Type L2, Prismatic lens designed to maximize light output and diffusion. Visible Light Transmission must be greater than 90 percent at 2.5 mm (0.100 inch) thick and complying with OBC Article 3.1.13.4.

- .1 Diffuser Collar: Attached to diffuser lens; 0.45 mm (0.018 inch) nominal thickness aluminum.
- .2 Diffuser Seal: "L" shaped EPDM closed cell foam, 21.8 mm (0.86 inch) wide by 34.8 mm (1.37 inch) tall by 4.1 mm (0.16 inch) thick to minimize condensation and bug, dirt, and air infiltration per ASTM E283.
- .3 Diffuser Band: Stainless steel diffuser band, 6.4 mm (0.25 inch) wide by 0.5 mm (0.020 inch) thick stainless steel Type 201 ASTM A666, for enhanced seal performance and protection.

2.3.11 Basis-of-Design: "SkyVault M74DS" as manufactured by Solatube.

## **2.4     Accessory Materials**

- 2.4.1 Fasteners: Same material as metals being fastened, non-magnetic steel, non-corrosive metal of type recommended by manufacturer, or injection molded nylon.
- 2.4.2 Suspension Wire: Steel, annealed, galvanized finish, size and type for application and ceiling system requirement.
- 2.4.3 Sealant: Polyurethane or copolymer based elastomeric sealant as provided or recommended by manufacturer.
- 2.4.4 Insulating Materials: Specified in Section 07 21 00, Thermal Insulation.
- 2.4.5 Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 0.762-mm (30-mil) thickness per coat.

## **2.5     Fabrication**

- 2.5.1 Fabricate aluminum components before finishing.
- 2.5.2 Fabricate aluminum components that, when assembled, have the following characteristics:
  - .1 Profiles that are sharp, straight, and free of defects or deformations.
  - .2 Accurately fitted joints with ends coped or mitered.
  - .3 Internal guttering systems or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within skylight to exterior.
  - .4 Physical and thermal isolation of glazing from framing members.
  - .5 Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
- 2.5.3 Fabricate aluminum sill closures with weep holes and for installation as continuous component.

- 2.5.4 Reinforce aluminum components as required to receive fastener threads.
- 2.5.5 Weld aluminum components in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- 2.5.6 After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

### **3 .     EXECUTION**

#### **3.1     Examination**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.

#### **3.2     Installation**

- 3.2.1 Installation, generally: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.
- 3.2.2 Coordinate installation with substrates, air and vapor retarders, roof insulation, roofing membrane, and flashing to ensure that each element of the Work performs properly, and that finished installation is weather tight.
- 3.2.3 Install flashing to produce weatherproof seal with curb and overlap with roofing system termination at top of curb.
- 3.2.4 Provide thermal isolation when components penetrate or disrupt building insulation. Pack fibrous insulation in rough opening to maintain continuity of thermal barriers.
- 3.2.5 Coordinate attachment and seal of perimeter air and vapor barrier material.
- 3.2.6 Do not install damaged components.
- 3.2.7 Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
- 3.2.8 Where metal surfaces of tubular unit skylights will contact incompatible metal or corrosive substrates, including preservative-treated wood, provide permanent separation as recommended by manufacturer
- 3.2.9 Align device free of warp or twist, maintain dimensional tolerances.

- 3.2.10 Inspect installation to verify secure and proper mounting. Test each fixture to verify operation, control functions, and performance. Correct deficiencies.

**3.3     Field Quality Control**

- 3.3.1 Inspection and Testing: As specified in Section 01 83 16 and Section 01 91 15.

3.3.2

**3.4     Protection**

- 3.4.1 Protect tubular skylights from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades.

- 3.4.2 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in writing by affected material's manufacturer. Do not use materials or process that can damage finishes, surfaces, or construction.

- 3.4.3 Promptly replace tubular skylights work damaged during construction that cannot be satisfactorily repaired.

**3.5     Cleaning And Waste Management**

- 3.5.1 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.

- 3.5.2 Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**END OF SECTION**

## **PART 1 – GENERAL**

### **1.1 WORK INCLUDED**

- .1 Furnish, deliver and install finish hardware.
- .2 It is intended that the following list of hardware will cover finish hardware to complete the project. Bring to the Consultants attention any omissions, discrepancies that will affect work in this section during the bidding period.

### **1.2 RELATED SECTIONS**

- .1 General Requirements Division 1
- .2 06 40 00 Architectural Woodwork
- .3 08 11 13 Steel and Doors and Frames
- .4 08 11 70 Glazed Interior Aluminum Doors and Frames
- .5 08 14 16 Flush Wood Doors
- .6 08 44 13 Glazed Aluminum Curtain Wall
- .7 Division 26 Electrical
- .8 Division 28 Electronic Safety and Security

### **1.3 PRODUCTS SUPPLIED BUT NOT INSTALLED IN THIS SECTION**

- .1 Power supplies, compressor/control boxes, junction boxes installed by Division 26.

### **1.4 REFERENCES**

- .1 Door and Hardware Institute - Recommended locations for Architectural Hardware for Standard Steel Doors and Frames
- .2 Door and Hardware Institute - Recommended locations for Architectural Hardware for Flush Wood Doors
- .3 CSDMA-Recommended Dimension Standards for Commercial Steel Doors and Frames (Hardware Locations)
- .4 NFPA 80-Standard for Fire Doors and Windows, 1999 Edition
- .5 Door and Hardware Institute - Sequence Format for Hardware Schedule
- .6 Door and Hardware Institute - Key Systems and Nomenclature
- .7 Door and Hardware Institute - Abbreviations and Symbols used in Architectural Door and Hardware Schedules and Specifications
- .8 Door and Hardware Institute – Installation Guide for Doors and Hardware
- .9 Ontario Building Code 2012

### **1.5 SUBMITTALS**



- .1 Updated Finish Hardware Schedule:  
Submit submittals in accordance with Section 01 30 00 Submittal Procedures. Prepare detailed hardware schedules in Door and Hardware (DHI) vertical format as detailed in Reference 1.4.4.
- .2 Product Data:  
Submit in a three-ring binder six (6) copies of product data sheets with the finish hardware schedule showing items of hardware to be used on the project.
- .3 Samples:  
When requested in writing, provide (to the Consultants Site Office) one sample of each hardware item complete with fasteners, within thirty (30) calendar days of award of a purchase order. Samples to be clearly labeled with their hardware schedule designation and manufacturers' name and model number. Samples will be incorporated into the work.
- .5 Templates:  
Submit templates within to related trades when requested.
- .6 Keying Schedule:  
After a keying meeting between representatives of the Owner, furnish a keying schedule listing the levels of keying as well as an explanation of the key system's function, the key symbols used, and the door numbers controlled. Utilize "Door and Hardware Institute - Key Systems and Nomenclature" as a guideline for nomenclature, definitions, and approach for selecting the optimal keying system. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
- .7 Wiring Diagrams  
Co-ordinate with related trades, meet with the owner and security provider and submit a written description of the functional use (mode of operation) of electrical hardware products specified. Include operation for ingress, egress, fire alarm, and after hours use where applicable. Include door and frame elevations showing the location of each item of electrical hardware to be installed, mode of operation including a diagram showing number and size of conductors. Indicate on elevation drawing items provided by related trades, include for back boxes, and 120V power sources. Provide point to point drawings showing terminal connections necessary for a complete installation.
- .8 Operations and Maintenance Data  
Prior to Substantial Completion, furnish to the owner, two (2) copies of an owner's operation and maintenance manuals in a three-ring binder with the following information:
  1. Name of hardware distributor, address and contact name
  2. Copy of final "as-built" finish hardware schedule
  3. As installed "wiring diagrams, elevations, risers, point to point"
  4. Copy of final keying schedule
  5. Copy of floor plans with keying nomenclature assigned to door numbers as per the approved keying schedule
  6. Catalogue cut sheets and product specifications for each product
  7. Parts list for each product
  8. Installation instructions and templates for each product

## **1.7 QUALITY ASSURANCE**

- .1 Review installation procedures with the Contractor's Designated Installers. Hold

instruction meetings with installers prior to installation and subsequent review meetings during the installation period. Submit minutes of meetings to the Consultant.

- .2 Substitutions  
Only approved products specified are accepted. Make substitution requests in accordance with Division 1. Include product data and indicate benefit to the project.
- .3 Supplier Qualifications  
Successful hardware distributor to have a minimum of five (5) years' experience in the door and hardware industry. Distributor to have on staff an Architectural Hardware Consultant (A.H.C.) whose name will be listed on the hardware schedule title page submittal and will be responsible for scheduling, detailing, (see Reference 1.5.4) ordering and co-ordination of the finishing hardware for this project. If so, requested by the Consultant and or installer this individual will be required to visit the jobsite for any installation problems that may occur.
- .4 Designated Installers  
Hardware Installers must have a minimum of five (5) years' experience in installation of hardware. Provide verification of installer's qualification to Consultant for approval. Installers to attend review meetings with the Hardware Distributor.

## 1.8 DELIVERY, STORAGE AND HANDLING

- .1 Marking and Packaging  
Mark cartons with heading number, door number, and key-set symbol where applicable in original packaging provided by the manufacturer. Pack packaged hardware in suitable wrappings and containers to protect it from damage during shipping and storage. Enclose accessories, fastening devices and other loose items with each applicable item of hardware.
- .2 Delivery  
Deliver hardware to related trades.
- .3 Storage  
Store in a clean, dry room with lockable man door and adequate shelving to permit organization so item numbers are readily visible.

## 1.9 WARRANTY

- .1 Furnish warranties by the accepted manufacturers:

Hardware Item	Length of Warranty
Mortise Hinges	1 year
Continuous Hinges	Lifetime
Electrified Continuous	1 Year
Pivot Sets	2 years
Locks ND Mechanical	10 years
Locks ND Electro-Mechanical	3 years
Exit Devices (98/99 33/35A) Mechanical)	10 Years
Exit Devices (98/99 33/35A) Electromechanical)	3 Years
Door Closers - Mechanical	10 years
Door Closers – Mechanical – High Security	15 years
Door Closers – Mechanical 4020 series	30 years
Door Closers – Mechanical 4040XP series	30 years
Door Closers – Mechanical 1460 series	30 years
Door Operators - Electro Mechanical	2 years
Electric Hold Open Devices - Electro mechanical	2 years
Overhead Stops/Holders	10 year

Floor/Wall stops	1 year
Electric Strikes	5 years
Key Switches/Power Supplies	1 year
Electromagnetic Locks	Lifetime
Gasketing (ZERO)	5 years
Power Supplies	3 years

#### 1.10 MAINTENANCE

##### .1 Maintenance Service

After the building is occupied arrange an appointment with the maintenance staff from the Region of Peel for instruction of proper use, servicing, adjusting and lubrication of hardware furnished. Submit to the consultant a list of attendees and meeting date.

##### .2 Extra Materials

Furnish the following items in proper manufacturer's cartons once the job has been completed:

1. 5 of each installation tool used for locks/passage/privacy, type of door closers, and exit devices.

#### PART 2 – PRODUCTS

##### 2.1 MANUFACTURERS

Products listed in the hardware groups are from the manufacturers listed below:

ITEM	MANUFACTURER NAME
Full Mortise Hinges	Ives
Continuous Hinges	Ives
Locksets, Latchsets/Deadbolts	Schlage
Cylinders	Schlage
Exit Devices	Von Duprin
Keypad Locks	Schlage
Pivots	Ives
Surface/Flush Bolts	Ives
Door Closers	LCN
Overhead Door Holders/Stops	Glynn Johnson
Door Pulls/Flatware	Ives
Wall/Floor Stops	Ives
Weather/Smoke/Sound Seals	Zero
Door Sweeps/Thresholds	Zero
Automatic Door Operators/Actuators	LCN
Keyswitch/Magnetic Locks	Schlage Electronics
Electric Strikes	Von Duprin
Access Controllers	Schlage Electronics
Power Supplies	Schlage Electronics, Von Duprin

##### 2.1 MATERIALS

###### 1. Screws and Fasteners:

Screws and fasteners to be matching finish to their product and to be manufacturer's standard. Door closers, door holders and exit devices installed on fire rated wood doors and hollow metal doors to be attached with fasteners to meet NFPA 80 requirements.

###### 2. Materials-Acceptable Manufacturers (Note: Supply products in a given category from the same manufacturer):

###### .1 Mortise Hinges

### 1.1.1

Provide five knuckle bearing hinges with NRP option on reverse bevel doors with locking hardware. Hinge width to accommodate door closer projection, door trim and allow for 180-degree swing. Doors up to 2286mm (90") in height, supply 3 hinges, doors greater than 2286mm in height add one hinge for every additional 760mm of door height. Doors 915mm (36") wide and less furnish 114mm (4-1/2") high hinges, doors greater than 915mm (36") wide furnish 127mm (5") high hinges, heavy weight or standard weight as specified. Supply ferrous (steel), stainless steel material for all interior and/or fire-rated doors and stainless steel for exterior doors.

As Specified: Ives Hinges, 5BB1, 5BB1HW

#### .2 Continuous Hinges:

Provide Ives heavy duty edge mount/edge guard continuous gear type aluminum hinges. Ives aluminum hinges tested and approved to UL 10C (90 minutes). Material 6063-T6 aluminum, clear satin finish (628). Aluminum geared hinges certified to ANSI 156.26 Grade 1. Hinge length to suit door height. Hinge length 25mm (1") less door height.

Supply as Specified: Ives 112XY

#### .3 Surface/Flush Bolts/Co-Ordinators:

##### **Manual Flush Bolts-Metal Doors:**

Manual flush bolt for metal doors to be cUL listed for 3-hour fire doors with 13mm (1/2") diameter bolt tip with 19mm (3/4") throw. Standard rod length to be 305mm (12"), supply longer length rods to suit higher door heights. Provide dustproof strikes with flush bolts that incorporate a bottom bolt.

Supply as Specified: Ives FB458 series.

##### **Automatic Flush Bolts- Wood Doors:**

Automatic flush bolts for wood doors to be fully automatic cUL listed for 90min fire doors, low actuation forces-top bolt has not spring tension, non -handed with 19mm (3/4") throw with a 22mm (7/8") vertical adjustment. Models with auxiliary fire latch that eliminates the bottom bolt for cUL listed doors (20min only). Provide dustproof strikes with auto flush bolts that incorporate bottom bolt.

Supply as Specified: Ives FB40 series

##### **Constant Latching Flush Bolts-Metal Doors:**

Constant latching flush bolts for metal doors to be cUL listed for 3-hour fire doors. Inactive door remains latched until the active door is opened, releasing the automatic bottom bolt and then the top bolt can be manually released. Inactive door will relatch automatically. Standard rod length 305mm (12"), supply longer rod length to suit higher door heights. Non-Handed with fire-rated models with auxiliary fire latch to eliminate the use of a bottom bolt. Provide dustproof strikes with flush bolts that incorporate bottom bolt.

Supply as Specified Ives FB50 series

##### **Co-Ordinators and Filler Bars**

cUL listed for installation on labeled frames. COR series co-ordinator channels and fillers made of aluminum, furnished in 628 finish. Provide co-ordinators of correct size for use on pairs of doors when one door is required to close before the other. Provide filler bar to suit opening width to maintain architecturally clean lines. Provide mounting brackets for other soffit applied hardware. Co-ordinator units to be equipped with an override feature which allows the active door to close under extreme pressure.

Supply as Specified: Ives COR Series Bar Co-ordinators

#### **.4 Locksets/Deadlocks/Privacy Sets:**

##### **Cylindrical:**

Extra heavy duty residential, commercial, institutional and industrial applications. Latch bolts to be steel with minimum 13mm (½") throw deadlocking on keyed functions. 19mm (¾") throw anti-friction latchbolt on pairs of fire doors. Provide manufacturer's standard wrought box strike for each latch or lock, with curved lip extended to protect frame. Locks and latchsets tested to exceed 8,000,000 cycles. Provide mox connections for electrified functions as a standard. Lock case to be steel, incorporate one-piece spring cage and spindle. Precision solid brass 6-pin cylinder with nickel silver keys available in Schlage keyways. Levers to be solid with no plastic inserts.

Supply as Specified: Schlage "ND" series

##### **Hospital Latches:**

Hospital latches to be supplied with paddles engraved "PUSH" and "PULL". Provide hospital latches with standard 127mm (5") backset, unless noted otherwise, with 13mm (½") latch throw. Provide proper latch throw of UL listing at pairs. Provide standard ASA strike unless extended lip strikes are necessary to protect trim. Mount trim with push paddle mounted up and pull paddle mounted down except at psychiatric or security areas provide both paddles mounted down, unless noted otherwise.

##### **Keypad Locks-Stand Alone Battery Operated:**

##### **Cylindrical:**

Heavy-duty cylindrical type with standard 13mm (½") throw latch bolt with chassis that will accommodate standard 161 cylindrical lock prep. Locksets shall be provided from the factory with the appropriate handing. Outside escutcheon to contain a 12-button keypad to support 500 user capacity with tri-coloured LED's and audible indicators to provide information on activation, operational system status, system error conditions and low power conditions. Electrical operation to be battery operated capable of 80,000 operating cycles using four non-proprietary "AA" alkaline batteries. Keypad lock to be capable of operation for exterior applications, operating temperature -35 to 66 degrees Celsius.

Supply as Specified: Schlage Electronics CO-100CY series

#### **.5 Exit Devices/Device Trims/Mullions:**

##### **Narrow Style:**

Exit device to be cUL listed for panic hardware and fire exit hardware. Supply exit devices and fire exit devices featuring coil compression springs on device mechanism subassemblies and dead latching mechanisms for active latch bolts. Supply exit devices with smooth mechanism case and "the quiet one" fluid

dampener to eliminate noise associated with exit device operations. Non-handed device with touchpad assemblies with no exposed fasteners and cast end caps, reinforced aluminum with stainless steel touchpad and raised edge to minimize pinching. Doors greater than 950mm wide supply long bar exit devices, doors greater than 2134mm (84") high supply extension rods were required. Fits door stiles as narrow as 45mm (1 3/4").

Supply as Specified: Von Duprin 35A series

#### **Heavy Duty**

Exit device to be cUL listed for panic hardware and fire exit hardware. Supply panic hardware and fire exit devices featuring coil compression springs on device mechanism subassemblies and dead latching mechanisms for active latch bolts. Supply exit devices with smooth mechanism case and "the quiet one" fluid dampener to eliminate noise associated with exit device operations. Non-handed device with touchpad assemblies with no exposed fasteners and cast end caps, reinforced aluminum with stainless steel touchpad and raised edge to minimize pinching. Roller strikes to be standard on rim and surface vertical rod devices, mortise exit devices (626) complete with strikes that match the same finish as the device. Doors greater than 950mm (37-13/32") wide supply long bar exit devices, doors greater than 2134mm (84") high supply extension rods for surface vertical rod series. 1,000,000cycle testing independently certified by ETL.

Supply as Specified: Von Duprin 98 series

#### **Exit Device Trim**

Supply device trim featuring recessed cylinder mounting and coil compression spring design with shear pin protection for lever designs. Similar lever designs for exits as specified for locksets.

Supply as Specified Von Duprin 996 series

### **.6 Door Closers:**

Door closers to have the following features (see separate closer sections below for further information):

- Fully hydraulic, rack and pinion action with high strength cast iron cylinders and one-piece forged steel pistons.
- Include high efficiency, low friction pinion bearings.
- Hydraulic fluid of a type requires no seasonal adjustments, ULTRA X TM fluid has constant temperature control from -35 degrees Celsius to +49 degrees Celsius.
- Hydraulic regulation controlled by tamper-proof, non-critical screw valves, adjustable with a hex wrench.
- Separate adjustments for backcheck, general speed and latch speed.
- Door closers with special template (ST-) numbers include required associated product, information sheets and instructions
- Size 1 manual door closers to provide less than 5 pounds opening force on a 900mm door leaf.
- Door closer with Pressure Relief Valves are not accepted.
- Door closer bodies, arms, covers to be powder coated
- Closers with powder coat finishes to exceed a minimum 100-hour salt spray test, as described in ANSI A156.18 and ASTM B117.
- Closers detailed with plated finishes to include plated covers (or finish plates), arms and visible fasteners.

#### **Medium Duty Mechanical (Interior/Exterior):**

Non-sized (1-6) and non-handed cylinder body to have 32mm (1 ¼") piston diameter with 16mm (5/8") single heat-treated shaft. Track closer cylinder body non-sized (2-4) or (1-2). Closers to have stamped main arm and forearm (forged steel main arm and forearm EDA and CUSH type arms). Optional arms to be interchangeable within the series of closers, except track arm type closers. Track arm type closers to have single lever arm with low friction track and roller assembly and provisions for an optional bumper to assist backcheck.

Supply as Specified: LCN1460 HD series

**Heavy Duty Mechanical (Top Jamb Mount):**

Non-sized (1-5) and handed cylinder body to have 38mm (1 1/2") piston diameter with 17mm (11/16") double heat-treated shaft and certified to exceed ten million (10,000,000) full load operating cycles by a recognized independent testing laboratory. Track closers sized 1,3 or 4. Closers to have forged steel main arm. Optional arms to be interchangeable within the series of closers, except track arm type closers. Track arm type closers to have single lever arm with low friction track and roller assembly and provisions for an optional bumper to assist backcheck. Provide drop plates, brackets, long rod and shoe or adapters for arms as to suit details.

Supply as Specified: LCN 4020 series

Supply as Specified: LCN 4040XP series

**Heavy Duty Mechanical (Parallel Arm Mount):**

Non-sized (1-5) and handed cast iron cylinder body to have 38mm (1 1/2") piston diameter with 17mm (11/16") double heat-treated shaft and certified to exceed ten million (10,000,000) full load operating cycles by a recognized independent testing laboratory. Track closers sized 1,3 or 4. Closers to have forged steel main arm and forearms. Optional arms to be interchangeable within the series of closers, except track arm type closers. Track arm type closers to have single lever arm with low friction track and roller assembly and provisions for an optional bumper to assist backcheck.

Supply as Specified: LCN 4110 series

**Heavy Duty Single Point Hold-Open (Pull and Push Side Mount):**

Non-sized (1-4) and non-handed cast iron cylinder body to have 38mm (1 1/2") piston diameter with 17mm (11/16") double heat-treated shaft with adjustable single-point hold open function controlled by solenoid assembly located in a head frame mounted track. Track arm to have single lever arm with low friction track and roller assembly. Unit to have a momentary on/off switch board assembly for testing door release and provides over-voltage protection.

Supply as Specified: LCN 4040SE series

**"NOTE: LOW ENERGY OPERATORS SUPPLIED AND INSTALLED BY THIS SECTION"**

**Medium Duty Electric Operator**

Provide non-handed low energy automatic operator units that are electro-mechanical design. Tested to minimum of 3 million cycles. In the event of a power loss or failure, the control box will save the installation settings thru Non-Volatile Memory. Operates between -34 deg. C and +71 deg. C. Powered by DC motor working through reduction gears. Door can be manually operated with

power on or off without damage to operator. Provide variable adjustments, including opening, closing and backcheck speeds, backcheck and latch position, and adjustable hold open delay from 2-30 seconds. Provide units with semi concealed on/off toggle switch, selectable push and go function to activate power operator, power assist closing, electric lock delay, LED illuminated power indicator and logic terminals to interface with accessories. Provide full length aluminum header, drop plates, brackets, long rod and shoe or adapters for arms as to suit details.

Supply as Specified: LCN 9131, 9142 Series

**Heavy Duty Electric Operator**

Provide low energy automatic operator units that are electro-mechanical design. Powered by DC motor working through reduction gears. Spring force closing. Motor is off when door is in closing mode. Door can be manually operated with power on or off without damage to operator. Provide variable adjustments, including opening and closing speed adjustment. Provide units with manual off/auto/hold-open switch, push and go function to activate power operator, vestibule interface delay, electric lock delay, hold-open delay adjustable from 2 to 30 seconds, and logic terminal to interface with accessories, mats, and sensors. Provide full length aluminum header, drop plates, angle brackets, or adapters for arms to suit details. Sequence operation of exterior and vestibule doors with automatic operators to allow ingress or egress through both sets of openings, consult with owner.

Supply as Specified: LCN 9542, series c/w keyswitch or rocker 8310-806K/R

**.7 Actuators:**

**Wall Type**

Wall plate switch to be hard-wired actuator with round, stainless steel touch plate in either 114mm (4-1/2") or 152mm (6") diameters. Engraved blue filled handicap symbol conforms to most accessibility codes. Units to include heavy grade components for vandal resistant mounting and weather resistant switch standard.

Supply as specified: LCN 8310-8528310-876 (152mm) escutcheon

**.8 Overhead Door Stops/Holders:**

**Heavy Duty Surface Mounted:**

Surface overhead stops/holders to be stainless steel base, non-handed for single-acting doors with a heavy-duty channel/slide-arm design and offset jamb bracket to allow for simple field modifications of functions. Channel to be surface mounted to the door with thru bolts and the jamb bracket is surface mounted to the frame soffit.

Supply as Specified: Glynn-Johnson 90 series

**Heavy Duty Concealed Mounting:**

Concealed overhead stops/holders to be stainless steel base, non-handed for single or double-acting doors with a low-profile channel, mortised in the door and jamb bracket is mortised in the doorframe. Unit to be fully concealed when door is in the closed position. Units to be field adjustable for function changes if required.

Supply as Specified: Glynn-Johnson 100 series



**.9 Door Pulls/Flatware/Coat Hooks:**

Door Pulls are to be 19mm (7/8"), 25mm (1") diameter  
Flatware to be of stainless-steel material, 1mm (.050 gauge).

Supply as Specified: 8103EZHD, 8145EZHD (Door Pull) mounting as indicated in the hardware sets.

Ives 8200 B-NH-A tape mounting for installation, sizes as specified in hardware groups  
Ives 8400 B-NH-A, tape mounting for installation (Kickplates 40mm (1-5/8") less door width single door and 25mm (1") less door width double doors)

**.10 Floor/Wall Stops:**

**Floor Stops:**

Floor stops to be heavy-duty cast dome stop constructed of brass/bronze with grey, non-marring rubber bumper.

Supply as Specified: Ives FS439

**Wall Stops (No Button on Locking Hardware):**

Wall stops to be constructed of stainless-steel base with special retainer cup that makes the rubber stop tamper resistant. Convex design of rubber bumper.

Supply as Specified: Ives WS406/407CVX

**Wall Stops (Projecting Button on Locking Hardware):**

Wall stops to be constructed of stainless-steel base with special retainer cup that makes the rubber stop tamper resistant. Concave rubber bumper to avoid damage to locks with projecting buttons.

Supply as Specified: Ives WS406/407CCV

**.11 Weather/Smoke/Sound Seals:**

Supply as Specified: Zero 429AA (head seal)

Note: Mount head seal prior to soffit mounted hardware.

Zero 328AA-S (jamb seal, head/jamb seal)

Zero 188SBK (head/jamb seal)

Zero 364AA (door bottom)

**.12 Thresholds/Weatherstrip/Door Sweeps:**

Supply as Specified: Zero 8192AA (Door Sweep)  
Zero 626A-223(Threshold)

Note: Threshold depth to suit site conditions (wall/frame/partition depth, overlap of floor finishes, floor grilles, etc.) Specified threshold indicated as basis for design purposes.

**.13 Keyswitch/Electric Strikes/Magnetic Locks/Power Supplies, Power Transfers, Mortar Guards. Schlage ENGAGE™:**

**Keyswitch:**

Keyswitch housing to be cast zinc to protect against vandalism, housing to provide a concealed rear mounting attachment which cannot be compromised when the cylinder is attached with a set screw. Standard stainless-steel cover plate.

Supply as Specified: Schlage Electronics 650 series

**Electric Strikes:**

Grade 1, electric strikes to be cUL listed burglary-resistant and electric strike for fire doors and frames. A label for single doors and B label for double doors. Electric strikes to be stainless steel construction, non-handed available in 12V or 24V AC or DC with continuous duty solenoid and accept 19mm (3/4") throw latchbolts. Strike box to be adjustable to compensate for any misalignment of the door or frame with two-piece plug connector for ease of installation.

Supply as Specified: Von Duprin 6000 series

**Magnetic Locks:**

Electromagnetic locks to be non-handed, field selectable dual voltage 12/24VDC with a holding force that meets or exceeds 1500lbs and certified to UL1034 and UL10C. Electromagnetic locks to be powered by filtered and regulated power supply. Electromagnetic locks to be furnished with magnetic bond sensor, door position switch and relock time delay standard. Operating temperature range from 0 to 49-degree Celsius. Provide filler bars and angles to mount maglocks as per frame details.

Supply as Specified: Schlage Electronics M490P

**Power Supplies:**

Power supplies to be tested and certified to meet UL294. Universal 120-240 VAC input, low voltage DC output, regulated and filtered. Power supplies to have 2A, 4A, 6A output, 12/24VDC field selectable with jumper. Provide emergency release terminals, where required, that allow the release of devices upon activation of the fire alarm system complete with fire alarm input for initiating "no delay" exiting mode. Power supply to be flat mounting design and polarized locking connections for additional option boards specified.

Supply as Specified: Schlage Electronics PS-902, PS-904, PS-906

**Electro-Magnetic Door Holders:**

Provide floor and wall mounted units to hold door in open position and to release and automatically close under fire alarm conditions. Electromagnet shall be protected against transients and voltage surges up to 600 volts. Power requirements, tri-voltage field selectable, 12, 24VDC, 120VAC.

Supply as Specified: LCN-SEM 7800 series

**Power Transfer**

Provide a means to transfer power from frame to door stile. Devices shall be reversible and allow a full 180° door swing with 114mm x 114mm (4 1/2" x 4 1/2") butt hinges or 19mm (3/4") offset pivots. When door is in closed position, transfer unit shall be concealed. Transfer units shall contain ten 24awg UL approved conductors. Rating: 10 Amps at 24 VDC (Class 1 low voltage)

Supply as Specified: Von Duprin EPT

**Mortar Guards:**

Provide and supply to hollow metal supplier to weld in place TA 6400 series by Thomas Access Control at frame locations where electrified hardware components are to be mounted. Provide handing of mortar guard boxes to the hollow metal frame supplier. Hollow Metal frame supplier is responsible for ensuring the proper location of required mortar boxes.

**Molex Connectors:**

Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with sufficient number and wire gauge with standardized Molex plug connectors to accommodate electric function of specified hardware. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

**Junction Box:**

Provide high quality NEMA 1, junction box to provide convenient installation for electrified hardware. Units are surface mounted 254mm (10") high, 254mm (10") wide, 152mm (6") deep and includes hinged door with twist turn lock, 20 position terminal strips to accept 24 to 12 gauge wire.

Supply as Specified: Von Duprin JB7

**Electric Washroom Accessories:**

Provide electric washroom accessories to compete the installation of automatic door operators for universal and barrier free washroom requirements

Supply as Specified: Camden - Push to lock, CM-400/8  
Camden – LED annunciator CM-AF500  
Camden – Advanced Logic Relay CX-33  
Camden – Emerg. Call Kit CX-WEC10

## 2.3 FINISHES

- .1 Unless otherwise specified, finishes to be brushed chrome (BHMA 626/652).

Finishes are specified as follows:

ITEM	BHMA#	DESCRIPTION	BASE MATERIAL
Hinges	630	satin stainless steel	stainless steel
Continuous Hinges	689	anodized aluminum	aluminum
Continuous Hinges	630	satin stainless steel	stainless steel
Lock Trim	626	satin chrome plated	brass/bronze
Exit Devices	626	satin chrome plated	brass/bronze
Door Closer	689	powder coat aluminum	steel
Door Pulls	630	satin stainless steel	stainless steel
Protective Plate	630	satin stainless steel	stainless steel
<b>Door Stops/holders</b>			
Overhead	630	satin stainless steel	stainless steel
Wall/Floor	626	satin chrome plated	brass/bronze
Thresholds	628	anodized aluminum	aluminum

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Weatherstrip	628	anodized aluminum	aluminum
<b>Miscellaneous</b>			
Key Switches	630	satin stainless steel	stainless steel
Electric Strikes	630	satin stainless steel	stainless steel
Magnetic Locks	628	anodized aluminum	aluminum

## 2.4 CYLINDERS, KEYING SYSTEMS AND KEY

- .1 Provide temporary construction keying system during construction period. Permanent keys will be furnished to the Owner's Representative prior to occupancy. The Owner or Owner's Security Agent will void the operation of the construction keys.
- .2 Permanent cylinders to be keys to be provided by owner.

**Keying requirements to be confirmed by owner.**

## PART 3 – EXECUTION

### 3.1 EXAMINATION

- .1 Ensure that doors and frames are prepared and reinforced to receive finish hardware prior to installation.
- .2 Ensure that door frames and finished floor are plumb and level to permit proper engagement and operation of hardware.
- .3 Verify power is run to door opening requiring electrified hardware.
- .4 Submit in writing a list of deficiencies determined as part of inspection required in 3.1.1 and 3.1.2 to supervising consultant prior to installation of finished hardware. Correct door frame installation before proceeding with finish hardware installation.

### 3.2 INSTALLATION

- .1 Hardware Installers must have a minimum of five (5) years' experience in installation of hardware.  
Provide verification of installer's qualification to Consultant for approval. Installers to attend review meetings conducted by the hardware distributor.
- .2 Install hardware at mounting heights as specified in the manufacturer's templates or specific references in approved hardware schedule or approved elevation drawings.
- .3 Where mounting height is not otherwise specified, install hardware at mounting heights as indicated in 1.4.1, 1.4.2.
- .4 Install hardware using only manufacturer supplied and approved fasteners in strict adherence with manufacturers published installation instructions.
- .5 Ensure locksets / latchsets / deadlocks are of the correct hand before installation to ensure that the cylinder is in the correct position. **Handing is part of installation procedure.**
- .6 Ensure that exit devices are of the correct hand and adjust device cam/drive screw for proper outside trim function prior to installation. Handing is part of installation procedure.
- .7 Follow manufactures installation instructions. Adjustment of door closers is inclusive of spring power, closing speed, latching speed and back-check, valve screws to achieve

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backcheck (4040, 4040XP series) at the time of installation.

- .8 Adjust delayed action door closers to forty (40) second delay for barrier free accessibility and movement of materials. Time period to be approved by Owner.
- .9 Install head seal weatherstrip prior to installation of soffit mounted hardware. Trim cut and notch thresholds and saddles neatly to minimally fit the profile of the door frame. Install thresholds and saddles in a bed of caulking completely sealing the underside from water and air penetration.
- .10 Counter sink through bolt of door pull under push plate during installation.
- .11 Install blocking material in cavities of metal and wood stud walls and partitions. Located concave and convex type door bumpers at the appropriate height to properly contact protruding door trim.

### **3.3 FIELD QUALITY CONTROL**

- .1 Verify each door leaf opens closes and latches. Inspect fire rated openings to ensure they are installed in compliance with NFPA 80 requirements. Test access control system and electrified hardware devices for proper operation with owner to sign off on verification of operation. Verify electric door release hardware operates to close the door upon activation of the fire alarm system.
- .2 Perform bi-monthly on-site inspections during hardware installation and provide inspection reports listing progress of work, unacceptable work and corrective measures. Repair or replace as directed by the Consultant.
- .3 Before completion of the work but after the hardware has been installed, submit a certificate to the Consultant stating that final inspection has been made and that hardware has been checked for installation and operation.

### **3.4 ADJUSTING AND CLEANING**

- .1 Check and make final adjustments to each operating item of hardware on each door to ensure proper operation and function.
- .2 Adjust doors with self-closing devices or automatic closing devices for operation after the HVAC system is balanced and adjusted. Adjust spring power of non sized door closers to close and latch the door.
- .3 Hardware to be left clean and free of disfigurements.
- .4 Instruct owner personnel in the operation, adjustment and maintenance of hardware.
- .5 Check locked doors against approved keying schedule.

### **3.5 PROTECTION**

- .1 Protect hardware from damage during construction. Wrap locks, panic hardware, and fire exit hardware, door pull trim with kraft paper or plastic bubble materials to protect finish from damage until date of substantial completion. Remove and reinstall or where necessary, use temporary hardware to maintain finish in new condition and maintain manufacturer's warranty.

### **3.6 HARDWARE GROUPS**

END


## Peel Regional Paramedic Services Dockstader PRPS

Hardware Group No. 01

For use on Door #(s):

D001 D002

Provide each SL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	MORTISE CYLINDER	20-062 ICX		626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1		HARDWARE	ALL HARDWARE BY DOOR SUPPLIER			

MODE OF OPERATION

DOOR CLOSED







USING A KEY WILL UNLOCK THE DOOR

Hardware Group No. 02

For use on Door #(s):

D1A-STA D1A-STB D1A-STD D2A-STB D2A-STD D227

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 127X114MM		652	IVE
1	EA	FIRE EXIT HARDWARE	98-L-BE-F-4'-17		626	VON
1	EA	SURFACE CLOSER	4040XP REG		689	LCN
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	SMOKE SEAL	188SBK (1 X W, 2 X H)		BK	ZER

MODE OF OPERATION

DOOR UNLOCKED AT ALL TIMES

FREE EGRESS













# Peel Regional Paramedic Services Docksteader PRPS

Hardware Group No. 03

For use on Door #(s):

D1A-STE      D116A      D131A      D229B      D302A      D302B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 127X114MM NRP		630	IVE
1	EA	POWER TRANSFER	EPT10 CON		⚡ 689	VON
1	EA	ELEC PANIC HARDWARE	LX-RX-QEL-98-NL-4'-CON 24 VDC		⚡ 626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	SURFACE CLOSER	4040XP SCUSH ST-1595 ST-3068		689	LCN
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT B-CS		630	IVE
1	SET	GASKETING (JAMB)	328AA-S X 2 X HT		AA	ZER
1	EA	GASKETING (HEADER)	429AA- INSTALL PRIOR TO ANY HARDWARE		AA	ZER
1	EA	DOOR SWEEP	8192AA X DR WIDTH		AA	ZER
1	EA	THRESHOLD	625A X DR WIDTH		A	ZER
1	EA	WIRE HARNESS	CON-___ TO SUIT		⚡	SCH
1	EA	WIRE HARNESS	CON-6W		⚡	SCH
1	EA	CARD READER	BY DIV. 28		⚡	
1	EA	DOOR CONTACT	679-05 TO SUIT DR MTRL.		⚡ BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS		⚡ LGR	SCE

## MODE OF OPERATION

DOOR SECURE AND LOCKED AT ALL TIMES

PRESENTING CREDENTIAL WILL UNLATCH THE EXIT DEVICE

WHEN EXIT DEVICE IS UNLATCHED PULL THE DOOR TO OPEN

MECHANICAL KEY FROM EXTERIOR WILL UNLOCK THE DOOR

DOOR CONTACTS MONITORS IF DOOR IS OPEN OR CLOSED

FREE EGRESS AT ALL TIMES











## Peel Regional Paramedic Services Docksteader PRPS

Hardware Group No. 04

For use on Door #(s):

D1B-STB      D102A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY		628	IVE
1	EA	PANIC HARDWARE	LD-35A-EO		626	VON
1	EA	OH STOP	100S		630	GLY
1	EA	SURFACE CLOSER	4040XP LONG TOP JAMB		689	LCN
1	EA	FLUSH CEILNG MTG PLT	4040XP-18G		689	LCN
1	EA	PERIMETER SEAL	BY ALUMINUM FRAME MANUFACTURER			
1	EA	THRESHOLD	CT__ x FROST INSERT x CT__ X REQ. WIDTH/DEPTH TO MATCH FRAME PROFILE / SITE CONDITIONS		719	KNC
1	EA	DOOR SWEEP	8192AA X DR WIDTH		AA	ZER
1	EA	THRESHOLD	625A X DR WIDTH		A	ZER
1	EA	DOOR CONTACT	679-05 TO SUIT DR MTRL.	 ⚡	BLK	SCE

MODE OF OPERATION

DOOR CLOSED AND LOCKED AT ALL TIMES

DOOR CONTACT MONITORS IF DOOR IS OPEN OR CLOSED

FREE EGRESS AT ALL TIMES










# Peel Regional Paramedic Services Docksteader PRPS

Hardware Group No. 05

For use on Door #(s):

D1B-STD D118C

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 127X114MM NRP		652	IVE
1	EA	POWER TRANSFER	EPT10 CON		⚡ 689	VON
1	EA	ELEC PANIC HARDWARE	LX-RX-QEL-98-L-NL-4'-17-CON 24 VDC		⚡ 626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	OH STOP	100S		630	GLY
1	EA	SURFACE CLOSER	4040XP EDA ST-3068		689	LCN
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT B-CS		630	IVE
1	EA	WIRE HARNESS	CON-___ TO SUIT		⚡	SCH
1	EA	WIRE HARNESS	CON-6W		⚡	SCH
1	EA	CARD READER	BY DIV. 28		⚡	
1	EA	DOOR CONTACT	679-05 TO SUIT DR MTRL.		⚡ BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS		⚡ LGR	SCE

MODE OF OPERATION

DOOR SECURE AND LOCKED AT ALL TIMES

PRESENTING CREDENTIAL WILL UNLATCH THE EXIT DEVICE

WHEN EXIT DEVICE IS UNLATCHED PULL THE DOOR TO OPEN

MECHANICAL KEY FROM EXTERIOR WILL UNLOCK THE DOOR

DOOR CONTACTS MONITORS IF DOOR IS OPEN OR CLOSED

FREE EGRESS AT ALL TIMES














# Peel Regional Paramedic Services Docksteader PRPS

Hardware Group No. 06

For use on Door #(s):

D1C-STD

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 127X114MM NRP		630	IVE
1	EA	POWER TRANSFER	EPT10 CON		⚡ 689	VON
1	EA	ELEC PANIC HARDWARE	LX-RX-QEL-98-NL-4'-CON 24 VDC		⚡ 626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	OH STOP	100S		630	GLY
1	EA	SURFACE CLOSER	4040XP EDA ST-3068		689	LCN
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT B-CS		630	IVE
1	SET	GASKETING (JAMB)	328AA-S X 2 X HT		AA	ZER
1	EA	GASKETING (HEADER)	429AA- INSTALL PRIOR TO ANY HARDWARE		AA	ZER
1	EA	DOOR SWEEP	8192AA X DR WIDTH		AA	ZER
1	EA	THRESHOLD	625A X DR WIDTH		A	ZER
1	EA	WIRE HARNESS	CON-___ TO SUIT		⚡	SCH
1	EA	WIRE HARNESS	CON-6W		⚡	SCH
1	EA	CARD READER	BY DIV. 28		⚡	
1	EA	DOOR CONTACT	679-05 TO SUIT DR MTRL.		⚡ BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC		⚡ LGR	SCE

## MODE OF OPERATION

DOOR SECURE AND LOCKED AT ALL TIMES

PRESENTING CREDENTIAL WILL UNLATCH THE EXIT DEVICE

WHEN EXIT DEVICE IS UNLATCHED PULL THE DOOR TO OPEN

MECHANICAL KEY FROM EXTERIOR WILL UNLOCK THE DOOR

DOOR CONTACTS MONITORS IF DOOR IS OPEN OR CLOSED

FREE EGRESS AT ALL TIMES











## Peel Regional Paramedic Services Dockstader PRPS

Hardware Group No. 07

For use on Door #(s):

D2A-STE

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 127X114MM NRP		652	IVE
1	EA	POWER TRANSFER	EPT10 CON		✂ 689	VON
1	EA	ELEC FIRE EXIT HARDWARE	LX-RX-QEL-98-L-NL-F-4'-17-CON 24 VDC		✂ 626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	SURFACE CLOSER	4040XP REG		689	LCN
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	SMOKE SEAL	188SBK (1 X W, 2 X H)		BK	ZER
1	EA	WIRE HARNESS	CON-___ TO SUIT		✂	SCH
1	EA	WIRE HARNESS	CON-6W		✂	SCH
1	EA	CARD READER	BY DIV. 28		✂	
1	EA	DOOR CONTACT	679-05 TO SUIT DR MTRL.		✂ BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS		✂ LGR	SCE

### MODE OF OPERATION

DOOR SECURE AND LOCKED AT ALL TIMES

PRESENTING CREDENTIAL WILL UNLATCH THE EXIT DEVICE

WHEN EXIT DEVICE IS UNLATCHED PULL THE DOOR TO OPEN

MECHANICAL KEY FROM EXTERIOR WILL UNLOCK THE DOOR

DOOR CONTACTS MONITORS IF DOOR IS OPEN OR CLOSED

FREE EGRESS AT ALL TIMES

Hardware Group No. 08

For use on Door #(s):

D003

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1		HARDWARE	ALL HARDWARE BY DOOR SUPPLIER			












# Peel Regional Paramedic Services Docksteader PRPS

Hardware Group No. 09

For use on Door #(s):

D3A-STB

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 127X114MM NRP		652	IVE
1	EA	POWER TRANSFER	EPT10 CON		⚡ 689	VON
1	EA	ELEC FIRE EXIT HARDWARE	LX-RX-QEL-98-L-NL-F-4'-17-CON 24 VDC		⚡ 626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	SURFACE CLOSER	4040XP REG		689	LCN
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	GASKETING	429AA X 1@HD X 2@JMB INSTALL PRIOR TO ANY HARDWARE		AA	ZER
1	EA	DOOR SWEEP	8192AA X DR WIDTH		AA	ZER
1	EA	THRESHOLD	625A X DR WIDTH		A	ZER
1	EA	WIRE HARNESS	CON-___ TO SUIT		⚡	SCH
1	EA	WIRE HARNESS	CON-6W		⚡	SCH
1	EA	CARD READER	BY DIV. 28		⚡	
1	EA	DOOR CONTACT	679-05 TO SUIT DR MTRL.		⚡ BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS		⚡ LGR	SCE

## MODE OF OPERATION

DOOR SECURE AND LOCKED AT ALL TIMES

PRESENTING CREDENTIAL WILL UNLATCH THE EXIT DEVICE

WHEN EXIT DEVICE IS UNLATCHED PULL THE DOOR TO OPEN

MECHANICAL KEY FROM EXTERIOR WILL UNLOCK THE DOOR

DOOR CONTACTS MONITORS IF DOOR IS OPEN OR CLOSED

FREE EGRESS AT ALL TIMES











## Peel Regional Paramedic Services Docksteader PRPS

Hardware Group No. 10

For use on Door #(s):

D3A-STD

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 127X114MM NRP		652	IVE
1	EA	POWER TRANSFER	EPT10 CON		✂ 689	VON
1	EA	ELEC FIRE EXIT HARDWARE	LX-RX-QEL-98-L-NL-F-4'-17-CON 24 VDC		✂ 626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	SURFACE CLOSER	4040XP EDA ST-3068		689	LCN
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	SMOKE SEAL	188SBK (1 X W, 2 X H)		BK	ZER
1	EA	WIRE HARNESS	CON-____ TO SUIT		✂	SCH
1	EA	WIRE HARNESS	CON-6W		✂	SCH
1	EA	CARD READER	BY DIV. 28		✂	
1	EA	DOOR CONTACT	679-05 TO SUIT DR MTRL.		✂ BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS		✂ LGR	SCE

### MODE OF OPERATION

DOOR SECURE AND LOCKED AT ALL TIMES

PRESENTING CREDENTIAL WILL UNLATCH THE EXIT DEVICE

WHEN EXIT DEVICE IS UNLATCHED PULL THE DOOR TO OPEN

MECHANICAL KEY FROM EXTERIOR WILL UNLOCK THE DOOR

DOOR CONTACTS MONITORS IF DOOR IS OPEN OR CLOSED






FREE EGRESS AT ALL TIMES

Hardware Group No. 11

For use on Door #(s):

D3B-STD

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 127X114MM NRP		652	IVE
1	EA	PANIC HARDWARE	98-L-BE-4'-17		626	VON
1	EA	SURFACE CLOSER	4040XP EDA ST-3068		689	LCN
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE

### MODE OF OPERATION

FREE ENTRY/ EGRESS AT ALL TIMES











## Peel Regional Paramedic Services Dockstader PRPS

Hardware Group No. 12

For use on Door #(s):

D101B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 127X114MM NRP		630	IVE
1	EA	PANIC HARDWARE	98-NL-4'		626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	SURFACE CLOSER	4040XP SCUSH ST-1595 ST-3068		689	LCN
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT B-CS		630	IVE
1	SET	GASKETING (JAMB)	328AA-S X 2 X HT		AA	ZER
1	EA	GASKETING (HEADER)	429AA- INSTALL PRIOR TO ANY HARDWARE		AA	ZER
1	EA	DOOR SWEEP	8192AA X DR WIDTH		AA	ZER
1	EA	THRESHOLD	625A X DR WIDTH		A	ZER
1	EA	DOOR CONTACT	679-05 TO SUIT DR MTRL.	 ✎	BLK	SCE

MODE OF OPERATION

DOOR SECURE AND LOCKED AT ALL TIMES

MECHANICAL KEY FROM EXTERIOR WILL UNLOCK THE DOOR

DOOR CAN BE DOGGED TO ACT AS PUSH/ PULL

DOOR CONTACTS MONITORS IF DOOR IS OPEN OR CLOSED

FREE EGRESS AT ALL TIMES

Hardware Group No. 13






For use on Door #(s):

D101C

D116E

D130D

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 127X114MM		652	IVE
1	EA	PANIC HARDWARE	98-L-BE-4'-17		626	VON
1	EA	SURFACE CLOSER	4040XP EDA ST-3068		689	LCN
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE

MODE OF OPERATION

DOOR UNLOCKED AT ALL TIMES

FREE EGRESS


## Peel Regional Paramedic Services Dockstader PRPS

Hardware Group No. 14

For use on Door #(s):

D102B                      D102C

Provide each SL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	MORTISE CYLINDER	20-062 ICX		626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	CARD READER	BY DIV. 28	⚡		
1	EA	MOTION SENSOR	BY DIV 28	⚡		UNK
1		HARDWARE	ALL HARDWARE BY DOOR SUPPLIER			

MODE OF OPERATION

DOOR LOCKED AND SECURE

CARD READER INSTALLED NOT ACTIVATED


SENSOR WILL ALLOW FREE EGRESS TO LEAVE

Hardware Group No. 15

For use on Door #(s):

D102D

Provide each SL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	MORTISE CYLINDER	20-062 ICX		626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
2	EA	CARD READER	BY DIV. 28	⚡		
1		HARDWARE	ALL HARDWARE BY DOOR SUPPLIER			

MODE OF OPERATION

DOOR LOCKED AND SECURE

PRESENTING PROPER CREDENTIAL WILL BEGIN SEQUENCING OF THE DOOR













## Peel Regional Paramedic Services Dockstader PRPS

Hardware Group No. 16

For use on Door #(s):

D102F

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 127X114MM NRP		630	IVE
1	EA	PANIC HARDWARE	LD-98-EO-4'		626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	SURFACE CLOSER	4040XP SCUSH ST-1595 ST-3068		689	LCN
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT B-CS		630	IVE
1	SET	GASKETING (JAMB)	328AA-S X 2 X HT		AA	ZER
1	EA	GASKETING (HEADER)	429AA- INSTALL PRIOR TO ANY HARDWARE		AA	ZER
1	EA	SECURITY ASTRAGAL	NGP 1392P X LENGTH		AA	NGP
1	EA	DOOR SWEEP	8192AA X DR WIDTH		AA	ZER
1	EA	THRESHOLD	625A X DR WIDTH		A	ZER
1	EA	DOOR CONTACT	679-05 TO SUIT DR MTRL.	 ⚡	BLK	SCE

MODE OF OPERATION

EXIT ONLY


FREE EGRESS AT ALL TIMES

Hardware Group No. 17

For use on Door #(s):

D103

Provide each SL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	REQUEST TO LOCK	BY DIV. 28		⚡	UNK
1	EA	MORTISE CYLINDER	20-062 ICX		626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	SAFE HAVEN SYSTEM	BY DIV. 28		⚡	UNK
1		HARDWARE	ALL HARDWARE BY DOOR SUPPLIER			

MODE OF OPERATION

EXTERIOR SENSOR TO ACTIVATE ENTRY DOORS

SENSOR WILL ALLOW FREE EGRESS TO LEAVE

DOOR ON SAFE HAVEN SYSTEM

## Peel Regional Paramedic Services Dockstader PRPS

Hardware Group No. 18

For use on Door #(s):

D104A

Provide each SL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	REQUEST TO EXIT	BY DIV. 28	⚡		UNK
1	EA	MORTISE CYLINDER	20-062 ICX	📄	626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	CARD READER	BY DIV. 28	⚡		
1		HARDWARE	ALL HARDWARE BY DOOR SUPPLIER			

MODE OF OPERATION

DOOR LOCKED AND SECURE

PRESENTING PROPER CREDENTIAL WILL BEGIN SEQUENCING OF THE DOOR

REQUEST TO EXIT BUTTON WILL ALLOW FREE EGRESS TO LEAVE

REMOTE LOCK RELEASE OPERABILITY FROM ADMIN. OFFICES

THIS DOOR TO HAVE HOLD-OPEN BY-PASS FUNCTIONALITY FOR LARGE EVENTS

Hardware Group No. 19

For use on Door #(s):

D104B

Provide each SL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	REQUEST TO EXIT	BY DIV. 28	⚡		UNK
1	EA	MORTISE CYLINDER	20-062 ICX	📄	626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	CARD READER	BY DIV. 28	⚡		
1		HARDWARE	ALL HARDWARE BY DOOR SUPPLIER			

MODE OF OPERATION

DOOR LOCKED AND SECURE

PRESENTING PROPER CREDENTIAL WILL BEGIN SEQUENCING OF THE DOOR

REQUEST TO EXIT BUTTON WILL ALLOW FREE EGRESS TO LEAVE

REMOTE LOCK RELEASE OPERABILITY FROM ADMIN. OFFICES









# Peel Regional Paramedic Services Dockstader PRPS

Hardware Group No. 20

For use on Door #(s):

D107	D121	D127A	D131B	D220	D303
D305	D306	D307			

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 127X114MM		652	IVE
1	EA	POWER TRANSFER	EPT10 CON		⚡ 689	VON
1	EA	EU STOREROOM LOCK	ND80TDEU SPA RX CON 12V/24V DC		⚡ 626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	SURFACE CLOSER	1461 REG		689	LCN
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	SMOKE SEAL	188SBK (1 X W, 2 X H)		BK	ZER
1	EA	WIRE HARNESS	CON-___ TO SUIT		⚡	SCH
1	EA	WIRE HARNESS	CON-6W		⚡	SCH
1	EA	CARD READER	BY DIV. 28		⚡	
1	EA	DOOR CONTACT	679-05 TO SUIT DR MTRL.		⚡ BLK	SCE
1	EA	CENTRALIZED POWER SUPPLY	TO BE CENTRALIZED		⚡	

## MODE OF OPERATION

DOOR SECURE AND LOCKED AT ALL TIMES

PRESENTING CREDENTIAL WILL UNLOCK LEVER

WHEN LEVER IS UNLOCKED TURNING LEVER WILL OPEN THE DOOR

MECHANICAL KEY FROM EXTERIOR WILL UNLOCK THE DOOR

DOOR CONTACTS MONITORS IF DOOR IS OPEN OR CLOSED

FREE EGRESS AT ALL TIMES

# Peel Regional Paramedic Services Docksteader PRPS












Hardware Group No. 21

For use on Door #(s):

D108

D205

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 127X114MM		652	IVE
1	EA	STOREROOM LOCK	ND80TD SPA		626	SCH
1	EA	ADVANCE LOGIC RELAY	CX-33	⚡		CAM
1	EA	INTERFACE BOX	JB7	⚡		VON
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	ELECTRIC STRIKE	6211 FSE CON 12/16/24/28 VAC/VDC	 ⚡	630	VON
1	EA	SURF. AUTO OPERATOR	9131 MS AS REQ (120 VAC)	 ⚡	ANCL R	LCN
2	EA	ACTUATOR, WALL MOUNT	8310-852T	 ⚡	630	LCN
2	EA	ESCUTCHEON	8310-876	 ⚡	689	LCN
1	EA	EMERGENCY CALL KIT	CX-WEC10K2	⚡		CAM
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	LED ANNUNCIATOR	CM-AF500			CAM
1	EA	DOOR CONTACT	679-05 TO SUIT DR MTRL.	 ⚡	BLK	SCE
1	EA	PUSH TO LOCK	CM-AF550R			CAM

## MODE OF OPERATION

DOOR IS NORMALLY CLOSED AND UNLOCKED.

TO ENTER PRESS EXTERIOR ACTUATOR OR PULL LEVER TO OPEN DOOR.

ONCE INSIDE PRESS PUSH TO LOCK BUTTON TO DISABLE EXTERIOR ACTUATOR AND ELECTRIC STRIKE.

WHEN OUTSIDE ACTUATOR IS DISABLED ANNUNCIATOR INDICATES THE "OCCUPIED WHEN LIT".

TO EXIT PRESS INTERIOR ACTUATOR OR ROTATE LEVER AND PUSH TO OPEN DOOR.

IN THE EVENT OF EMERGENCY PRESS EMERGENCY ASSISTANCE BUTTON OR USE MECHANICAL KEY TO PROVIDE ACCESS.

WHEN BUTTON IS PRESSED AN AUDIBLE ALARM WILL SOUND AND ANNUNCIATOR INDICATES "ASSISTANCE REQUESTED" AND ELECTRIC STRIKE RELEASES TO ALLOW ENTRY.

IN THE EVENT OF FIRE ALARM OR LOSS OF POWER DOOR REMAINS LOCKED.

FREE EGRESS AT ALL TIMES.





## Peel Regional Paramedic Services Docksteader PRPS

Hardware Group No. 22

For use on Door #(s):

D109	D122	D123	D204	D208	D209
D216	D231	D232	D233	D236	D237
D238					

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 114X102MM		630	IVE
1	EA	HOSPITAL PRIVACY W/ OUTSIDE INDICATOR	ND44S SPA OS-OCC		626	SCH
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE

MODE OF OPERATION

DOOR UNLOCKED

PUSH BUTTON WILL LOCK THE DOOR







INDICATOR USED FOR OCCUPIED / VACANT SIGNAGE

Hardware Group No. 23

For use on Door #(s):

D110

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGES	BY PC350			UNK
1	EA	ELECTRIC STRIKE	4500C X 4501-1 (1" LIP EXTENSION) (BY SECURITY)		630	HES
1	EA	CLASSROOM LOCK	ND70TD SPA		626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	SURF. AUTO OPERATOR	4631 WMS 120 VAC		⚡ 689	LCN
2	EA	ACTUATOR, WALL MOUNT	8310-852T		⚡ 630	LCN
2	EA	ESCUTCHEON	8310-876		⚡ 689	LCN
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	WIRE HARNESS	CON-6W	⚡		SCH

NOTE: EXTENDED LIP STRIKE FOR PC350 FRAME

NOTE: ADO WILL NEED TO BE TURNED OFF TO LOCK THE DOOR

MODE OF OPERATION

DOOR CLOSED AT ALL TIMES

PRESSING ACTUATOR FROM EITHER SIDE I WILL BEGIN SEQUENCING OF AUTOMATIC OPERATOR

MECHANICAL KEY FROM EXTERIOR WILL UNLOCK THE DOOR

TO LOCK THE DOOR TURN OFF AUTOMATIC OPERATOR AND LOCK THE DOOR

FREE EGRESS AT ALL TIMES




## Peel Regional Paramedic Services Dockstader PRPS

Hardware Group No. 24

For use on Door #(s):

D111

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGES	BY PC350			UNK
1	EA	CLASSROOM LOCK	ND70TD SPA		626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE

NOTE: EXTENDED LIP STRIKE FOR PC350 FRAME

MODE OF OPERATION

DOOR CAN BE LEFT LOCKED OR UNLOCKED

FREE EGRESS AT TIMES










# Peel Regional Paramedic Services Dockstader PRPS

Hardware Group No. 25

For use on Door #(s):

D112A                      D211                      D212

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGES	BY PC350			UNK
1	EA	ELECTRIC STRIKE	4500C X 4501-1 (1" LIP EXTENSION) (BY SECURITY)		630	HES
1	EA	STOREROOM LOCK	ND80TD SPA		626	SCH
1	EA	ADVANCE LOGIC RELAY	CX-33	⚡		CAM
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	OH STOP	100S ADJ		630	GLY
1	EA	SURF. AUTO OPERATOR	4631 WMS 120 VAC	 ⚡	689	LCN
2	EA	ACTUATOR, WALL MOUNT	8310-852T	 ⚡	630	LCN
2	EA	ESCUTCHEON	8310-876	 ⚡	689	LCN
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT B-CS		630	IVE
1	EA	WIRE HARNESS	CON-6W	⚡		SCH
1	EA	CARD READER	BY DIV. 28	⚡		
1	EA	DOOR CONTACT	679-05 TO SUIT DR MTRL.	 ⚡	BLK	SCE
1	EA	MOTION SENSOR (REQUEST TO EXIT)	SCANII 12/24 VDC	 ⚡	BLK	SCE

NOTE: EXTENDED LIP STRIKE FOR PC350 FRAME

MODE OF OPERATION

DOOR SECURE AND LOCKED AT ALL TIMES

PRESENTING CREDENTIAL WILL UNLATCH THE ELECTRIC STRIKE

WHEN ELECTRIC STRIKE IS UNLATCHED PRESSING ACTUATOR WILL BEGIN SEQUENCING OF  
THE AUTOMATIC OPERATOR

WHEN ELECTRIC STRIKE IS UNLATCHED DOOR CAN BE PULLED OPEN

PRESSING ACTUATOR FROM INSIDE OF DOOR WILL BEGIN SEQUENCING OF AUTOMATIC  
OPERATOR

MECHANICAL KEY FROM EXTERIOR WILL UNLOCK THE DOOR

DOOR CONTACTS MONITORS IF DOOR IS OPEN OR CLOSED

FREE EGRESS AT ALL TIMES










# Peel Regional Paramedic Services Dockstader PRPS

Hardware Group No. 26

For use on Door #(s):

D112B                      D210A                      D213

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGES	BY PC350			UNK
1	EA	ELECTRIC STRIKE	4500C X 4501-1 (1" LIP EXTENSION) (BY SECURITY)		630	HES
1	EA	STOREROOM LOCK	ND80TD SPA		626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	SURF. AUTO OPERATOR	4631 WMS 120 VAC	 ⚡	689	LCN
2	EA	ACTUATOR, WALL MOUNT	8310-852T	 ⚡	630	LCN
2	EA	ESCUTCHEON	8310-876	 ⚡	689	LCN
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	WIRE HARNESS	CON-6W	⚡		SCH
1	EA	CARD READER	BY DIV. 28	⚡		
1	EA	DOOR CONTACT	679-05 TO SUIT DR MTRL.	 ⚡	BLK	SCE
1	EA	MOTION SENSOR (REQUEST TO EXIT)	SCANII 12/24 VDC	 ⚡	BLK	SCE

NOTE: EXTENDED LIP STRIKE FOR PC350 FRAME

MODE OF OPERATION DOOR

SECURE AND LOCKED AT ALL TIMES

PRESENTING CREDENTIAL WILL UNLATCH THE ELECTRIC STRIKE

WHEN ELECTRIC STRIKE IS UNLATCHED PRESSING ACTUATOR WILL BEGIN SEQUENCING OF THE AUTOMATIC OPERATOR

WHEN ELECTRIC STRIKE IS UNLATCHED DOOR CAN BE PULLED OPEN

PRESSING ACTUATOR FROM INSIDE OF DOOR WILL BEGIN SEQUENCING OF AUTOMATIC OPERATOR

MECHANICAL KEY FROM EXTERIOR WILL UNLOCK THE DOOR

DOOR CONTACTS MONITORS IF DOOR IS OPEN OR CLOSED

FREE EGRESS AT ALL TIMES







## Peel Regional Paramedic Services Dockstader PRPS

Hardware Group No. 27

For use on Door #(s):

D114A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGES	BY PC350			UNK
1	EA	CLASSROOM LOCK	ND70TD SPA		626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	SURFACE CLOSER	4040XP REG		689	LCN
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE

NOTE: EXTENDED LIP STRIKE FOR PC350 FRAME

MODE OF OPERATION

DOOR CAN BE LEFT LOCKED OR UNLOCKED

FREE EGREES AT TIMES














# Peel Regional Paramedic Services Docksteader PRPS

Hardware Group No. 28

For use on Door #(s):

D114B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY		628	IVE
1	EA	DEADLATCH	TL4510	 ⚡	628	TAH
1	EA	LEVER	TH4560		628	TAH
1	EA	MORTISE CYLINDER	20-062 ICX		626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	ELECTRIC STRIKE	6211AL FSE CON	 ⚡	630	VON
1	EA	45 DEGREE OFFSET PULL	8145EZHD O		630	IVE
1	EA	OH STOP	100S ADJ		630	GLY
1	EA	SURF. AUTO OPERATOR	9542 MS (ARM PER REVEAL) (120/240 VAC)	 ⚡	ANCL R	LCN
1	EA	KEYSWITCH	8310-806K	 ⚡		LCN
2	EA	36" LONG ACTUATOR	8310-836T	 ⚡	630	LCN
1	EA	PERIMETER SEAL	BY ALUMINUM FRAME MANUFACTURER			
1	EA	ASTRAGAL	BY ALUMINUM DOOR SUPPLIER			
1	EA	THRESHOLD	CT__ x FROST INSERT x CT__ X REQ. WIDTH/DEPTH TO MATCH FRAME PROFILE / SITE CONDITIONS		719	KNC
1	EA	DOOR SWEEP	8192AA X DR WIDTH		AA	ZER
1	EA	WIRE HARNESS	CON-6W	⚡		SCH
1	EA	CARD READER	BY DIV. 28	⚡		
1	EA	DOOR CONTACT	679-05 TO SUIT DR MTRL.	 ⚡	BLK	SCE
1	EA	MOTION SENSOR (REQUEST TO EXIT)	SCANII 12/24 VDC	 ⚡	BLK	SCE
1	EA	CENTRALIZED POWER SUPPLY	TO BE CENTRALIZED	⚡		

## MODE OF OPERATION

DOOR SECURE AND LOCKED AT ALL TIMES

PRESENTING CREDENTIAL WILL UNLATCH THE ELECTRIC STRIKE

WHEN ELECTRIC STRIKE IS UNLATCHED PRESSING ACTUATOR WILL BEGIN SEQUENCING OF THE AUTOMATIC OPERATOR

WHEN ELECTRIC STRIKE IS UNLATCHED DOOR CAN BE PULLED OPEN

PRESSING ACTUATOR FROM INSIDE OF DOOR WILL BEGIN SEQUENCING OF AUTOMATIC OPERATOR

MECHANICAL KEY FROM EXTERIOR WILL UNLOCK THE DOOR

DOOR CONTACTS MONITORS IF DOOR IS OPEN OR CLOSED

FREE EGRESS AT ALL TIMES
















# Peel Regional Paramedic Services Docksteader PRPS

Hardware Group No. 29

For use on Door #(s):

D118A

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112XY EPT		628	IVE
1	EA	ELEC PANIC HARDWARE	LX-RX-QEL-3549A-EO-4'-CON 24 VDC	 ⚡	626	VON
1	EA	ELEC PANIC HARDWARE	LX-RX-QEL-3549A-NL-OP-4'- 388-CON 24 VDC	 ⚡	626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
2	EA	45 DEGREE OFFSET PULL	8145EZHD 305MM O		630	IVE
1	EA	OH STOP	100S		630	GLY
1	EA	OH STOP	100S ADJ		630	GLY
1	EA	SURFACE CLOSER	4040XP LONG TOP JAMB		689	LCN
1	EA	SURF. AUTO OPERATOR	9542 MS (ARM PER REVEAL) (120/240 VAC)	 ⚡	ANCL R	LCN
1	EA	FLUSH CEILING MTG PLT	4040XP-18G		689	LCN
1	EA	KEYSWITCH	8310-806K	 ⚡		LCN
2	EA	36" LONG ACTUATOR	8310-836T	 ⚡	630	LCN
1	EA	PERIMETER SEAL	BY ALUMINUM FRAME MANUFACTURER			
1	EA	THRESHOLD	CT__ x FROST INSERT x CT__ X REQ. WIDTH/DEPTH TO MATCH FRAME PROFILE / SITE CONDITIONS		719	KNC
2	EA	DOOR SWEEP	8192AA X DR WIDTH		AA	ZER
2	EA	WIRE HARNESS	CON-___ TO SUIT	⚡		SCH
2	EA	WIRE HARNESS	CON-6W	⚡		SCH
1	EA	CARD READER	BY DIV. 28	⚡		
2	EA	DOOR CONTACT	679-05 TO SUIT DR MTRL.	 ⚡	BLK	SCE
1	EA	POWER SUPPLY	PS904 900-4RL 120/240 VAC	 ⚡	LGR	SCE

## MODE OF OPERATION

DOOR SECURE AND LOCKED AT ALL TIMES

PRESENTING CREDENTIAL WILL UNLATCH THE EXIT DEVICE

WHEN PROPER CREDENTIAL HAS BEEN PRESENTED PRESSING EXTERIOR ACTUATOR WILL  
BEGIN SEQUENCING OF THE AUTO OPERATOR

PRESSING INTERIOR ACTUATOR WILL BEGIN SEQUENCING OF THE AUTO OPERATOR

WHEN EXIT DEVICE IS UNLATCHED PULL THE DOOR TO OPEN

MECHANICAL KEY FROM EXTERIOR WILL UNLOCK THE DOOR

DOOR CONTACTS MONITORS IF DOOR IS OPEN OR CLOSED

FREE EGRESS AT ALL TIMES














# Peel Regional Paramedic Services Docksteader PRPS

Hardware Group No. 30

For use on Door #(s):

D118B

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112XY EPT		628	IVE
1	EA	ELEC PANIC HARDWARE	LX-RX-QEL-3549A-EO-4'-CON 24 VDC	 ⚡	626	VON
1	EA	ELEC PANIC HARDWARE	LX-RX-QEL-3549A-NL-OP-4'- 388-CON 24 VDC	 ⚡	626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
2	EA	45 DEGREE OFFSET PULL	8145EZHD 305MM O		630	IVE
1	EA	OH STOP	100S		630	GLY
1	EA	OH STOP	100S ADJ		630	GLY
1	EA	SURFACE CLOSER	4040XP LONG TOP JAMB		689	LCN
1	EA	SURF. AUTO OPERATOR	9542 MS (ARM PER REVEAL) (120/240 VAC)	 ⚡	ANCL R	LCN
1	EA	FLUSH CEILNG MTG PLT	4040XP-18G		689	LCN
1	EA	KEYSWITCH	8310-806K	 ⚡		LCN
2	EA	36" LONG ACTUATOR	8310-836T	 ⚡	630	LCN
2	EA	WIRE HARNESS	CON-___ TO SUIT		⚡	SCH
2	EA	WIRE HARNESS	CON-6W		⚡	SCH
1	EA	CARD READER	BY DIV. 28		⚡	
1	EA	POWER SUPPLY	PS904 900-4RL 120/240 VAC	 ⚡	LGR	SCE

NOTE- CARD READER TO BE ACTIVATED AT THE LATER DATE.

## MODE OF OPERATION

DOOR SECURE AND LOCKED AT ALL TIMES

PRESENTING CREDENTIAL WILL UNLATCH THE EXIT DEVICE

WHEN PROPER CREDENTIAL HAS BEEN PRESENTED PRESSING EXTERIOR ACTUTOR WILL  
BEGIN SEQUENCING OF THE AUTO OPERATOR

PRESSING INTERIOR ACTUATOR WILL BEGIN SEQUENCING OF THE AUTO OPERATOR

WHEN EXIT DEVICE IS UNLATCHED PULL THE DOOR TO OPEN

MECHANICAL KEY FROM EXTERIOR WILL UNLOCK THE DOOR

DOOR CONTACTS MONITORS IF DOOR IS OPEN OR CLOSED

FREE EGRESS AT ALL TIMES








# Peel Regional Paramedic Services Dockstader PRPS

Hardware Group No. 31

For use on Door #(s):

D119A                      D119B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 127X114MM		652	IVE
1	EA	POWER TRANSFER	EPT10 CON		⚡ 689	VON
1	EA	EU STOREROOM LOCK	ND80TDEU SPA RX CON		⚡ 626	SCH
			12V/24V DC			
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	OH STOP	90S		630	GLY
1	EA	SURFACE CLOSER	4040XP REG		689	LCN
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT		630	IVE
			B-CS			
1	EA	WIRE HARNESS	CON-___ TO SUIT		⚡	SCH
1	EA	WIRE HARNESS	CON-6W		⚡	SCH
1	EA	CARD READER	BY DIV. 28		⚡	
1	EA	DOOR CONTACT	679-05 TO SUIT DR MTRL.		⚡ BLK	SCE
1	EA	CENTRALIZED POWER	TO BE CENTRALIZED		⚡	
		SUPPLY				

NOTE- CARD READER TO BE ACTIVATED ON DOOR D119A AT THE LATER DATE.

MODE OF OPERATION

DOOR SECURE AND LOCKED AT ALL TIMES

PRESENTING CREDENTIAL WILL UNLOCK LEVER

WHEN LEVER IS UNLOCKED TURNING LEVER WILL OPEN THE DOOR

MECHANICAL KEY FROM EXTERIOR WILL UNLOCK THE DOOR

DOOR CONTACTS MONITORS IF DOOR IS OPEN OR CLOSED

FREE EGRESS AT ALL TIMES

# Peel Regional Paramedic Services Docksteader PRPS

Hardware Group No. 32

For use on Door #(s):

D125A                      D126A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 127X114MM		630	IVE
1	EA	POWER TRANSFER	EPT10 CON		⚡ 689	VON
1	EA	EU STOREROOM LOCK	ND80TDEU SPA RX CON		⚡ 626	SCH
		12V/24V DC				
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	OH STOP	100S		630	GLY
1	EA	SURFACE CLOSER	4040XP REG ST-1630		689	LCN
1	EA	DROP PLATE	4040-18TJ		689	LCN
1	EA	EMERGENCY CALL KIT	CX-WEC10K2		⚡	CAM
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT		630	IVE
		B-CS				
1	SET	GASKETING	870AA-S (1 X W, 2 X H)		AA	ZER
1	EA	DOOR BOTTOM	365AA (1 X W)		AA	ZER
2	EA	LED ANNUNCIATOR	CM-AF500			CAM
1	EA	WIRE HARNESS	CON-___ TO SUIT		⚡	SCH
1	EA	WIRE HARNESS	CON-6W		⚡	SCH
1	EA	CARD READER	BY DIV. 28		⚡	
1	EA	DOOR POSITION SWITCH	1076D DPDT		⚡ GRY	INT
1	EA	CENTRALIZED POWER	TO BE CENTRALIZED		⚡	
		SUPPLY				
1	EA	MULTI-FUNCTION RELAY	CX-EMF-2		⚡	CAM

## MODE OF OPERATION

DOOR SECURE AND LOCKED AT ALL TIMES

PRESENTING CREDENTIAL WILL UNLOCK LEVER

WHEN LEVER IS UNLOCKED TURNING LEVER WILL OPEN THE DOOR

MECHANICAL KEY FROM EXTERIOR WILL UNLOCK THE DOOR

DOOR CONTACTS MONITORS IF DOOR IS OPEN OR CLOSED

FREE EGRESS AT ALL TIMES










# Peel Regional Paramedic Services Docksteader PRPS

Hardware Group No. 33

For use on Door #(s):

D125B                      D126B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 127X114MM		630	IVE
1	EA	POWER TRANSFER	EPT10 CON		⚡ 689	VON
1	EA	EU STOREROOM LOCK	ND80TDEU SPA RX CON		⚡ 626	SCH
			12V/24V DC			
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	OH STOP	100S		630	GLY
1	EA	SURFACE CLOSER	4040XP REG ST-1630		689	LCN
1	EA	DROP PLATE	4040-18TJ		689	LCN
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT		630	IVE
			B-CS			
1	SET	GASKETING	870AA-S (1 X W, 2 X H)		AA	ZER
1	EA	DOOR BOTTOM	365AA (1 X W)		AA	ZER
1	EA	WIRE HARNESS	CON-___ TO SUIT		⚡	SCH
1	EA	WIRE HARNESS	CON-6W		⚡	SCH
1	EA	CARD READER	BY DIV. 28		⚡	
1	EA	DOOR POSITION SWITCH	1076D DPDT		⚡ GRY	INT
1	EA	CENTRALIZED POWER	TO BE CENTRALIZED		⚡	
		SUPPLY				

## MODE OF OPERATION

DOOR SECURE AND LOCKED AT ALL TIMES

PRESENTING CREDENTIAL WILL UNLOCK LEVER

WHEN LEVER IS UNLOCKED TURNING LEVER WILL OPEN THE DOOR

MECHANICAL KEY FROM EXTERIOR WILL UNLOCK THE DOOR

DOOR CONTACTS MONITORS IF DOOR IS OPEN OR CLOSED

FREE EGRESS AT ALL TIMES













# Peel Regional Paramedic Services Docksteader PRPS

Hardware Group No. 34

For use on Door #(s):

D130A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 127X114MM NRP		630	IVE
1	EA	POWER TRANSFER	EPT10 CON		⚡ 689	VON
1	EA	ELEC PANIC HARDWARE	LX-RX-QEL-98-NL-4'-CON 24 VDC		⚡ 626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	SURFACE CLOSER	4040XP SCUSH ST-1595 ST-3068		689	LCN
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT B-CS		630	IVE
1	SET	GASKETING (JAMB)	328AA-S X 2 X HT		AA	ZER
1	EA	GASKETING (HEADER)	429AA- INSTALL PRIOR TO ANY HARDWARE		AA	ZER
1	EA	DOOR SWEEP	8192AA X DR WIDTH		AA	ZER
1	EA	THRESHOLD	625A X DR WIDTH		A	ZER
1	EA	WIRE HARNESS	CON-___ TO SUIT		⚡	SCH
1	EA	WIRE HARNESS	CON-6W		⚡	SCH
1	EA	CARD READER	BY DIV. 28		⚡	
1	EA	DOORBELL	BY OTHERS		⚡	UNK
1	EA	DOOR CONTACT	679-05 TO SUIT DR MTRL.		⚡ BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS		⚡ LGR	SCE

## MODE OF OPERATION

DOOR SECURE AND LOCKED AT ALL TIMES

PRESENTING CREDENTIAL WILL UNLATCH THE EXIT DEVICE

WHEN EXIT DEVICE IS UNLATCHED PULL THE DOOR TO OPEN

MECHANICAL KEY FROM EXTERIOR WILL UNLOCK THE DOOR

DOOR CONTACTS MONITORS IF DOOR IS OPEN OR CLOSED

FREE EGRESS AT ALL TIMES

DOORBELL CONNECTED TO CCTV





## Peel Regional Paramedic Services Docksteader PRPS

Hardware Group No. 35

For use on Door #(s):

D133

Provide each SL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	MORTISE CYLINDER	20-062 ICX		626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	CARD READER	BY DIV. 28	⚡		
1	EA	MOTION SENSOR (REQUEST TO EXIT)	SCANII 12/24 VDC		⚡ BLK	SCE
1	EA	MOTION SENSOR	BY DIV 28	⚡		UNK
1		HARDWARE	ALL HARDWARE BY DOOR SUPPLIER			

MODE OF OPERATION

DOOR LOCKED AND SECURE

PRESENTING PROPER CREDENTIAL WILL BEGIN SEQUENCING OF THE DOOR


SENSOR WILL ALLOW FREE EGRESS TO LEAVE

Hardware Group No. 36

For use on Door #(s):

D135

Provide each SL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	REQUEST TO EXIT	BY DIV. 28	⚡		UNK
1	EA	MORTISE CYLINDER	20-062 ICX		626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	BOLLARD	BY OTHERS			UNK
1	EA	CARD READER	BY DIV. 28	⚡		
1		HARDWARE	ALL HARDWARE BY DOOR SUPPLIER			

MODE OF OPERATION

DOOR LOCKED AND SECURE

PRESENTING PROPER CREDENTIAL WILL BEGIN SEQUENCING OF THE DOOR

REQUEST TO EXIT BUTTON ALLOWS ACCESS TO LEAVE (NO MOTION SENSOR ON THIS DOOR)













# Peel Regional Paramedic Services Dockstader PRPS

Hardware Group No. 37

For use on Door #(s):

D138

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 127X114MM NRP		630	IVE
1	EA	POWER TRANSFER	EPT10 CON		⚡ 689	VON
1	EA	ELEC FIRE EXIT HARDWARE	LX-RX-QEL-98-NL-F-4'-CON 24 VDC		⚡ 626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	SURFACE CLOSER	4040XP SCUSH ST-1595 ST- 3068		689	LCN
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT B-CS		630	IVE
1	SET	GASKETING (JAMB)	328AA-S X 2 X HT		AA	ZER
1	EA	GASKETING (HEADER)	429AA- INSTALL PRIOR TO ANY HARDWARE		AA	ZER
1	EA	DOOR SWEEP	8192AA X DR WIDTH		AA	ZER
1	EA	THRESHOLD	625A X DR WIDTH		A	ZER
1	EA	WIRE HARNESS	CON-___ TO SUIT		⚡	SCH
1	EA	WIRE HARNESS	CON-6W		⚡	SCH
1	EA	CARD READER	BY DIV. 28		⚡	
1	EA	DOOR CONTACT	679-05 TO SUIT DR MTRL.		⚡ BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS		⚡ LGR	SCE

## MODE OF OPERATION

DOOR SECURE AND LOCKED AT ALL TIMES

PRESENTING CREDENTIAL WILL UNLATCH THE EXIT DEVICE

WHEN EXIT DEVICE IS UNLATCHED PULL THE DOOR TO OPEN

MECHANICAL KEY FROM EXTERIOR WILL UNLOCK THE DOOR

DOOR CONTACTS MONITORS IF DOOR IS OPEN OR CLOSED

FREE EGRESS AT ALL TIMES

## Peel Regional Paramedic Services Dockstader PRPS

Hardware Group No. 38

For use on Door #(s):

D202B

Provide each SL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	REQUEST TO EXIT	BY DIV. 28	⚡		UNK
1	EA	MORTISE CYLINDER	20-062 ICX	📄	626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	CARD READER	BY DIV. 28	⚡		
1		HARDWARE	ALL HARDWARE BY DOOR SUPPLIER			

MODE OF OPERATION

DOOR LOCKED AND SECURE

CARD READER FROM TRAINING AREA

REQUEST TO EXIT FROM ADMIN AREA TO EAST

Hardware Group No. 39

For use on Door #(s):

D202C

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112XY	📄	628	IVE
1	EA	FIRE EXIT HARDWARE	3549A-L-F-4'-17-LBL	📄	626	VON
1	EA	FIRE EXIT HARDWARE	3549A-L-F-4'-17-LBLAFL	📄	626	VON
2	EA	RIM CYLINDER	20-057 ICX	📄	626	SCH
2	EA	PERMANENT CORE	BY OWNER			UNK
2	EA	OH STOP	100S	📄	630	GLY
2	EA	SURFACE CLOSER	4040XP LONG TOP JAMB	📄	689	LCN
2	EA	FLUSH CEILNG MTG PLT	4040XP-18G	📄	689	LCN
1	EA	PERIMETER SEAL	BY ALUMINUM FRAME MANUFACTURER			
1	EA	ASTRAGAL	BY ALUMINUM DOOR SUPPLIER			

NOTE- GC TO CONFIRM THE COMPATIBILITY OF THE PRODUCT BEFORE ORDERING.

MODE OF OPERATION

DOOR CAN BE LEFT LOCKED OR UNLOCKED

FREE EGRESS AT ALL TIMES








## Peel Regional Paramedic Services Dockstader PRPS

Hardware Group No. 40

For use on Door #(s):

D206                      D207A                      D304

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 127X114MM		652	IVE
1	EA	POWER TRANSFER	EPT10 CON		⚡ 689	VON
1	EA	EU STOREROOM LOCK	ND80TDEU SPA RX CON		⚡ 626	SCH
			12V/24V DC			
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	SURFACE CLOSER	1461 REG		689	LCN
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT		630	IVE
			B-CS			
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	WIRE HARNESS	CON-___ TO SUIT		⚡	SCH
1	EA	WIRE HARNESS	CON-6W		⚡	SCH
1	EA	CARD READER	BY DIV. 28		⚡	
1	EA	DOOR CONTACT	679-05 TO SUIT DR MTRL.		⚡ BLK	SCE
1	EA	CENTRALIZED POWER	TO BE CENTRALIZED		⚡	
		SUPPLY				

### MODE OF OPERATION

DOOR SECURE AND LOCKED AT ALL TIMES

PRESENTING CREDENTIAL WILL UNLOCK LEVER

WHEN LEVER IS UNLOCKED TURNING LEVER WILL OPEN THE DOOR

MECHANICAL KEY FROM EXTERIOR WILL UNLOCK THE DOOR

DOOR CONTACTS MONITORS IF DOOR IS OPEN OR CLOSED





FREE EGRESS AT ALL TIMES

Hardware Group No. 41

For use on Door #(s):

D207B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 127X114MM NRP		652	IVE
1	EA	STOREROOM LOCK	ND80TD SPA		626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	SURFACE CLOSER	1461 DEL CUSH STD		689	LCN
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT		630	IVE
			B-CS			

### MODE OF OPERATION

DOOR LOCKED AT ALL TIMES

FREE EGRESS AT ALL TIMES









## Peel Regional Paramedic Services Dockstader PRPS

Hardware Group No. 42

For use on Door #(s):

D210B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGES	BY PC350			UNK
1	EA	ELECTRIC STRIKE	4500C X 4501-1 (1" LIP EXTENSION) (BY SECURITY)		630	HES
1	EA	STOREROOM LOCK	ND80TD SPA 14-042		626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	OH STOP	100S		630	GLY
1	EA	SURFACE CLOSER	4040XP REG ST-1630		689	LCN
1	EA	TOP JAMB MTG PLATE	4040XP-18TJ		689	LCN
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT B-CS		630	IVE
1	EA	WIRE HARNESS	CON-6W	⚡		SCH
1	EA	CARD READER	BY DIV. 28	⚡		
1	EA	DOOR CONTACT	679-05 TO SUIT DR MTRL.		⚡ BLK	SCE
1	EA	MOTION SENSOR (REQUEST TO EXIT)	SCANII 12/24 VDC		⚡ BLK	SCE
1	EA	CENTRALIZED POWER SUPPLY	TO BE CENTRALIZED	⚡		

NOTE: EXTENDED LIP STRIKE FOR PC350 FRAME

MODE OF OPERATION

DOOR SECURE AND LOCKED AT ALL TIMES

PRESENTING CREDENTIAL WILL UNLATCH THE ELECTRIC STRIKE

WHEN ELECTRIC STRIKE IS UNLATCHED DOOR CAN BE PULLED OPEN

MECHANICAL KEY FROM EXTERIOR WILL UNLOCK THE DOOR

DOOR CONTACTS MONITORS IF DOOR IS OPEN OR CLOSED



FREE EGRESS AT ALL TIMES

Hardware Group No. 43

For use on Door #(s):

D213B

Provide each BD door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	COMPLETE TRACK KIT 1 DR(SIDE MOUNT)	CCL-1-410-W X REQ. WIDTH			KNC
1	EA	PRIVACY LOCK WITH FLUSH PULL	C-94BL-ET		626	KNC

MODE OF OPERATION

WHEN DOOR IS CLOSED DOOR CAN BE LOCKED VIA PUSH BUTTON








## Peel Regional Paramedic Services Dockstader PRPS

Hardware Group No. 44

For use on Door #(s):

D215

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 127X114MM		652	IVE
1	EA	CLASSROOM DEADBOLT	B663T 12-631		626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	DOOR PULL, 1" ROUND	8103EZHD 305MM O		630-316	IVE
1	EA	PUSH PLATE	8200 100X405MM CFT		630	IVE
1	EA	OH STOP	90S		630	GLY
1	EA	SURFACE CLOSER	4040XP REG		689	LCN
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT B-CS		630	IVE

MODE OF OPERATION

DOOR CLOSED AT ALL TIMES

PUSH / PULL


DOOR CAN BE LOCKED FROM OUTSIDE WITH A KEY

Hardware Group No. 45

For use on Door #(s):

D215B

Provide each PD door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	POCKET DR FRAME	KN CROWDER TYPE B (38MM DR)			KNC
1	EA	POCKET DOOR LOCK & EDGE PULL	C-90L-CT LESS CYLINDER		626	KNC

MODE OF OPERATION

DOOR CAN BE LOCKED FROM INSIDE THUMB TURN










## Peel Regional Paramedic Services Dockstader PRPS

Hardware Group No. 46

For use on Door #(s):

D217

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 127X114MM		630	IVE
1	EA	SGL CYL DEADBOLT	B660T		626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	MONITOR STRIKE	LSM-1		⚡ 630	SEC
1	EA	DOOR PULL, 1" ROUND	8103EZHD 205MM O		630-316	IVE
1	EA	SURF. AUTO OPERATOR	4631 WMS 120 VAC		⚡ 689	LCN
2	EA	ACTUATOR, WALL MOUNT	8310-852T		⚡ 630	LCN
2	EA	ESCUTCHEON	8310-876		⚡ 689	LCN
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	WIRE HARNESS	CON-6W		⚡	SCH

### MODE OF OPERATION

DOOR CLOSED AT ALL TIMES

PUSHING ACTUATORS WILL BEGIN SEQUENCING OF THE AUTOMATIC OPERATOR

DOOR CAN BE LOCKED FROM OUTSIDE WITH A KEY

OR FROM INSIDE WITH VIA THE THUMBTURN

WHEN DOOR IS LOCKED MONITOR SWITCH WILL DISABLE POWER TO THE ACTUATORS








# Peel Regional Paramedic Services Dockstader PRPS

Hardware Group No. 47

For use on Door #(s):

D219

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 127X114MM NRP		652	IVE
1	EA	POWER TRANSFER	EPT10 CON		⚡ 689	VON
1	EA	EU STOREROOM LOCK	ND80TDEU SPA RX CON		⚡ 626	SCH
			12V/24V DC			
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	SURFACE CLOSER	1461 CUSH		689	LCN
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT		630	IVE
			B-CS			
1	EA	SMOKE SEAL	188SBK (1 X W, 2 X H)		BK	ZER
1	EA	WIRE HARNESS	CON-___ TO SUIT		⚡	SCH
1	EA	WIRE HARNESS	CON-6W		⚡	SCH
1	EA	CARD READER	BY DIV. 28		⚡	
1	EA	DOOR CONTACT	679-05 TO SUIT DR MTRL.		⚡ BLK	SCE
1	EA	CENTRALIZED POWER	TO BE CENTRALIZED		⚡	
		SUPPLY				

## MODE OF OPERATION

DOOR SECURE AND LOCKED AT ALL TIMES

PRESENTING CREDENTIAL WILL UNLOCK LEVER

WHEN LEVER IS UNLOCKED TURNING LEVER WILL OPEN THE DOOR

MECHANICAL KEY FROM EXTERIOR WILL UNLOCK THE DOOR

DOOR CONTACTS MONITORS IF DOOR IS OPEN OR CLOSED

FREE EGRESS AT ALL TIMES












# Peel Regional Paramedic Services Dockstader PRPS

Hardware Group No. 48

For use on Door #(s):

D221

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 127X114MM		630	IVE
1	EA	STOREROOM LOCK	ND80TD SPA		626	SCH
1	EA	ADVANCE LOGIC RELAY	CX-33	⚡		CAM
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	ELECTRIC STRIKE	6211 FSE CON	 ⚡	630	VON
1	EA	SURF. AUTO OPERATOR	4631 WMS 120 VAC	 ⚡	689	LCN
2	EA	ACTUATOR, WALL MOUNT	8310-852T	 ⚡	630	LCN
2	EA	ESCUTCHEON	8310-876	 ⚡	689	LCN
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	WIRE HARNESS	CON-6W	⚡		SCH
1	EA	CARD READER	BY DIV. 28	⚡		
1	EA	DOOR CONTACT	679-05 TO SUIT DR MTRL.	 ⚡	BLK	SCE
1	EA	CENTRALIZED POWER SUPPLY	TO BE CENTRALIZED	⚡		

## MODE OF OPERATION

DOOR SECURE AND LOCKED AT ALL TIMES

PRESENTING CREDENTIAL WILL UNLATCH THE ELECTRIC STRIKE

WHEN ELECTRIC STRIKE IS UNLATCHED PRESSING ACTUATOR WILL BEGIN SEQUENCING OF THE AUTOMATIC OPERATOR

WHEN ELECTRIC STRIKE IS UNLATCHED DOOR CAN BE PULLED OPEN

PRESSING ACTUATOR FROM INSIDE OF DOOR WILL BEGIN SEQUENCING OF AUTOMATIC OPERATOR

MECHANICAL KEY FROM EXTERIOR WILL UNLOCK THE DOOR

DOOR CONTACTS MONITORS IF DOOR IS OPEN OR CLOSED

FREE EGRESS AT ALL TIMES












# Peel Regional Paramedic Services Docksteader PRPS

Hardware Group No. 49

For use on Door #(s):

D222                      D224                      D239

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 127X114MM		630	IVE
1	EA	STOREROOM LOCK	ND80TD SPA		626	SCH
1	EA	ADVANCE LOGIC RELAY	CX-33	⚡		CAM
1	EA	INTERFACE BOX	JB7	⚡		VON
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	ELECTRIC STRIKE	6211 FSE CON 12/16/24/28 VAC/VDC	 ⚡	630	VON
1	EA	OH STOP	100S ADJ		630	GLY
1	EA	SURF. AUTO OPERATOR	9131 MS AS REQ (120 VAC)	 ⚡	ANCL R	LCN
2	EA	ACTUATOR, WALL MOUNT	8310-852T	 ⚡	630	LCN
2	EA	ESCUTCHEON	8310-876	 ⚡	689	LCN
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT B-CS		630	IVE
1	EA	LED ANNUNCIATOR	CM-AF500			CAM
1	EA	WIRE HARNESS	CON-6W	⚡		SCH
1	EA	DOOR CONTACT	679-05 TO SUIT DR MTRL.	 ⚡	BLK	SCE
1	EA	PUSH TO LOCK	CM-AF550R			CAM

## MODE OF OPERATION

DOOR IS NORMALLY CLOSED AND UNLOCKED.

TO ENTER PRESS EXTERIOR ACTUATOR OR PULL LEVER TO OPEN DOOR.

ONCE INSIDE PRESS PUSH TO LOCK BUTTON TO DISABLE EXTERIOR ACTUATOR AND ELECTRIC STRIKE.

WHEN OUTSIDE ACTUATOR IS DISABLED ANNUNCIATOR INDICATES THE "OCCUPIED WHEN LIT".

TO EXIT PRESS INTERIOR ACTUATOR OR ROTATE LEVER AND PUSH TO OPEN DOOR.

IN THE EVENT OF EMERGENCY PRESS EMERGENCY ASSISTANCE BUTTON OR USE MECHANICAL KEY TO PROVIDE ACCESS.

WHEN BUTTON IS PRESSED AN AUDIBLE ALARM WILL SOUND AND ANNUNCIATOR INDICATES "ASSISTANCE REQUESTED" AND ELECTRIC STRIKE RELEASES TO ALLOW ENTRY.

IN THE EVENT OF FIRE ALARM OR LOSS OF POWER DOOR REMAINS LOCKED.

FREE EGRESS AT ALL TIMES.












# Peel Regional Paramedic Services Dockstader PRPS

Hardware Group No. 50

For use on Door #(s):

D223

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 114X102MM NRP		652	IVE
1	EA	POWER TRANSFER	EPT10 CON		⚡ 689	VON
2	EA	AUTO FLUSH BOLT	FB32		630	IVE
1	EA	DUST PROOF STRIKE	DP1		626	IVE
1	EA	EU STOREROOM LOCK	ND80TDEU SPA RX CON 12V/24V DC		⚡ 626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	COORDINATOR	COR X FL		628	IVE
2	EA	MOUNTING BRACKET	MB1/MB2 TO SUIT		689	IVE
2	EA	SURFACE CLOSER	1461 CUSH		689	LCN
1	EA	SMOKE SEAL	188SBK (1 X W, 2 X H)		BK	ZER
1	EA	MEETING STILE	383AA X DR HT		AA	ZER
1	EA	WIRE HARNESS	CON-___ TO SUIT		⚡	SCH
1	EA	WIRE HARNESS	CON-6W		⚡	SCH
1	EA	CARD READER	BY DIV. 28		⚡	
2	EA	DOOR CONTACT	679-05 TO SUIT DR MTRL.		⚡ BLK	SCE
1	EA	CENTRALIZED POWER SUPPLY	TO BE CENTRALIZED		⚡	

## MODE OF OPERATION

DOOR SECURE AND LOCKED AT ALL TIMES

PRESENTING CREDENTIAL WILL UNLOCK LEVER

WHEN LEVER IS UNLOCKED TURNING LEVER WILL OPEN THE DOOR

MECHANICAL KEY FROM EXTERIOR WILL UNLOCK THE DOOR

DOOR CONTACTS MONITORS IF DOOR IS OPEN OR CLOSED

FREE EGRESS AT ALL TIMES










## Peel Regional Paramedic Services Dockstader PRPS

Hardware Group No. 51

For use on Door #(s):

D225

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
8	EA	HINGE	5BB1 114X102MM		652	IVE
1	EA	POWER TRANSFER	EPT10 CON		⚡ 689	VON
2	EA	AUTO FLUSH BOLT	FB32		630	IVE
1	EA	DUST PROOF STRIKE	DP1		626	IVE
1	EA	EU STOREROOM LOCK	ND80TDEU SPA RX CON 12V/24V DC		⚡ 626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	SURFACE CLOSER	1461 REG		689	LCN
2	EA	KICK PLATE	8400 255MM X SIZED TO SUIT B-CS		630	IVE
2	EA	FLOOR STOP	FS439		630	IVE
1	EA	WIRE HARNESS	CON-___ TO SUIT		⚡	SCH
1	EA	WIRE HARNESS	CON-6W		⚡	SCH
1	EA	CARD READER	BY DIV. 28		⚡	
2	EA	DOOR CONTACT	679-05 TO SUIT DR MTRL.		⚡ BLK	SCE
1	EA	CENTRALIZED POWER SUPPLY	TO BE CENTRALIZED		⚡	

### MODE OF OPERATION

DOOR SECURE AND LOCKED AT ALL TIMES

PRESENTING CREDENTIAL WILL UNLOCK LEVER

WHEN LEVER IS UNLOCKED TURNING LEVER WILL OPEN THE DOOR

MECHANICAL KEY FROM EXTERIOR WILL UNLOCK THE DOOR

DOOR CONTACTS MONITORS IF DOOR IS OPEN OR CLOSED

FREE EGRESS AT ALL TIMES













# Peel Regional Paramedic Services Dockstader PRPS

Hardware Group No. 52

For use on Door #(s):

D229A

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
8	EA	HINGE	5BB1 114X102MM		652	IVE
1	EA	POWER TRANSFER	EPT10 CON		⚡ 689	VON
2	EA	AUTO FLUSH BOLT	FB32		630	IVE
1	EA	DUST PROOF STRIKE	DP1		626	IVE
1	EA	EU STOREROOM LOCK	ND80TDEU SPA RX CON 12V/24V DC		⚡ 626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	COORDINATOR	COR X FL		628	IVE
2	EA	SURFACE CLOSER	1461 REG		689	LCN
2	EA	KICK PLATE	8400 255MM X SIZED TO SUIT B-CS		630	IVE
2	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	SMOKE SEAL	188SBK (1 X W, 2 X H)		BK	ZER
1	EA	MEETING STILE	383AA X DR HT		AA	ZER
1	EA	WIRE HARNESS	CON-___ TO SUIT		⚡	SCH
1	EA	WIRE HARNESS	CON-6W		⚡	SCH
1	EA	CARD READER	BY DIV. 28		⚡	
2	EA	DOOR CONTACT	679-05 TO SUIT DR MTRL.		⚡ BLK	SCE
1	EA	CENTRALIZED POWER SUPPLY	TO BE CENTRALIZED		⚡	

## MODE OF OPERATION

DOOR SECURE AND LOCKED AT ALL TIMES

PRESENTING CREDENTIAL WILL UNLOCK LEVER

WHEN LEVER IS UNLOCKED TURNING LEVER WILL OPEN THE DOOR

MECHANICAL KEY FROM EXTERIOR WILL UNLOCK THE DOOR

DOOR CONTACTS MONITORS IF DOOR IS OPEN OR CLOSED

FREE EGRESS AT ALL TIMES











# Peel Regional Paramedic Services Dockstader PRPS

Hardware Group No. 53

For use on Door #(s):

D229C

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 127X114MM NRP		652	IVE
1	EA	POWER TRANSFER	EPT10 CON		✂ 689	VON
1	EA	ELEC FIRE EXIT HARDWARE	LX-RX-QEL-98-L-NL-F-4'-17-CON 24 VDC		✂ 626	VON
1	EA	RIM CYLINDER	20-057 ICX		626	SCH
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	SURFACE CLOSER	1461 EDA		689	LCN
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	SMOKE SEAL	188SBK (1 X W, 2 X H)		BK	ZER
1	EA	WIRE HARNESS	CON-___ TO SUIT		✂	SCH
1	EA	WIRE HARNESS	CON-___ TO SUIT		✂	SCH
1	EA	WIRE HARNESS	CON-6W		✂	SCH
1	EA	CARD READER	BY DIV. 28		✂	
1	EA	DOOR CONTACT	679-05 TO SUIT DR MTRL.		✂ BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS FA900 120/240 VAC		✂ LGR	SCE

## MODE OF OPERATION

DOOR SECURE AND LOCKED AT ALL TIMES

PRESENTING CREDENTIAL WILL UNLOCK LEVER

WHEN LEVER IS UNLOCKED TURNING LEVER WILL OPEN THE DOOR

MECHANICAL KEY FROM EXTERIOR WILL UNLOCK THE DOOR

DOOR CONTACTS MONITORS IF DOOR IS OPEN OR CLOSED

FREE EGRESS AT ALL TIMES











# Peel Regional Paramedic Services Dockstader PRPS

Hardware Group No. 54

For use on Door #(s):

D230

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 127X114MM		630	IVE
1	EA	STOREROOM LOCK	ND80TD SPA		626	SCH
1	EA	ADVANCE LOGIC RELAY	CX-33	⚡		CAM
1	EA	INTERFACE BOX	JB7	⚡		VON
1	EA	PERMANENT CORE	BY OWNER			UNK
1	EA	ELECTRIC STRIKE	6211 FSE CON 12/16/24/28 VAC/VDC	 ⚡	630	VON
1	EA	SURF. AUTO OPERATOR	9131 MS AS REQ (120 VAC)	 ⚡	ANCL R	LCN
2	EA	ACTUATOR, WALL MOUNT	8310-852T	 ⚡	630	LCN
2	EA	ESCUTCHEON	8310-876	 ⚡	689	LCN
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	LED ANNUNCIATOR	CM-AF500			CAM
1	EA	DOOR CONTACT	679-05 TO SUIT DR MTRL.	 ⚡	BLK	SCE
1	EA	PUSH TO LOCK	CM-AF550R			CAM

## MODE OF OPERATION

DOOR IS NORMALLY CLOSED AND UNLOCKED.

TO ENTER PRESS EXTERIOR ACTUATOR OR PULL LEVER TO OPEN DOOR.

ONCE INSIDE PRESS PUSH TO LOCK BUTTON TO DISABLE EXTERIOR ACTUATOR AND ELECTRIC STRIKE.

WHEN OUTSIDE ACTUATOR IS DISABLED ANNUNCIATOR INDICATES THE "OCCUPIED WHEN LIT".

TO EXIT PRESS INTERIOR ACTUATOR OR ROTATE LEVER AND PUSH TO OPEN DOOR.

IN THE EVENT OF EMERGENCY PRESS EMERGENCY ASSISTANCE BUTTON OR USE MECHANICAL KEY TO PROVIDE ACCESS.

WHEN BUTTON IS PRESSED AN AUDIBLE ALARM WILL SOUND AND ANNUNCIATOR INDICATES "ASSISTANCE REQUESTED" AND ELECTRIC STRIKE RELEASES TO ALLOW ENTRY.

IN THE EVENT OF FIRE ALARM OR LOSS OF POWER DOOR REMAINS LOCKED.

FREE EGRESS AT ALL TIMES.






## Peel Regional Paramedic Services Dockstader PRPS

Hardware Group No. 55

For use on Door #(s):

D235

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 127X114MM		652	IVE
1	EA	PANIC HARDWARE	LD-98-EO-4'		626	VON
1	EA	SURFACE CLOSER	4040XP EDA ST-3068		689	LCN
1	EA	KICK PLATE	8400 255MM X SIZED TO SUIT B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE

MODE OF OPERATION

EXIT ONLY



FREE EGRESS AT ALL TIMES

Hardware Group No. 56

For use on Door #(s):

MISC. HW SET

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
10	EA	CONTROL, CONSTR KEY	48-056 ICX		468	SCH
10	EA	CONSTRUCTION KEY	48-101 ICX		468	SCH
1	EA	KEY CABINET	REGENT WALL KEY CABINET- 75 CAP.		GRY	TEL
4	EA	POWER SUPPLY	PS906 900-8F 120/240 VAC	 ⚡	LGR	SCE
7	EA	POWER SUPPLY	PS906 900-8F-FA 120/240 VAC	 ⚡	LGR	SCE

NOTE- CONSOLIDATED POWER SUPPLY FOR ALL THE DOORS.

Hardware Group No. 57

For use on Door #(s):

OHD101A	OHD101D	OHD102B	OHD102C	OHD102D	OHD102E
OHD102F	OHD116B	OHD116C	OHD116D	OHD128A	OHD128B
OHD130B	OHD130C	OHD135			

Provide each RU door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA		COMPLETE BY OVERHEAD DOOR SUPPLIER			



## Peel Regional Paramedic Services Dockstader PRPS

Door#	HwSet#
D001	01
D1A-STA	02
D1A-STB	02
D1A-STD	02
D1A-STE✓	03
D1B-STB✓	04
D1B-STD✓	05
D1C-STD✓	06
D002	01
D2A-STB	02
D2A-STD	02
D2A-STE✓	07
D003	08
D3A-STB✓	09
D3A-STD✓	10
D3B-STD	11
D101B✓	12
D101C	13
D102A✓	04
D102B✓	14
D102C✓	14
D102D✓	15
D102F✓	16
D103✓	17
D104A✓	18
D104B✓	19
D107✓	20
D108✓	21
D109	22
D110✓	23
D111	24
D112A✓	25
D112B✓	26
D114A	27
D114B✓	28
D116A✓	03
D116E	13
D118A✓	29
D118B✓	30
D118C✓	05
D119A✓	31
D119B✓	31
D121✓	20
D122	22
D123	22

Door#	HwSet#
D125A✓	32
D125B✓	33
D126A✓	32
D126B✓	33
D127A✓	20
D130A✓	34
D130D	13
D131A✓	03
D131B✓	20
D133✓	35
D135✓	36
D138✓	37
D202B✓	38
D202C	39
D204	22
D205✓	21
D206✓	40
D207A✓	40
D207B	41
D208	22
D209	22
D210A✓	26
D210B✓	42
D211✓	25
D212✓	25
D213✓	26
D213B	43
D215	44
D215B	45
D216	22
D217✓	46
D219✓	47
D220✓	20
D221✓	48
D222✓	49
D223✓	50
D224✓	49
D225✓	51
D227	02
D229A✓	52
D229B✓	03
D229C✓	53
D230✓	54
D231	22
D232	22

Door#	HwSet#
D233	22
D235	55
D236	22
D237	22
D238	22
D239✓	49
D302A✓	03
D302B✓	03
D303✓	20
D304✓	40
D305✓	20
D306✓	20
D307✓	20
MISC. HW SET✓	56
OHD101A	57
OHD101D	57
OHD102B	57
OHD102C	57
OHD102D	57
OHD102E	57
OHD102F	57
OHD116B	57
OHD116C	57
OHD116D	57
OHD128A	57
OHD128B	57
OHD130B	57
OHD130C	57
OHD135	57

**1. GENERAL**

**1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

**1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the Window Operators work specified herein. This includes, but is not necessarily limited, to:
  - .1 Window actuators for all operable windows.
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

**1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

**1.4 Preinstallation Meetings**

- 1.4.1 General Requirements and Procedures for Project Meetings: In accordance with Section 01 31 00, Project Management and Coordination.
- 1.4.2 Pre-installation Meetings: Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
  - .1 Ensure attendance of Subcontractor performing work of this Section, as well as representatives from manufacturers and fabricators involved in or affected by installation. Notify Consultant and Owner of scheduled meeting dates in advance.

- .2 Agenda:
  - .1 Review progress of related construction activities and preparations for particular activity under consideration.
  - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
  - .3 Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
  - .4 Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

## **1.5 Submittals**

- 1.5.1 General Requirements and Procedures for Submittals: In accordance with Section, Submittal Procedures.
- 1.5.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for Window Operators work specified in this Section.
- 1.5.3 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
  - .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
  - .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
  - .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.5.4 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:
  - .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.
  - .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.5.5 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:
  - .1 Include plans, elevations, sections and details as applicable.

.2 Indicate field-measured dimensions on Shop Drawings.

1.5.6 Samples:

.1 Initial Selection Samples: Submit initial selection samples for Products requiring colour, texture, or design selection. Submit manufacturer's list of finishes or colour swatches for Consultant's selection.

**1.6 Quality Assurance**

1.6.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least years' experience manufacturing such materials.

1.6.2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.

.1 Certification: Installer must be trained and certified by manufacturer.

1.6.3 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.

1.6.4 Mock-Ups: Construct mock-ups to verify selections made under submittals, demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

.1 Location: In-situ (i.e. first installation), as directed on site by Consultant.

.2 Purpose: To set benchmarks for installation and to judge subsequent work. Maintain Mock-ups during construction in undisturbed condition.

.3 Reviewed mock-ups: May become part of the completed work if undisturbed at the time of Substantial Performance of The work, provided they are undisturbed, and comply with requirements outlined in Contract Documents.

**1.7 Delivery, Storage And Handling**

1.7.1 General Product Requirements: In accordance with Section, Common Product Requirements. Deliver, store and handle window operators materials in accordance with manufacturer's written instructions.

1.7.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

1.7.3 Store materials in off-ground, in clean, dry, well-ventilated area.

1.7.4 Replace defective or damaged materials with new.

**1.8 Field Conditions**

1.8.1 Field Measurements: Verify actual dimensions of construction contiguous with Window Operators by field measurements before fabrication.

**1.9 Warranty**

1.9.1 Extended warranty: Submit for Owner's review and acceptance, manufacturer's extended warranty in which manufacturer commits to repair or replace components of Window Operators that fail within specified warranty period. Manufacturer's extended warranty is in addition to, and does not supersede, any other rights that Owner may have under Contract Documents.

- .1 Warranty Period: 5 years from date of Substantial Performance of The work.
- .2 Warranty Scope: Materials only

**2 . PRODUCTS**

**2.1 Manufacturers**

2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:

- .1 Automated Fenestration Inc.
- .2 Window Master Industries
- .3 Approved equivalent

2.1.2 Substitution Limitations: Conforming to requirements of Section 01 25 00.

**2.2 Window Operators**

2.2.1 Motorized Window Actuators: WMX/WMU/WMB actuators by Window Master Clearline Inc. or equivalent and mounted with matching coordinated brackets.

- .1 Provide minimum one motorized actuator per operable window. Total number of actuators to be based on window size, weight, glass thickness and window movement and must be confirmed by the manufacturer.
- .2 Provide 24v DC window actuators . Motors and all low voltage system components shall be Underwriter Laboratory (UL) recognized or listed.

- .3 Coordinate voltage drop calculation with Division 26 for wire runs to actuators to ensure adequate power for synchronized motor operation in each room.
- .4 Coordinate wiring (correctly sized for voltage drop), conduit, connectors, junction boxes, electrical enclosures, and required fuses with Division 26.
- .5 Characteristics:
  - .1 Voltage Supply: 24V DC (max. 10% ripple)
  - .2 Open Circuit Voltage: max. 36 VDC
  - .3 Actuator Max Stroke: from 500-1000 mm
  - .4 Traction Force: 100-1500 N
  - .5 Locking Force: 3000 N
  - .6 Power: Max 24W
  - .7 Current consumption: 0.5-5Amp per actuator
- .6 Colour: to be selected by Consultant at a later date.
- .7 Basis-of-Design: "Motorized Window Actuator" by WindowMaster Industries or approved equivalent.

## **2.3 Actuator Control**

### **2.3.1 Programmable 24V DC Window Actuators:**

- .1 Provide programmable 24V DC window actuators suitable for surface or concealed installation in comfort ventilation applications.
- .2 Ensure actuators have a reverse function to prolong weather seal life and are programmable for adjusting tractive force and closing pressure, considering factors such as hinges, window type, and application.

### **2.3.2 Actuators and Control Panels:**

- .1 Actuator Position Feedback: Provide two-way communication between the actuator and the control panel for precise position feedback, enabling accurate control and a security indicator for open windows.

### **2.3.3 Pressure Safety Function: Equip actuators with a pressure safety function to monitor for entrapment. Use microprocessors within the actuator to monitor electrical current and window position in real-time with less than 1 mm accuracy.**

- .1 Ensure actuator can detect and respond to obstructions in the window's path by reversing to release the object. Adjust the pressure safety sensitivity based on factors such as window size, weight, configuration, and hinge type, to maintain system performance throughout the building's life.

- 2.3.4 Fault Indication: Enable two-way communication between the actuator and control panel for early detection of errors in actuator operation or wiring.
- 2.3.5 Synchronization Function: Ensure actuators operate fully synchronized, with two actuators working together on one window within a tolerance of less than 2 mm (0.08 in). Actuators must communicate directly to adjust their speed and maintain synchronization.

## **2.4 Materials**

- 2.4.1 Aluminum: Alloy and temper recommended by aluminum producer and finisher for use and finish indicated, and with not less than the strength and durability of alloy and temper designated below:
  - .1 Aluminum: Extruded Bars and Shapes: to ASTM B221, alloy 6063-T6.
  - .2 Aluminum: Plate and Sheet: to ASTM B209, alloy 6061-T6.

## **2.5 Finishes**

- 2.5.1 Generally: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Protect finishes by applying a strippable, temporary protective covering before shipping.

# **3 . EXECUTION**

## **3.1 Examination**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.

## **3.2 Installation**

- 3.2.1 General Requirements: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.
- 3.2.2 Install components in plumb, level and square. Maintain dimensional tolerances and alignment with surrounding construction.

## **3.3 Adjusting**

- 3.3.1 Adjust moving parts for smooth and uniform operation.

- 3.3.2 Testing and Commissioning: Perform commissioning of window operator systems upon completion of Work of this Section.

**3.4 Protection**

- 3.4.1 Protect Window Operators from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades.
- 3.4.2 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in writing by affected material's manufacturer. Do not use materials or process that can damage finishes, surfaces, or construction.
- 3.4.3 Promptly replace Window Operators work damaged during construction that cannot be satisfactorily repaired.

**3.5 Cleaning And Waste Management**

- 3.5.1 General Requirements for Cleaning and Waste Management: In accordance with Section, Cleaning and Waste Management.
- 3.5.2 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
- 3.5.3 Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**END OF SECTION**



## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the general requirements for glass and glazing work specified herein.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only:
  - .1 Section 08 81 23 – Exterior Glass and Glazing Requirements
  - .2 Section 08 81 26 – Interior Glass and Glazing Requirements

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

### **1.4 Preinstallation Meetings**

- 1.4.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.
- 1.4.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
  - .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.
  - .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.

- .3 Agenda:
  - .1 Review progress of related construction activities and preparations for particular activity under consideration.
  - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
- .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
- .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

## **1.5 Submittals**

- 1.5.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.5.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for general requirements for glass and glazing work specified in this Section.
- 1.5.3 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:
  - .1 Include plans, elevations, sections and details as applicable.
  - .2 Indicate field-measured dimensions on Shop Drawings.
- 1.5.4 Delegated Design Submittals:
  - .1 Engineering design completion of general requirements for glass and glazing work is delegated to Contractor based on structural design criteria indicated in Contract Documents.
  - .2 Submit Shop Drawings for work of this Section that bear the stamp of a Professional Engineer registered in Province of Ontario.
  - .3 Submit copy of structural calculations upon request by Consultant.
- 1.5.5 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
  - .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
  - .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.

- .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.5.6 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:
  - .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.
  - .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.5.7 Low-Emitting Materials: For applicable Products specified or used for activities of this Section (i.e., site-applied coatings, adhesives, and sealants), submit certifications from third-party organizations indicating compliance with following:
  - .1 VOC Emissions: California Department of Public Health (CDPH) Standard Method v1.2–2017, using applicable exposure scenario.
  - .2 VOC Content: SCAQMD Rule 1113 (for paints and coatings) and SCAQMD Rule 1168 (for adhesives and sealants).

## **1.6 Closeout Submittals**

- 1.6.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.
- 1.6.2 Operating and Maintenance Data: Submit care and maintenance instructions for general requirements for glass and glazing to be included in building operation and maintenance manual.
- 1.6.3 Warranty Documentation: Submit copy of extended warranties specified in this Section.

## **1.7 Quality Assurance**

- 1.7.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.
- 1.7.2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.
- 1.7.3 Professional Engineer's Qualifications: Employ Professional Engineer licensed to practice in Province of Ontario who carries professional liability insurance and has at least five years'

experience providing engineering services of similar kind, scope, and complexity.

.1 Professional Engineer's Responsibility:

- .1 production and review of Shop Drawings,
- .2 design and certification of general requirements for glass and glazing, including attachments for building construction, in accordance with applicable codes and regulations,
- .3 stamping and signing of each Shop Drawing and associated calculations

1.7.4 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.

1.7.5 Mock-Ups / First Installation Review: Construct mock-ups to verify selections made under submittals, demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

- .1 Location: In-situ (i.e. first installation), as directed on site by Consultant.
- .2 Purpose: To set benchmarks for installation and to judge subsequent work. Maintain Mock-ups during construction in undisturbed condition.
- .3 Reviewed mock-ups: May become part of the completed work if undisturbed at the time of Substantial Performance of The work, provided they are undisturbed, and comply with requirements outlined in Contract Documents.

**1.8 Delivery, Storage And Handling**

- 1.8.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.
- 1.8.2 Deliver, store and handle glass and glazing materials in accordance with manufacturer's written instructions.
- 1.8.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.8.4 Store materials in off-ground, in clean, dry, well-ventilated area.
- 1.8.5 Replace defective or damaged materials with new.
- 1.8.6 Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

**1.9 Field Conditions**

- 1.9.1 Environmental Restrictions: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
- 1.9.2 Field Measurements: Verify actual dimensions of construction contiguous with general requirements for glass and glazing by field measurements before fabrication.
- 1.9.3 Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 7 deg C (44 deg F).

**1.10 Warranty**

- 1.10.1 Refer to Section 08 81 23 for exterior glass and glazing requirements.
- 1.10.2 Refer to Section 08 81 26 for interior glass and glazing requirements.

**2 . PRODUCTS**

**2.1 Performance / Design Criteria**

- 2.1.1 Glass Thickness and Strength:
  - .1 Unless indicated otherwise, Provide minimum 6 mm (1/4 inch) thick glass. Increase glass thicknesses as required to meet project-specific loading requirements based on engineering design.
  - .2 Unless otherwise indicated, Provide fully tempered glass or heat-strengthened glass, Kind FT or Kind H complying with ASTM C1048 or equivalent to CAN/CGSB 12.1-M; complying with testing requirements in ANSI Z97.1, Class A and 16 CFR 1201 for Category II materials. Annealed glass used without heat-strengthening is not acceptable.
  - .1 Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated on Drawings and Schedules or in the following applications:
    - .1 glass units with ceramic frit and base dimensions greater than 2134 mm (84 inch),
    - .2 clear 13 mm (1/2 inch) thick glass with base dimensions greater than 2134 mm (84 inch),
    - .3 other configurations with base dimensions > 2440 mm (96 inch).

**CONSTRUCTION OF THE  
DOCKSTEADER PRPS  
REPORTING STATION**

**08 80 05  
General Requirements  
For Glass And Glazing**

- 
- .2 Visual Distortion: Ensure glass is tempered by the horizontal toughening process only and conforms to the following roll wave factor (RW) limits measured in accordance with ASTM C1652 requirements:
    - .1 Roller Wave Distortion Tolerance: Maximum peak-to-valley tolerance of 0.08 mm (0.03 inch) in central area of glass and 0.20 mm (0.008 inch) within 292 mm (11.5 inch) of a leading or trailing edge
    - .2 Maximum bow and warp: 1/32" per lineal foot.
  - .3 Heat-Soaking: Provide in-line heat soaking of tempered glass in accordance with BS EN 14179 (2 hour dwell at 290°C±10°C) for glass used in following applications:
    - .1 Where required by the Ontario Building Code (Supplementary Standard SB-13)
    - .2 Tempered glass used in glazed railings and balustrades, where the glass assembly is not laminated
    - .3 Statistical heat-soaking is not acceptable.
  - .3 Glass thicknesses and heat treatments indicated in Contract Documents are minimum requirements. Confirm glass thicknesses and heat treatments, verified by analysis and engineering design, as required to meet performance and testing requirements specified in this Section.
  - .4 Glazing details shown are for convenience of detailing only and are to be confirmed relative to cited standards and final framing details.
  - .5 Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other
  - .6 All exterior glazing (i.e. glazing forming part of the building envelope of the project) must consist at least of double-glazed units with 90% argon-fill, and low-e coating on surface no. 2. Provide such glazing whether specifically indicated on Drawings or not (e.g. where not specifically called out for exterior door assemblies or other miscellaneous openings).
- 2.1.2 Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
- .1 For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.

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- .2 For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
  - .3 U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F).
  - .4 Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
  - .5 Visible Reflectance: Center-of-glazing values, according to NFRC 300.
- 2.1.3 Professional Engineering Design and Certification:
- .1 Design glass, including comprehensive engineering analysis according to CAN/CGSB-12.20 or equivalent to ASTM E1300 by a Professional Engineer licensed to practice in the Province of Ontario, using the design criteria indicated.
- 2.1.4 All glazing within 1070 mm of the finished floor that surrounds interior and exterior openings 600 mm or more in height from the finished floor shall be designed as a guard. This glazing shall be tempered or laminated.
- 2.1.5 Glazing acting as guards from either the interior or exterior must withstand the loads specified in the Ontario Building Code, the requirements of CAN/CSA A500 and applicable loads specified in this section.
- 2.1.6 Visibility of Glazing: Unless design is specifically indicated on Drawings, provide films on all fully glazed transparent doors, sidelights and panels that are mullion-less as follows:
- .1 Minimum height: 50 mm (2 inches)
  - .2 Extent: full width of the door, sidelight or panel.
  - .3 Placement: between 1350 mm (53 inches) and 1500 mm (60 inches) above the floor. Provide consistent placement height throughout project.
- 2.1.7 VOC Content and Emissions:
- .1 VOC Emissions: For applicable items in this Section, comply with CDPH Standard Method v1.2–2017 (CA Spec 01350) and ensure products are certified per UL 2818, SCS Global Gold, or equivalent.
  - .2 VOC Content Requirements: Wet-applied materials used in scope of this Section must conform to the following:
    - .1 Paints and Coatings: SCAQMD Rule 1113 or CARB SCM.

- .2 Adhesives and Sealants: SCAQMD Rule 1168.
- .3 Methylene chloride and perchloroethylene must not be intentionally added in paints, coatings, adhesives, or sealants.

## **2.2     Basic Glass Materials**

- 2.2.1 Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.
- 2.2.2 Tempered Glass: ASTM C1048 Type I; Quality-Q3; Class I (clear); Kind FT or equivalent to CAN/CGSB-12.1. Perform heat strengthening using horizontal tong free method; surface compression not less than 69 MPa (10,000 psi). Glazing must comply with testing requirements in 16 CFR 1201 for Category II materials.
- 2.2.3 Heat-Strengthened Glass: ASTM C1048 Type I; Quality-Q3; Class I (clear) unless otherwise indicated; Kind HS or equivalent to CAN/CGSB-12.1. Perform heat strengthening using horizontal tong free method; surface compression between 24.1 MPa (3,500 psi) and 51.7 MPa (7,500 psi), but preferably not more than 34.5 MPa (5,000 psi) .
- 2.2.4 Laminated Glass: ASTM C1172 and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified in this Section. Use materials that have a proven record of no tendency to bubble, discolour, or lose physical and mechanical properties after fabrication and installation.
  - .1 Construction: Unless indicated otherwise, laminate glass with interlayer to comply with interlayer manufacturer's written recommendations and specifications indicated for individual assemblies.
  - .2 Interlayer Thickness: Provide thickness indicated in specific assemblies and as needed to comply with requirements, but not less than 1.5 mm (60 mil).
  - .3 Assembly thickness: As specified in individual Specifications.
  - .4 Interlayer Colour: Clear unless otherwise indicated.
- 2.2.5 Fire-Rated Glass: to CAN/ULC S104 for door assemblies and CAN/ULC S106 for window assemblies.
  - .1 Film-Faced Ceramic Glazing: Clear, ceramic flat glass; 5-mm (3/16-inch) nominal thickness; faced on one surface with a clear glazing film; complying with testing requirements in 16 CFR 1201 for Category II materials (safety glazing).
  - .2 Laminated Ceramic Glazing: Laminated glass made from 2 plies of clear, ceramic flat glass; 8-mm (5/16-inch) total nominal



thickness; complying with testing requirements in 16 CFR 1201 for Category II materials (safety glazing).

- .3 Fire-Resistive Glass: Laminated glass made from multiple plies of uncoated, clear glass; with intumescent interlayers or fully transparent, heat-absorbing gel; complying with testing requirements in 16 CFR 1201 for Category II materials (safety glazing).

- .4 Wire Glass: Not permitted.

2.2.6 Ultraclear (low-iron) Glass: Fully tempered glass complying with other requirements specified in this Section and with visible light transmission not less than 91 percent.

2.2.7 Mirrors: ASTM C1503, or equivalent to CAN/CGSB-12.5; manufactured using copper-free, low-lead mirror coating process. Provide Mirror Select Quality; annealed glass with film backing as specified.

2.2.8 Glazing Films: Refer to Section 08 87 00.

## **2.3 Glazing Gaskets**

2.3.1 Dense Compression Gaskets (aluminum framing): Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:

- .1 Silicone complying with ASTM C1115.
- .2 Acceptable Products: "VISIONstrip" by Tremco or approved equivalent.

2.3.2 Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned silicone gaskets complying with ASTM C509, Type II, black; of profile and hardness required to maintain watertight seal.

- .1 Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

2.3.3 At fire-rated glazed doors and partitions, use similar sized fire-rated silicone as recommended by fire-rated glass manufacturer and identical to Product used in test assembly to obtain rating.

## **2.4 Glazing Sealants**

2.4.1 General:

- .1 Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

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- .2 Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated on Drawings and Schedules and for conditions existing at time of installation.
  - .3 Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
  - .4 Colours of Exposed Glazing Sealants: As selected by Consultant from manufacturer's full range.
- 2.4.2 Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 50, Use NT.
- .1 Acceptable Products:
    - .1 "DOWSIL 795 or DOWSIL 995" by Dow Chemical of Canada ULC
    - .2 "SilGlaze II SCS2800 or SilPruf NB SCS9000 or SilPruf SCS2000 or UltraPruf II SCS2900" by GE Advanced Materials - Silicones
    - .3 "864" or "895" or "898" by Pecora Corporation
    - .4 "SikaSil-C995" by Sika Corporation, Construction Products Division
    - .5 "Spectrem 2" or "Spectrem 3" by Tremco Incorporated
  - .2 Applications: Interior structural glazing applications.
- 2.4.3 Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use NT.
- .1 Acceptable Products:
    - .1 "Dowsil 799" by Dow Chemical of Canada ULC
    - .2 "UltraGlaze SSG4000" or "UltraGlaze SSG4000AC" by GE Advanced Materials - Silicones
    - .3 "Tremsil 200" by Tremco Incorporated
  - .2 Applications: Non-structural sealing for butt-glazing in interior applications.
- 2.4.4 Glazing Sealants for Fire-Rated Glazing Acceptable Products: Products that are approved by testing agencies that listed and labeled fire-resistant glazing products with which they are used for applications and fire-protection ratings indicated on Drawings and Schedules.

## **2.5     Glazing Tapes**

- 2.5.1 Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:
- .1 AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
  - .2 AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
  - .3 Acceptable Products: "POLYshim II Tape" by Tremco or approved equivalent.

## **2.6     Miscellaneous Glazing Materials**

- 2.6.1 General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated on Drawings and Schedules, and with a proven record of compatibility with surfaces contacted in installation.
- 2.6.2 Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- 2.6.3 Setting Blocks: Elastomeric EPDM material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- 2.6.4 Spacers: Elastomeric EPDM blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated on Drawings and Schedules.
- 2.6.5 Edge Blocks: Elastomeric EPDM material of hardness needed to limit glass lateral movement (side walking).
- 2.6.6 Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- 2.6.7 Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated on Drawings and Schedules.

## **2.7     Fabrication**

- 2.7.1 General Glass Fabrication Requirements: ASTM C1036, Type I, Quality-Q3, Class I (clear) or equivalent to CAN/CGSB-12.2.
- 2.7.2 Fabricate glazing units in sizes required to fit openings indicated on Drawings and Schedules for Project, with edge and face clearances, edge and surface conditions, and bite complying with

written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

2.7.3 Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

2.7.4 Grind smooth and polish exposed glass edges and corners.

### **3 . EXECUTION**

#### **3.1 Examination**

3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.

3.1.2 Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

- .1 Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
- .2 Presence and functioning of weep systems.
- .3 Minimum required face and edge clearances.
- .4 Effective sealing between joints of glass-framing members.

3.1.3 Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 Preparation**

3.2.1 Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.2.2 Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

#### **3.3 Installation**

3.3.1 Installation, generally: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.

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**3.4     Glazing**

- 3.4.1 Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated on Drawings and Schedules, including those in referenced glazing publications.
- 3.4.2 Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- 3.4.3 Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- 3.4.4 Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- 3.4.5 Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- 3.4.6 Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- 3.4.7 Provide spacers for glass lites where length plus width is larger than 1270 mm (50 inches).
  - .1 Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
  - .2 Provide 3-mm (1/8-inch) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- 3.4.8 Provide edge blocking where indicated on Drawings and Schedules or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- 3.4.9 Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- 3.4.10 Set glass lites with proper orientation so that coatings face exterior or interior as specified.

- 3.4.11 Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- 3.4.12 Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

### **3.5     Tape Glazing**

- 3.5.1 Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- 3.5.2 Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- 3.5.3 Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- 3.5.4 Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- 3.5.5 Do not remove release paper from tape until right before each glazing unit is installed.
- 3.5.6 Apply heel bead of elastomeric sealant.
- 3.5.7 Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- 3.5.8 Apply cap bead of elastomeric sealant over exposed edge of tape.

### **3.6     Gasket Glazing (Dry)**

- 3.6.1 Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- 3.6.2 Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- 3.6.3 Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal

without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

3.6.4 Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

3.6.5 Install gaskets so they protrude past face of glazing stops.

### **3.7 Sealant Glazing (Wet)**

3.7.1 Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

3.7.2 Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

3.7.3 Tool exposed surfaces of sealants to provide a substantial wash away from glass.

### **3.8 Protection**

3.8.1 Protect glass and glazing from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades.

3.8.2 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in writing by affected material's manufacturer. Do not use materials or process that can damage finishes, surfaces, or construction.

3.8.3 Promptly replace glass and glazing work damaged during construction that cannot be satisfactorily repaired.

### **3.9 Cleaning And Waste Management**

3.9.1 Cleaning and Waste Management, generally: in accordance with Section 01 74 00, Cleaning and Waste Management.

3.9.2 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.

- 3.9.3 Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Performance of the Work. Wash glass as recommended in writing by glass manufacturer.
- 3.9.4 Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**END OF SECTION**



## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the exterior glass and glazing work specified herein. This includes, but is not necessarily limited, to:
  - .1 Curtain walls.
  - .2 Glazing in openings (doors, windows, and similar components) forming part of building envelope.
  - .3 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only:
  - .1 Section 08 80 05 – General Requirements for Glass and Glazing

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

### **1.4 Definitions**

- 1.4.1 Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- 1.4.2 Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C1036.
- 1.4.3 Glazing cavity: Space between lites of an insulating-glass unit.

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**1.5     Preinstallation Meetings**

- 1.5.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.
- 1.5.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
  - .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.
  - .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.
  - .3 Agenda:
    - .1 Review progress of related construction activities and preparations for particular activity under consideration.
    - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
  - .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
  - .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

**1.6     Submittals**

- 1.6.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.6.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for exterior glass and glazing work specified in this Section.
- 1.6.3 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:
  - .1 Include plans, elevations, sections and details as applicable.
  - .2 Indicate field-measured dimensions on Shop Drawings.
- 1.6.4 Delegated Design Submittals:
  - .1 Engineering design completion of exterior glass and glazing work is delegated to Contractor based on structural design criteria indicated in Contract Documents.
  - .2 Submit Shop Drawings for work of this Section that bear the stamp of a Professional Engineer registered in Province of Ontario.

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- .3 Submit copy of structural calculations upon request by Consultant.
  - 1.6.5 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
    - .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
    - .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
    - .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
  - 1.6.6 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:
    - .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.
    - .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
  - 1.6.7 Low-Emitting Materials: For applicable Products specified or used for activities of this Section (i.e., site-applied coatings, adhesives, and sealants), submit certifications from third-party organizations indicating compliance with following:
    - .1 VOC Emissions: California Department of Public Health (CDPH) Standard Method v1.2–2017, using applicable exposure scenario.
    - .2 VOC Content: SCAQMD Rule 1113 (for paints and coatings) and SCAQMD Rule 1168 (for adhesives and sealants).
  - 1.6.8 Samples: Submit selection and verification samples for Products requiring colour, texture, or design selection. Submit manufacturer's list of finishes or colour swatches for Consultant's selection.
    - .1 As a minimum submit samples of the following:
      - .1 Insulating glass
      - .2 Submit glazing accessory samples in accordance with Division 01 for gaskets and sealants, in 300-mm (12-inch) lengths. Install sealant Samples between two strips of material representative in colour of the adjoining framing system.
  - 1.6.9 Glazing Schedule: Submit glazing schedule list of glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings and Schedules.

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**1.7     Informational Submittals**

- 1.7.1 Product Certificates: Submit product certificates in accordance with Division 01 for glass and glazing products, from manufacturer.
- 1.7.2 Test and Evaluation Reports: Submit test reports based on evaluation of comprehensive tests performed by a qualified testing agency, for insulating glass, glazing sealants and glazing gaskets.
  - .1 Provide adhesion test reports on metal and glass tested in accordance with ASTM C794, 14 Day cure and 7 Day submersion.
  - .2 Submit test report for tensile adhesion properties of structural silicone sealants in accordance with test method procedures conforming to ASTM C1135.
  - .3 Submit compatibility test reports on gaskets, spacers, setting blocks materials in contact with structural sealants to ensure compatibility with sealant in accordance with ASTM C1087.
  - .4 Submit test data substantiating that stress on silicone sealants when exposed to maximum specified wind load does not exceed 20 psi and provides minimum safety factor of 2-1/2:1.
  - .5 Provide to sealant manufacturer, Shop Drawings showing size of lites, design loads and sealant dimensions for sealant manufacturer's evaluation and statement on stress.
  - .6 For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
  - .7 If requested provide test report for resistance to wear and staining in accordance with ASTM C501 and ASTM C1378 respectively.

**1.8     Closeout Submittals**

- 1.8.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.
- 1.8.2 Operating and Maintenance Data: Submit care and maintenance instructions for exterior glass and glazing to be included in building operation and maintenance manual.
- 1.8.3 Warranty Documentation: Submit copy of extended warranties specified in this Section.

**1.9     Quality Assurance**

- 1.9.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.
- 1.9.2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and

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Schedules, and whose work has resulted in construction with a track record of successful in-service performance.

- .1 For exterior glazing applications, Provide qualified installer who employs glass installers for this Project who are certified under “Window Wise” program of the Siding and Window Dealers Association of Canada.
- 1.9.3 Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.
- 1.9.4 Professional Engineer’s Qualifications: Employ Professional Engineer licensed to practice in Province of Ontario who carries professional liability insurance and has at least five years’ experience providing engineering services of similar kind, scope, and complexity.
  - .1 Professional Engineer’s Responsibility:
    - .1 production and review of Shop Drawings,
    - .2 design and certification of exterior glass and glazing, including attachments for building construction, in accordance with applicable codes and regulations,
    - .3 stamping and signing of each Shop Drawing and associated calculations
- 1.9.5 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.
- 1.9.6 Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of FGIA/IGMAC.
- 1.9.7 Mock-Ups / First Installation Review: Construct mock-ups to verify selections made under submittals, demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - .1 Location: In-situ (i.e. first installation), as directed on site by Consultant.
  - .2 Purpose: To set benchmarks for installation and to judge subsequent work. Maintain Mock-ups during construction in undisturbed condition.
  - .3 Reviewed mock-ups: May become part of the completed work if undisturbed at the time of Substantial Performance of The work, provided they are undisturbed, and comply with requirements outlined in Contract Documents.

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**1.10 Delivery, Storage And Handling**

- 1.10.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.
- 1.10.2 Deliver, store and handle exterior glass and glazing materials in accordance with manufacturer's written instructions.
- 1.10.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.10.4 Store materials in off-ground, in clean, dry, well-ventilated area.
- 1.10.5 Replace defective or damaged materials with new.
- 1.10.6 Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

**1.11 Field Conditions**

- 1.11.1 Environmental Restrictions: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
- 1.11.2 Field Measurements: Verify actual dimensions of construction contiguous with exterior glass and glazing by field measurements before fabrication.
- 1.11.3 Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 7 deg C (44 deg F).

**1.12 Warranty**

- 1.12.1 Manufacturer's Extended Warranty for Low-E Coated-Glass: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
  - .1 Warranty Period: 10 years from date of Substantial Performance of the Work.
- 1.12.2 Manufacturer's Extended Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and

cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

.1 Warranty Period: 10 years from date of Substantial Performance of the Work.

1.12.3 Manufacturer's Extended Warranty for Laminated glass Units: Warrant laminated glass against defects and deficiencies in accordance with General Conditions of the Contract. Promptly correct defects or deficiencies which become apparent within warranty period, to satisfaction of Consultant and at no additional expense. Defects include but are not limited to: deterioration, edge separation, delamination, material obstructing vision glass and blemishes exceeding those allowed by GANA (LGSA) standards. Upon notification of such deterioration within the warranty period, Provide full replacement of glass units showing defects at no additional cost to Owner.

.1 Warranty Period: 5 years from Substantial Performance of the Work

## **2 . PRODUCTS**

### **2.1 Manufacturers**

2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:

- .1 Cardinal Glass Industries: <https://www.cardinalcorp.com/>
- .2 Guardian Industries Corporation:  
<http://www.guardian.com/us/en>
- .3 Viracon: <https://www.viracon.com/>
- .4 Vitro Architectural Glass (formerly PPG Industries, Inc.):  
<https://www.vitroglazings.com/>
- .5 Saint-Gobain Glass: <https://www.saint-gobain-glass.com/>

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

### **2.2 Performance / Design Criteria**

2.2.1 VOC Content and Emissions:

- .1 VOC Emissions: For applicable items in this Section, comply with CDPH Standard Method v1.2–2017 (CA Spec 01350) and ensure products are certified per UL 2818, SCS Global Gold, or equivalent.
- .2 VOC Content Requirements: Wet-applied materials used in scope of this Section must conform to the following:

- .1 Paints and Coatings: SCAQMD Rule 1113 or CARB SCM.
- .2 Adhesives and Sealants: SCAQMD Rule 1168.
- .3 Methylene chloride and perchloroethylene must not be intentionally added in paints, coatings, adhesives, or sealants.

## **2.3 Glass Materials**

- 2.3.1 Refer to Section 08 80 05 for additional information.

## **2.4 Insulating-Glass Units, Generally**

- 2.4.1 Factory-assembled units consisting of sealed lites of glass separated by a dehydrated glazing cavity, qualified according to ASTM E2190 or equivalent to CAN/CGSB-12.8, and complying with other requirements specified.
  - .1 Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary.
    - .1 Basis-of-Design (Silicone Secondary Seal): DOWSIL 982 by Dow Chemical of Canada ULC.
  - .2 Spacer: Stainless steel or Polypropylene covered stainless steel or Thermally broken aluminum.
    - .1 Basis-of-Design: "CHROMATECH ULTRA" by Roll-Tech A/S; <http://www.rolltech.dk>
  - .3 Desiccant: Molecular sieve or silica gel, or blend of both.

## **2.5 Insulating Glass Unit, Triple Glazed – Bird-Friendly (GL1A)**

- 2.5.1 Total unit thickness: 44 mm (1-3/4 in)
- 2.5.2 Exterior lite: Minimum 6 mm (1/4 in) thick, heat-strengthened glass unless indicated otherwise. Provide heat-soaked tempered glass where glass must be fully tempered based on thermal stress analysis for project.
  - .1 Thickness: Thickness indicated must be considered minimum. Increase thickness as required based on engineering design and analysis.
  - .2 Glass Substrate: "Starphire low-iron" by Vitro Architectural Glass (formerly PPG)
  - .3 Low E coating: on surface No. 2.
    - .1 Low E Basis-of-Design: "Solarban 72" by Vitro Architectural Glass (formerly PPG) or approved equivalent meeting aesthetic and performance criteria.



- .4 Bird-Friendly Coating: Acid-etched types, on surface No. 1 and complying with CSA A460 and City of Brampton Bird-Friendly Guidelines.
  - .1 Pattern: 5 mm (0.2 inch) diameter round dots, 50 mm x 50 mm (2 x 2 inch) diagonal spacing.
  - .2 Basis-of-Design Products: "AviProtek®" by Walker Glass/ Vitro Architectural Glass (formerly PPG) or approved equivalent meeting aesthetic and performance criteria:
    - .1 "Guardian Bird1st™ Etch" by Guardian Glass.
    - .2 "Surface One Eco-etch®" by Skyline Design.
    - .3 "PreAirSecur Etch with LowE #2" by Prelco.
- 2.5.3 Air Space 1: 14.3 mm (6/16 in.) argon filled (minimum 90% argon, 10% air)
- 2.5.4 Middle Lite: Minimum 6 mm (1/4 in) thick, heat-strengthened glass unless indicated otherwise. Provide heat-soaked tempered glass where glass must be fully tempered based on thermal stress analysis for project.
  - .1 Thickness: Thickness indicated must be considered minimum. Increase thickness as required based on engineering design and analysis.
  - .2 Glass Substrate: "Starphire low-iron" by Vitro Architectural Glass (formerly PPG)
- 2.5.5 Air Space 2: 14.3 mm (6/16 in.) argon filled (minimum 90% argon, 10% air)
- 2.5.6 Interior lite: Minimum 6 mm (1/4 in) fully-tempered unless indicated otherwise.
  - .1 Glass Substrate: "Starphire low-iron" by Vitro Architectural Glass (formerly PPG)
  - .2 Low E coating: on surface No. 5.
    - .1 Low E Basis-of-Design: "Sungate 400" by Vitro Architectural Glass (formerly PPG) or approved equivalent meeting aesthetic and performance criteria.
- 2.5.7 Performance Criteria (not including bird-frit):
  - .1 Visible Light Transmittance: 60 percent minimum.
  - .2 Exterior Solar Reflectance: 56 percent maximum +/- 1.
  - .3 Winter Nighttime U-Factor: 0.13 maximum.
  - .4 Solar Heat Gain Coefficient: 0.25 maximum.

## **2.6 Insulating Glass Unit - Triple Glazed – Guard Loads (GL1B)**

- 2.6.1 Total unit thickness: 44 mm (1-3/4 in)

- 
- 2.6.2 Exterior lite: Minimum 6 mm (1/4 in) thick, heat-strengthened glass unless indicated otherwise. Provide heat-soaked tempered glass where glass must be fully tempered based on thermal stress analysis for project.
- .1 Thickness: Thickness indicated must be considered minimum. Increase thickness as required based on engineering design and analysis.
  - .2 Glass Substrate: "Starphire low-iron" by Vitro Architectural Glass (formerly PPG)
  - .3 Low E coating: on surface No. 2.
    - .1 Low E Basis-of-Design: "Solarban 72" by Vitro Architectural Glass (formerly PPG) or approved equivalent meeting aesthetic and performance criteria.
  - .4 Bird-Friendly Coating: Acid-etched types, on surface No. 1 and complying with CSA A460 and City of Brampton Bird-Friendly Guidelines.
    - .1 Pattern: 5 mm (0.2 inch) diameter round dots, 50 mm x 50 mm (2 x 2 inch) diagonal spacing.
    - .2 Basis-of-Design Products: "AviProtek®" by Walker Glass/Vitro Architectural Glass (formerly PPG) or approved equivalent meeting aesthetic and performance criteria:
      - .1 "Guardian Bird1st™ Etch" by Guardian Glass.
      - .2 "Surface One Eco-etch®" by Skyline Design.
      - .3 "PreAirSecur Etch with LowE #2" by Prelco.
- 2.6.3 Air Space 1: 14.3 mm (6/16 in.) argon filled (minimum 90% argon, 10% air)
- 2.6.4 Middle Lite: Minimum 6 mm (1/4 in) thick, heat-strengthened glass unless indicated otherwise. Provide heat-soaked tempered glass where glass must be fully tempered based on thermal stress analysis for project.
- .1 Thickness: Thickness indicated must be considered minimum. Increase thickness as required based on engineering design and analysis.
  - .2 Glass Substrate: "Starphire low-iron" by Vitro Architectural Glass (formerly PPG)
- 2.6.5 Air Space 2: 14.3 mm (6/16 in.) argon filled (minimum 90% argon, 10% air)
- 2.6.6 Interior lite: Minimum 6 mm (1/4 in) fully-tempered, laminated unless indicated otherwise to meet OBC Guard Loads.
- .1 Glass Substrate: "Starphire low-iron" by Vitro Architectural Glass (formerly PPG)
  - .2 Low E coating: on surface No. 5.

- .1 Low E Basis-of-Design: "Sungate 400" by Vitro Architectural Glass (formerly PPG) or approved equivalent meeting aesthetic and performance criteria.

2.6.7 Performance Criteria:

- .1 Visible Light Transmittance: 60 percent minimum.
- .2 Exterior Solar Reflectance: 17 percent maximum +/- 1.
- .3 Winter Nighttime U-Factor: 0.21 maximum.
- .4 Solar Heat Gain Coefficient: 0.25 maximum.

**2.7 Insulating Glass Unit, Translucent, Double Glazed – Bird-Friendly (GL2)**

2.7.1 Total unit thickness: 44 mm (1.75 in)

2.7.2 Exterior lite: Minimum 6 mm (1/4 in) thick, heat-strengthened glass unless indicated otherwise. Provide heat-soaked tempered glass where glass must be fully tempered based on thermal stress analysis for project.

- .1 Thickness: Thickness indicated must be considered minimum. Increase thickness as required based on engineering design and analysis.
- .2 Glass Substrate: Clear
- .3 Light Diffusing Veil: on surface No. 2 and No. 3.
- .4 Bird-Friendly Coating: Acid-etched types, on surface No. 1 and complying with CSA A460 and City of Brampton Bird-Friendly Guidelines.

- .1 Pattern: 5 mm (0.2 inch) diameter round dots, 50 mm x 50 mm (2 x 2 inch) diagonal spacing.

2.7.3 Air Space: Filled with aerogel.

2.7.4 Interior lite: Minimum 6 mm (1/4 in) fully-tempered unless indicated otherwise.

- .1 Glass Substrate: Clear

2.7.5 Performance Criteria:

- .1 Visible Light Transmittance: 9-40 percent.
- .2 Winter Nighttime U-Factor: 0.11 maximum.
- .3 Solar Heat Gain Coefficient: 0.30-0.37 maximum.

2.7.6 Basis-of-Design: "Soleragel T R9 + Aerogel" by Advanced Lazing

**2.8 Insulating Glass Unit, Double Glazed (GL3)**

2.8.1 Total unit thickness: 25 mm (1 in)

2.8.2 Exterior lite: Minimum 6 mm (1/4 in) thick, heat-strengthened glass unless indicated otherwise. Provide heat-soaked tempered glass

where glass must be fully tempered based on thermal stress analysis for project.

- .1 Thickness: Thickness indicated must be considered minimum. Increase thickness as required based on engineering design and analysis.
- .2 Glass Substrate: "Starphire low-iron" by Vitro Architectural Glass (formerly PPG)
- .3 Low E coating: on surface No. 2.
  - .1 Low E Basis-of-Design: "Solarban 60" by Vitro Architectural Glass (formerly PPG) or approved equivalent meeting aesthetic and performance criteria:
    - .1 "SN 68" by Guardian Industries
    - .2 "VE 1-2M" by Viracon
    - .3 "LoE2-272" by Cardinal Glass Industries.
    - .4 "COOL-LITE SKN 176" II by Saint-Gobain Glass
  - .2 Bird-Friendly Coating: Acid-etched types, on surface No. 1 and complying with CSA A460 and City of Brampton Bird-Friendly Guidelines.
    - .1 Pattern: 5 mm (0.2 inch) diameter round dots, 50 mm x 50 mm (2 x 2 inch) diagonal spacing.
    - .2 Basis-of-Design Products: "AviProtek®" by Walker Glass/ Vitro Architectural Glass (formerly PPG) or approved equivalent meeting aesthetic and performance criteria:
      - .1 "Guardian Bird1st™ Etch" by Guardian Glass.
      - .2 "Surface One Eco-etch®" by Skyline Design.
      - .3 "PreAirSecur Etch with LowE #2" by Prelco.
- 2.8.3 Air Space: 13 mm (1/2 in.) argon filled (minimum 90% argon, 10% air)
- 2.8.4 Interior lite: Minimum 6 mm (1/4 in) fully-tempered unless indicated otherwise.
  - .1 Glass Substrate: "Starphire low-iron" by Vitro Architectural Glass (formerly PPG)
- 2.8.5 Performance Criteria:
  - .1 Visible Light Transmittance: 74 percent minimum.
  - .2 Exterior Solar Reflectance: 11 percent maximum +/- 1.
  - .3 Winter Nighttime U-Factor: 0.24 maximum.
  - .4 Solar Heat Gain Coefficient: 0.41 maximum.

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**2.9      Glazing Materials And Accessories**

- 2.9.1 Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated on Drawings and Schedules, and with a proven record of compatibility with surfaces contacted in installation.
- 2.9.2 Refer to Section 08 80 05 for additional requirements.

**2.10     Fabrication**

- 2.10.1 General Glass Fabrication Requirements: ASTM C1036, Type I, Quality-Q3, Class I (clear) or equivalent to CAN/CGSB-12.2.
- 2.10.2 Fabricate glazing units in sizes required to fit openings indicated on Drawings and Schedules for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

**3 .      EXECUTION**

**3.1      Examination**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.
- 3.1.2 Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
  - .1 Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
  - .2 Presence and functioning of weep systems.
  - .3 Minimum required face and edge clearances.
  - .4 Effective sealing between joints of glass-framing members.

**3.2      Preconstruction Testing**

- 3.2.1 Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
  - .1 Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
  - .2 Use ASTM C1087 to determine whether priming and other specific joint-preparation techniques are required to obtain

rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.

- .3 Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
- .4 Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
- .5 For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

### **3.3 Installation**

- 3.3.1 Installation, generally: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.
- 3.3.2 Refer to Section 08 80 05 as supplemented by requirements specified in this Section.

### **3.4 Preparation**

- 3.4.1 Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- 3.4.2 Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

### **3.5 Protection**

- 3.5.1 Protect exterior glass and glazing from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades.
- 3.5.2 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in writing by affected material's manufacturer. Do not use materials or process that can damage finishes, surfaces, or construction.
- 3.5.3 Promptly replace exterior glass and glazing work damaged during construction that cannot be satisfactorily repaired.

### **3.6 Cleaning And Waste Management**

- 3.6.1 Cleaning and Waste Management, generally: in accordance with Section 01 74 00, Cleaning and Waste Management.

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- 3.6.2 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
  - 3.6.3 Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Performance of the Work. Wash glass as recommended in writing by glass manufacturer.
  - 3.6.4 Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**END OF SECTION**

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the interior glass and glazing work specified herein. This includes, but is not necessarily limited, to:
  - .1 Glazing for interior applications including, but not limited to:
    - .1 swing doors, borrowed lites and screens.
    - .2 sliding doors, manual and automatic.
    - .3 custom mirrors.
    - .4 all-glass screens and entrances.
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only:
  - .1 Section 08 80 05 – General Requirements for Glass and Glazing

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

### **1.4 Definitions**

- 1.4.1 Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.



1.4.2 Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C1036.

1.4.3 Glazing cavity: Space between lites of an air-gap unit.

## **1.5 Preinstallation Meetings**

1.5.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.

1.5.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.

- .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.
- .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.
- .3 Agenda:
  - .1 Review progress of related construction activities and preparations for particular activity under consideration.
  - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
- .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
- .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

## **1.6 Submittals**

1.6.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.

1.6.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for interior glass and glazing work specified in this Section.

1.6.3 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:

- .1 Include plans, elevations, sections and details as applicable.
- .2 Indicate field-measured dimensions on Shop Drawings.

1.6.4 Delegated Design Submittals:

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- .1 Engineering design completion of interior glass and glazing work is delegated to Contractor based on structural design criteria indicated in Contract Documents.
  - .2 Submit Shop Drawings for work of this Section that bear the stamp of a Professional Engineer registered in Province of Ontario.
  - .3 Submit copy of structural calculations upon request by Consultant.
- 1.6.5 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
- .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
  - .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
  - .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.6.6 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:
- .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.
  - .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.6.7 Low-Emitting Materials: For applicable Products specified or used for activities of this Section (i.e., site-applied coatings, adhesives, and sealants), submit certifications from third-party organizations indicating compliance with following:
- .1 VOC Emissions: California Department of Public Health (CDPH) Standard Method v1.2–2017, using applicable exposure scenario.
  - .2 VOC Content: SCAQMD Rule 1113 (for paints and coatings) and SCAQMD Rule 1168 (for adhesives and sealants).
- 1.6.8 Samples: Submit selection and verification samples for Products requiring colour, texture, or design selection. Submit manufacturer's list of finishes or colour swatches for Consultant's selection.
- .1 As a minimum submit samples of the following:
    - .1 Specialty and decorative glazing materials.

- 1.6.9 Glazing Schedule: Submit glazing schedule list of glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings and Schedules.

**1.7 Closeout Submittals**

- 1.7.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.
- 1.7.2 Operating and Maintenance Data: Submit care and maintenance instructions for interior glass and glazing to be included in building operation and maintenance manual.
- 1.7.3 Warranty Documentation: Submit copy of extended warranties specified in this Section.

**1.8 Quality Assurance**

- 1.8.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.
- 1.8.2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.
- 1.8.3 Professional Engineer's Qualifications: Employ Professional Engineer licensed to practice in Province of Ontario who carries professional liability insurance and has at least five years' experience providing engineering services of similar kind, scope, and complexity.
- .1 Professional Engineer's Responsibility:
- .1 production and review of Shop Drawings,
- .2 design and certification of interior glass and glazing, including attachments for building construction, in accordance with applicable codes and regulations,
- .3 stamping and signing of each Shop Drawing and associated calculations
- 1.8.4 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.
- 1.8.5 Mock-Ups / First Installation Review: Construct mock-ups to verify selections made under submittals, demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

- .1 Location: In-situ (i.e. first installation), as directed on site by Consultant.
- .2 Purpose: To set benchmarks for installation and to judge subsequent work. Maintain Mock-ups during construction in undisturbed condition.
- .3 Reviewed mock-ups: May become part of the completed work if undisturbed at the time of Substantial Performance of The work, provided they are undisturbed, and comply with requirements outlined in Contract Documents.

**1.9 Delivery, Storage And Handling**

- 1.9.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.
- 1.9.2 Deliver, store and handle interior glass and glazing materials in accordance with manufacturer's written instructions.
- 1.9.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.9.4 Store materials in off-ground, in clean, dry, well-ventilated area.
- 1.9.5 Replace defective or damaged materials with new.

**1.10 Field Conditions**

- 1.10.1 Environmental Restrictions: Do not deliver or install interior glass and glazing until building is enclosed, wet work is complete, and HVAC system is operational and will maintain temperature and relative humidity levels equal to occupancy levels for remainder of construction period.
- 1.10.2 Field Measurements: Verify actual dimensions of construction contiguous with interior glass and glazing by field measurements before fabrication.
- 1.10.3 Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 7 deg C (44 deg F).

**1.11 Warranty**

- 1.11.1 Extended warranty: Submit for Owner's review and acceptance, manufacturer's extended warranty in which manufacturer commits to repair or replace components of interior glass and glazing that fail within specified warranty period. Manufacturer's extended warranty is in addition to, and does not supersede, any other rights that Owner may have under Contract Documents.
  - .1 Warranty Period: Not less than 5 years from date of Substantial Performance of The work.

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## **2 . PRODUCTS**

### **2.1 Manufacturers**

2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:

.1 Fire-rated Glazing:

- .1 Nippon Electric Glass Co., Ltd. / Technical Glass Products (TGP)
- .2 Pilkington Group Limited / Technical Glass Products (TGP)
- .3 Safti First
- .4 Schott North America, Inc.
- .5 Vetrotech Saint-Gobain

.2 Glazing Sealant:

- .1 Dow Chemical of Canada ULC
- .2 GE Advanced Materials - Silicones
- .3 Pecora Corporation
- .4 Sika Corporation, Construction Products Division
- .5 Tremco Incorporated

.3 Ultraclear (low-iron) Glass:

- .1 Cardinal Glass
- .2 Guardian Glass Industries
- .3 Pilkington North America
- .4 Saint-Gobain Glass
- .5 Vitro Architectural Glass (formerly PPG Industries, Inc.)

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

### **2.2 Performance / Design Criteria**

2.2.1 Unless indicated otherwise, all interior glazing to ultraclear / 'low-iron' type.

2.2.2 Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

2.2.3 VOC Content and Emissions:

- .1 VOC Emissions: For applicable items in this Section, comply with CDPH Standard Method v1.2–2017 (CA Spec 01350) and ensure products are certified per UL 2818, SCS Global Gold, or equivalent.

- .2 VOC Content Requirements: Wet-applied materials used in scope of this Section must conform to the following:
  - .1 Paints and Coatings: SCAQMD Rule 1113 or CARB SCM.
  - .2 Adhesives and Sealants: SCAQMD Rule 1168.
  - .3 Methylene chloride and perchloroethylene must not be intentionally added in paints, coatings, adhesives, or sealants.

**2.3     Glass Materials, Generally**

- 2.3.1 Refer to Section 08 80 05.

**2.4     Tempered Glass (GL10)**

- 2.4.1 Low-iron, ASTM C1048 Type I; Quality-Q3; Class I (clear); Kind FT or equivalent to CAN/CGSB-12.1. Perform heat strengthening using horizontal tong free method; surface compression not less than 69 MPa (10,000 psi). Glazing must comply with testing requirements in 16 CFR 1201 for Category II materials.
- 2.4.2 Refer to Drawings for thickness.
- 2.4.3 Acceptable Low-Iron Products:
  - .1 Optiwhite - Pilkington North America
  - .2 Starphire Ultra-Clear Glass - Vitro Architectural Glass
  - .3 Guardian UltraClear - Guardian Industries Corp.
  - .4 Diamant - Saint-Gobain Glass

**2.5     Laminated Glass (GL11, GL12, GL13)**

- 2.5.1 Low-iron, ASTM C1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified in this Section. Use materials that have a proven record of no tendency to bubble, discolour, or lose physical and mechanical properties after fabrication and installation.
- 2.5.2 Construction: Unless indicated otherwise, laminate glass with interlayer to comply with interlayer manufacturer's written recommendations and specifications indicated for individual assemblies.
  - .1 Interlayer Thickness: Provide thickness indicated in specific assemblies and as needed to comply with requirements, but not less than 1.5 mm (60 mil). Provide ionoplast (SGP) interlayer at guards, and PVB at other locations.
  - .2 Assembly thickness: Refer to Drawings for thickness.
  - .3 Refer to Section 08 87 00, Glazing Surface Films for applied films.

.4 Interlayer Colour: Clear unless otherwise indicated.

2.5.3 Acceptable Low-Iron Products:

- .1 Optiwhite - Pilkington North America
- .2 Starphire Ultra-Clear Glass - Vitro Architectural Glass
- .3 Guardian UltraClear - Guardian Industries Corp.
- .4 Diamant - Saint-Gobain Glass

**2.6 Fire-Rated Glass (GL14)**

2.6.1 Following types are acceptable: to CAN/ULC S104 and CAN/ULC S106.

.1 Film-Faced Type: Clear, ceramic flat glass; 13-mm (1/2-inch) nominal thickness; faced on one surface with a clear glazing film; complying with testing requirements in 16 CFR 1201 for Category II materials.

.1 Acceptable Products:

- .1 "FireLite NT" by Nippon Electric Glass Co., Ltd.  
(distributed by Technical Glass Products)
- .2 "Pyran Platinum F" by Schott North America, Inc.  
(McGrory Glass),
- .3 "Keralite F" by Vetrotech Saint-Gobain

.2 Laminated glass made from multiple plies of uncoated, clear glass; with intumescent interlayers or fully transparent, heat-absorbing gel; complying with testing requirements in 16 CFR 1201 for Category II materials and CAN/ULC S101.

.1 Acceptable Products:

- .1 "Pyrobel" by AGC (McGrory Glass),
- .2 "PyroStop" by Pilkington Group Limited  
(distributed by Technical Glass Products)
- .3 "SGG Contraflam" or "SGG Swissflam" by  
Vetrotech Saint-Gobain (McGrory Glass),
- .4 "SuperLite II" by Safli First

**2.7 Glazing Materials And Accessories**

2.7.1 Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated on Drawings and Schedules, and with a proven record of compatibility with surfaces contacted in installation.

2.7.2 Refer to Section 08 80 05 for additional requirements.

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**2.8     Fabrication**

- 2.8.1 General Glass Fabrication Requirements: ASTM C1036, Type I, Quality-Q3, Class I (clear) or equivalent to CAN/CGSB-12.2.
- 2.8.2 Fabricate glazing units in sizes required to fit openings indicated on Drawings and Schedules for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- 2.8.3 Mirrors:
  - .1 Cutouts: Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.
  - .2 Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.
  - .3 Require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.
  - .4 Apply film backing with adhesive coating over mirror backing paint as recommended in writing by film-backing manufacturer to produce a surface free of bubbles, blisters, and other imperfections.
- 2.8.4 Decorative Glass:
  - .1 Fabricate decorative glass and provide other glazing products in sizes required to glaze openings indicated on Drawings and Schedules for Project, with edge and face clearances, edge and surface conditions, and bite complying with recommendations of product manufacturer and referenced glazing standard.
  - .2 Clean cut or flat grind vertical edges of butt-glazed lites in a manner that produces square edges with slight kerfs.
- 2.8.5 Glazing Film: Apply glazing squarely aligned to glass edges, uniformly smooth, and free from tears, air bubbles, wrinkles, and rough edges in pattern indicated on reviewed Shop Drawings and with graphic images as indicated to the back face of clean glass, according to manufacturer's written instructions, including surface preparation and application temperature limitations.

**3 .     EXECUTION**

**3.1     Examination**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.



- 3.1.2 Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
  - .1 Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
  - .2 Presence and functioning of weep systems.
  - .3 Minimum required face and edge clearances.
  - .4 Effective sealing between joints of glass-framing members.

### **3.2     Preparation**

- 3.2.1 Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- 3.2.2 Examine glazing units to locate interior surfaces. Label or mark units as needed so that interior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

### **3.3     Installation**

- 3.3.1 Installation, generally: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.
- 3.3.2 Refer to Section 08 80 05 as supplemented by requirements specified in this Section.

### **3.4     Film Application**

- 3.4.1 Install film in accordance with manufacturer's instructions. Cut film edges neatly and square at a uniform distance of 3 mm (1/8 inch) to 1.5 mm (1/16 inch) of glazing sealants.
- 3.4.2 Apply slip solution on glass and adhesive to facilitate proper positioning of film.
- 3.4.3 Apply film to glass and spray film with slip solution.
- 3.4.4 Squeegee from top to bottom of window. Spray slip solution to film and squeegee again.
- 3.4.5 Bump film edge with lint-free towel wrapped around edge of a 5-way tool.
- 3.4.6 Upon completion of application, allow 30 days for moisture from film installation to dry, and to allow film to dry with no moisture dimples when viewed under normal viewing conditions.
- 3.4.7 In exterior applications, Provide edge sealing as recommended by manufacturer.

- 3.4.8 In security applications, Install film attachment system according to manufacturer's instructions. Provide minimum bead overleap as required to ensure impact-resistance specified in this Section can be achieved.

### **3.5 Mirror Installation**

- 3.5.1 Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
- 3.5.2 Provide a minimum air space of 3 mm (1/8 inch) between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.
- 3.5.3 Wall-Mounted Mirrors: Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.
- .1 Install mastic as follows:
- .1 Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material.
- .2 Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
- .3 After mastic is applied, align mirrors and press into place while maintaining a minimum air space of 3 mm (1/8 inch) between back of mirrors and mounting surface.

### **3.6 Protection**

- 3.6.1 Protect interior glass and glazing from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades.
- 3.6.2 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in writing by affected material's manufacturer. Do not use materials or process that can damage finishes, surfaces, or construction.
- 3.6.3 Promptly replace interior glass and glazing work damaged during construction that cannot be satisfactorily repaired.

### **3.7 Cleaning And Waste Management**

- 3.7.1 Cleaning and Waste Management, generally: in accordance with Section 01 74 00, Cleaning and Waste Management.

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- 3.7.2 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
  - 3.7.3 Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Performance of the Work. Wash glass as recommended in writing by glass manufacturer.
  - 3.7.4 Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**END OF SECTION**

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Glazing Surface Films specified herein. This includes, but is not necessarily limited, to:
  - .1 Glazing films as specified in this Section.
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.
  - .1 Related requirements provided below are for convenience purposes only.
    - .1 Section 08 80 05 General Requirements for Glass and Glazing

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Preinstallation Meetings**

- 1.4.1 Pre-installation Meetings: Schedule, and conduct pre-installation meeting at Project Site, in order to coordinate work of this Section, with work of related Subcontractors.
  - .1 Ensure attendance of Subcontractor performing work of this Section and representatives of manufacturers and fabricators involved in, or affected by, installation and coordination with other materials and installations that have preceded or will

follow. Advise Consultant and Owner in advance of scheduled meeting dates.

- .2 Agenda: Review progress of other construction activities and preparations for the particular activity under consideration.
- .3 Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
- .4 Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.

## **1.5 Submittals**

1.5.1 Product Data: Submit product data in accordance with Division 01 for the following:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for the Glazing Surface Films work and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Provide documentation confirming that adhesive used on for specified films is Pressure Sensitive Adhesive (PSA) allowing for removal of film at end of useful life.
- .3 Low-Emitting Materials: Submit certifications indicating compliance with the following:
  - .1 VOC Emissions: California Department of Public Health (CDPH) Standard Method v1.2–2017 "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers", using the applicable exposure scenario.
  - .2 VOC Content: SCAQMD Rule 1113 (for paints and coatings) and SCAQMD Rule 1168 (for adhesives and sealants).
  - .4 Submit copy of installation, storage and maintenance instructions.

1.5.2 Product Disclosure and Transparency:

- .1 Environmental Product Declarations (EPD): When available, submit Product-specific Type III EPD or industry-wide (generic) EPD conforming to ISO 14025 or other recognized environmental product declaration framework.
- .2 Material Ingredient Reporting: When available, submit documentation demonstrating chemical inventory of materials to at least 0.1% (1000ppm) and conforming to one of the following:
  - .1 Health Product Declaration open Standard,
  - .2 Cradle to Cradle v2 Basic level or Cradle to Cradle v3 Bronze level,

- .3 International Living Future Institute Declare
- .4 Other approved framework.
- .3 When multiple Products are specified, give preference to Products with compliant documentation.
- 1.5.3 Test Reports: Submit copy of test report demonstrating compliance with requirement specified in this Section.
- 1.5.4 Samples: Submit samples of the following items:
  - .1 For each film specified, provide two samples representing actual film colour and pattern.

## **1.6 Quality Assurance**

- 1.6.1 Manufacturer Qualifications: Provide Products for Work of this Section by manufacturer with minimum 10 years' experience in the manufacture of such materials.
- 1.6.2 Installer Qualifications: For the work of this Section, engage an entity with at least 5 years' experience in installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.
  - .1 Upon request, submit documentation confirming that installer is authorized by manufacturer to perform Work specified in this section.
- 1.6.3 Single Source Responsibility: Ensure primary materials provided in this Section are obtained from 1 source by a single manufacturer and secondary materials are obtained from sources recommended by primary materials manufacturers.
- 1.6.4 Mock-Ups: Provide mock-up as required to demonstrate quality of workmanship.
  - .1 Location: to be determined on site by Consultant.
  - .2 Do not proceed with remaining work until workmanship, colour, and sheen are confirmed by Consultant.
  - .3 Refinish mock-up area as required to produce acceptable work.

## **1.7 Delivery, Storage And Handling**

- 1.7.1 Deliver, store and handle materials in accordance with manufacturer's written instructions .
- 1.7.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

1.7.3 Storage and Handling Requirements: Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

1.7.4 Replace defective or damaged materials with new.

**1.8 Site Conditions**

1.8.1 Maintain environmental conditions (temperature, relative humidity, and ventilation) within manufacturer-specified parameters. Do not install products in conditions that exceed the manufacturer's recommended limits.

**1.9 Warranty**

1.9.1 Extended Warranty: Repair or replace Glazing Surface Films that fail in materials or workmanship within specified warranty period.

- .1 Warranty Period: Five years from Substantial Performance of the Work.
- .2 Defects include, but are not limited to: loss of peel adhesive, excessive hazing and similar defects under normal use conditions.

**2 . PRODUCTS**

**2.1 Manufacturers**

2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.

- .1 3M c/o Convenience Group;  
<https://www.conveniencegroup.com/>
- .2 Solyx Films; <https://www.solyxfilms.com/>
- .3 Madico Window Films; <https://madico.com/>
- .4 Saint-Gobain Solar Gard LLC; <https://www.solargard.com/>

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

**2.2 Regulatory Requirements**

2.2.1 Fire Performance Criteria: Glazing surface films specified in this Section must comply with following criteria based on testing performed by a recognized testing agency acceptable to Authorities Having Jurisdiction.

- .1 Test Method: CAN/ULC-S102/S102.2 with following results:
  - .1 Flame-Spread Rating: not more than 25.
  - .2 Smoke-Developed Classification: not more than 55.

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**2.3     Design And Performance Requirements**

- 2.3.1 Abrasion Resistance: film must have an abrasion-resistant surface coating that results in less than a 2% increase in transmitted light haze when evaluated in accordance with ASTM D1044 utilizing 100 cycles, 500 grams weight, and CS10F Calibrase Wheel.
- 2.3.2 UV Light Rejection: Minimum of 99 percent UV light rejection (300 - 380 nm) per ASTM E903.

**2.4     Privacy Film**

- 2.4.1 Translucent, dimensionally stable cast PVC film, with pressure-sensitive clear adhesive back for adhering to glass and releasable protective backing.
  - .1 Thickness: minimum 0.08 mm (3.2 mil)
  - .2 Basis-of-Design: "Scotchcal Dusted Crystal" by 3M Canada or approved equivalent.

**2.5     Printable Decorative Glazing Film**

- 2.5.1 Optically-clear, dimensionally stable cast PVC film, with pressure-sensitive clear adhesive back for adhering to glass and releasable protective backing.
  - .1 Thickness: minimum 0.05 mm (2 mil)
  - .2 Use: Exterior and interior applications.
  - .3 Outdoor Durability: Not less than five years.
  - .4 Graphic: To be supplied by Consultant at a later date.
  - .5 Printing method: As recommended by film manufacturer to authenticate warranties.
  - .6 Overlamine: As recommended by film manufacturer for specific conditions.
  - .7 Basis-of-Design: "Scotchcal Clear View Graphic Film" or "Scotchcal Electrocut Graphic Film" (in double-sided applications) by 3M Canada or approved equivalent.

**2.6     Accessories**

- 2.6.1 Adhesive: Manufacturer's standard low-VOC pressure-sensitive adhesive (PSA) for application conditions. Clear Dry Adhesives (CDA) are not permitted.

**3 .     EXECUTION**

**3.1     Examination**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions



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which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.

**3.2      Preparation**

- 3.2.1 Thoroughly clean surfaces prior to installation. Prepare surfaces according to manufacturer's recommendations for achieving the optimal results for substrates under project conditions.

**3.3      Film Installation**

- 3.3.1 Install in accordance with manufacturer's instructions.
- 3.3.2 Cut film edges neatly and squarely at a consistent distance of 3 to 1.5 mm (1/8 to 1/16 inch) from window sealant. Replace blade tips every three to four cuts.
- 3.3.3 Spray a slip solution onto the window glass and adhesive to facilitate proper film placement.
- 3.3.4 Apply film to glass and lightly mist with slip solution.
- 3.3.5 Squeegee window from top to bottom. Spray slip solution onto film and squeegee again.
- 3.3.6 Rake film edge with lint-free towel wrapped around the edge of five-way tool.
- 3.3.7 Allow 30 days for moisture from film installation to dry thoroughly, and allow film to dry flat with no moisture dimples when viewed under normal viewing conditions.
- 3.3.8 Provide edge sealing of film in exterior applications.

**3.4      Cleaning And Protection**

- 3.4.1 Remove left over material and debris from Work area. Use necessary means to protect film before, during, and after installation.
- 3.4.2 Touch-up, repair or replace damaged products before Substantial Performance of the Work.
- 3.4.3 After application of film, wash film using common window cleaning solutions, including ammonia solutions, 30 days after application.
- 3.4.4 Protect film from scratching film by avoiding use of abrasive cleaning agents and bristle brushes. Utilize synthetic sponges or soft cloths.

**END OF SECTION**

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## 1. **GENERAL**

### 1.1 **General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### 1.2 **Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Fixed Louvers work specified herein. This includes, but is not necessarily limited, to:
- .1 Fixed, extruded-aluminum louvres.
  - .2 \Blank-off panels for louvres
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.
- .1 Related requirements provided below are for convenience purposes only.
    - .1 Section 08 11 13, Hollow Metal Doors and Frames for louvres in hollow-metal doors.
    - .2 Section 08 14 16, Flush Wood Doors for louvres in flush wood doors.
    - .3 Section 09 91 13, Exterior Painting for field painting louvres.

### 1.3 **References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### 1.4 **Definitions**

- 1.4.1 Louvre Terminology: Definitions of terms for metal louvres contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- 1.4.2 Horizontal Louvre: Louvre with horizontal blades (i.e., the axis of the blades is horizontal).
- 1.4.3 Vertical Louvre: Louvre with vertical blades (i.e., the axis of the blades is vertical).

- 1.4.4 Drainable-Blade Louvre: Louvre with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.
- 1.4.5 Wind-Driven-Rain-Resistant (Storm-resistant) Louvre: Louvre that provides specified wind-driven-rain performance, as determined by testing according to AMCA 500-L.
- 1.4.6 Windborne-Debris-Impact-Resistant Louvre: Louvre that provides specified windborne-debris-impact resistance, as determined by testing according to AMCA 540.

## **1.5      Action Submittals**

- 1.5.1 Product Data: Submit product data in accordance with Division 01 for the following:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for the Fixed Louvers work and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 For louvres specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- 1.5.2 Shop Drawings: Submit Shop Drawings in accordance with Division 01 for louvres and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
  - .1 Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
  - .2 Show mullion profiles and locations.
- 1.5.3 Samples: Submit samples in accordance with Division 01 for each type of metal finish required.
- 1.5.4 Professional Engineer's Stamped Shop Drawings and Submittals: For louvres indicated to comply with structural and seismic performance requirements and design criteria, including analysis data signed and sealed by the qualified Professional Engineer responsible for their preparation.

## **1.6      Informational Submittals**

- 1.6.1 Product Test Reports: Submit product test reports test reports based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louvre and showing compliance with performance requirements specified.

- 1.6.2 Sample Warranties: Submit sample warranties in accordance with Division 01 for extended warranties specified in this Section..

**1.7 Quality Assurance**

1.7.1 Welding Qualifications:

- .1 Provide welding in accordance with CSA W59-M performed by a fabricator and mechanics fully approved by the Canadian Welding Bureau as specified herein.
- .2 Ensure fabricator is fully certified by Canadian Welding Bureau for fusion welding of steel structures to CSA W47.1 and for fusion welding of aluminum to CSA W47.2.

- 1.7.2 Source Limitations: Obtain fixed louvres from single source from a single manufacturer where indicated to be of same type, design, or factory-applied colour finish.

**1.8 Field Conditions**

- 1.8.1 Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

**1.9 Warranty**

- 1.9.1 Extended Warranty for Finishes: Repair or replace components on which finishes fail in materials or workmanship within specified warranty period.

- .1 Deterioration includes, but is not limited to, the following:
  - .1 Colour fading more than 5 Hunter units when tested according to ASTM D2244.
  - .2 Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
  - .3 Cracking, checking, peeling, or failure of paint to adhere to bare metal.
- .2 Warranty Period: 10 years from date of Substantial Performance of the Work.

**2 . PRODUCTS**

**2.1 Manufacturers**

- 2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.

- .1 Airolite Company, LLC (The).
- .2 Construction Specialties, Inc.
- .3 Greenheck Fan Corporation.

- .4 Nystrom, Inc.
- .5 TenPlus
- .6 Ventex
- .7 E.H Price

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

## **2.2 Performance Requirements**

2.2.1 Professional Engineering Design and Certification: Design louvres, including comprehensive engineering analysis by a Professional Engineer licensed to practice in the Province of Ontario, using structural performance requirements and design criteria indicated.

2.2.2 Structural Performance: Louvres shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louvre components, noise or metal fatigue caused by louvre-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

- .1 Wind Loads: Determine loads based on pressures as indicated on Drawings.
- .2 Limit louvre member deflection  $L/180$ .
- .3 Provide additional structural supports as required to adequately secure louvres within openings.
- .4 Vibration Control: Ensure louvre members do not vibrate when subjected to above wind loading. Provide integral bosses as required.

2.2.3 Seismic Performance: Provide products and systems specified in this Section to withstand the effects of earthquake motions in accordance with OBC 4.1.8.18 and CAN/CSA S832.

- .1 Professional engineer specified in Division 01 and referenced in this Section shall be responsible for designing systems and submitting signed and sealed analysis data and Shop Drawings illustrating seismic-resistant systems.
- .2 Refer to Structural Drawings for seismic sensitivity values.

2.2.4 Louvers shall be designed to withstand a 25 psf (100 mph wind equivalent) wind load. Louver performance shall be based on tests and procedures in accordance with AMCA publication 511 and comply with the requirements of the AMCA Certified Rating Program.

2.2.5 Louver performance shall be based on tests and procedures in accordance with AMCA publication 500-L. Louver blades and

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frames shall be minimum 0.081 inch wall thickness. Louver assemblies shall be 4 inches deep with 39-degree stationary drainable blades. Louvers shall be welded construction.

- 2.2.6 Seismic Performance: Louvres, including attachments to other construction, shall withstand the effects of earthquake motions determined according to the requirements of the Ontario Building Code.
- 2.2.7 Louvre Performance Ratings (based on testing on a 1220 mm x 1220 mm (4 ft x 4ft) unit): Provide louvres complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L and AMC 511.
- 2.2.8 Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - .1 Temperature Change (Range): 67 deg C (120 deg F), ambient; 100 deg C (180 deg F), material surfaces.
- 2.2.9 SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

## **2.3 Materials**

- 2.3.1 Aluminum Extrusions: ASTM B 221M (ASTM B 221), Alloy 6063-T5, T-52, or T6.
- 2.3.2 Aluminum Sheet: ASTM B 209M (ASTM B 209), Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- 2.3.3 Fasteners: Use types and sizes to suit unit installation conditions.
  - .1 Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.
  - .2 For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
  - .3 For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.
  - .4 For fastening stainless steel, use 300 series stainless-steel fasteners.
  - .5 For color-finished louvres, use fasteners with heads that match colour of louvres.
- 2.3.4 Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187.

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**2.4     Horizontal, Wind-Driven-Rain-Resistant (Storm-Resistant) Louvre (LVR-1)**

- 2.4.1 Louvre Depth: As indicated on Drawings.
- 2.4.2 Frame and Blade Nominal Thickness: Not less than 1.52 mm (0.060 inch) for blades and 2.03 mm (0.080 inch) for frames.
- 2.4.3 Louvre Performance Ratings (based on testing on a 1220 mm x 1220 mm (4 ft x 4ft) unit):
  - .1 Free Area: Not less than 0.63 sq. m (6.76 sq. ft.) for 1220-mm- (48-inch-) wide by 1220-mm- (48-inch-) high louvre.
  - .2 Percent free area: Not less than 50.0%
  - .3 Free Area Velocity at Point of Beginning Water Penetration: Not less than 6.35 m/s (1250 fpm).
  - .4 Intake Pressure Drop: Not more than 91-Pa (0.37-inch wg) static pressure drop at 5.3 m/s (1050-fpm) free-area intake velocity.
  - .5 Exhaust Pressure Drop: Not more than 124-Pa (0.5-inch wg) static pressure drop at 6.9 m/s (1357 fpm) exhaust velocity.
  - .6 Wind-Driven Rain Performance: Class A - Not less than 99 percent effectiveness when subjected to a rainfall rate of 200 mm (8 inches) per hour.
- 2.4.4 AMCA Seal: Mark units with AMCA Certified Ratings Seal.
- 2.4.5 Basis-of-Design:
  - .1 4-inch louvre:
    - .1 "Model RS-4700" by Construction Specialties.
    - .2 "Model EHH401" by Greenheck
  - .2 5-inch louvre:
    - .1 "Model EHH501" by Greenheck
  - .3 7-inch louvre:
    - .1 "Model RS-7705" by Construction Specialties.
    - .2 "Model EHH701" by Greenheck

**2.5     Louvre Screens**

- 2.5.1 General: Provide screen at each exterior louvre.
  - .1 Screen Location for Fixed Louvres: Interior face.
  - .2 Screening Type: Bird screening.
- 2.5.2 Secure screen frames to louvre frames with stainless-steel machine screws, spaced a maximum of 150 mm (6 inches) from each corner and at 300 mm (12 inches) o.c.
- 2.5.3 Louvre Screen Frames: Fabricate with mitered corners to louvre sizes indicated.

- .1 Metal: Same type and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
- .2 Finish: Same finish as louver frames to which louver screens are attached.

2.5.4 Louvre Screening for Aluminum Louvers:

- .1 Bird Screening: Aluminum, 13-mm- (1/2-inch-) square mesh, 1.60-mm (0.063-inch) wire or flattened, expanded aluminum, 19 by 1.27 mm (3/4 by 0.050 inch) thick.

**2.6 Blank-Off Panels**

2.6.1 Insulated, Blank-Off Panels: Laminated panels consisting of an insulating core surfaced on back and front with metal sheets and attached to back of louver.

- .1 Thickness: Not less than 50 mm (2 inches) unless otherwise indicated on Drawings.
- .2 Metal Facing Sheets: Aluminum sheet, not less than 1-mm (0.039-inch) nominal thickness.
- .3 Insulating Core: Rigid, glass-fiber-board insulation or mineral wool insulation.
- .4 Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, not less than 2.03-mm (0.080-inch) nominal thickness, with corners mitered and with same finish as panels.
- .5 Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
- .6 Panel Finish: Same finish applied to louvers.
- .7 Attach blank-off panels with sheet metal screws.

**2.7 Fabrication**

- 2.7.1 Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- 2.7.2 Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- 2.7.3 Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.



- 2.7.4 Include supports, anchorages, and accessories required for complete assembly.
- 2.7.5 Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 1830 mm (72 inches) o.c., whichever is less.
  - .1 Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louvre blades. Where length of louvre exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction.
  - .2 Semirecessed Mullions: Where indicated, provide mullions partly recessed behind louvre blades so louvre blades appear continuous. Where length of louvre exceeds fabrication and handling limitations, fabricate with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.
  - .3 Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louvre frame. Where length of louvre exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.
  - .4 Exterior Corners: Prefabricated corner units with mitered and welded blades and with fully recessed mullions at corners.
- 2.7.6 Provide subsills made of same material as louvres for recessed louvres.
- 2.7.7 Join frame members to each other and to fixed louvre blades with fillet welds concealed from view unless otherwise indicated or size of louvre assembly makes bolted connections between frame members necessary.

## **2.8 Aluminum Finishes**

- 2.8.1 Finish louvres after assembly.
- 2.8.2 High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70percent PVDF resin by weight in both colour coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - .1 Colour and Gloss: As selected by Consultant from manufacturer's full range.

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### **3 .     EXECUTION**

#### **3.1     Manufacturer's Instructions**

- 3.1.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

#### **3.2     Examination**

- 3.2.1 Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- 3.2.2 Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.3     Preparation**

- 3.3.1 Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

#### **3.4     Installation**

- 3.4.1 Locate and place louvres level, plumb, and at indicated alignment with adjacent work.
- 3.4.2 Use concealed anchorages where possible. Provide brass washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- 3.4.3 Form closely fitted joints with exposed connections accurately located and secured.
- 3.4.4 Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- 3.4.5 Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- 3.4.6 Install concealed gaskets, flashings, joint fillers, and insulation as louvre installation progresses, where weathertight louvre joints are required. Comply with Section 07 92 00, Joint Sealants for sealants applied during louvre installation.

#### **3.5     Field Quality Control**

- 3.5.1 Manufacturer Services: Arrange for Product manufacturer's technical representative to:

- 
- .1 meet and discuss installation procedures and unique conditions at the Place of the Work.
  - .2 inspect substrate surfaces and recommend solutions to accommodate adverse conditions.
  - .3 periodically visit and inspect installation and report unsatisfactory conditions to Contractor.
  - .4 attend final inspection and to submit written certification that Products, systems and assemblies have been installed in accordance with manufacturer's requirements.

**3.6 Adjusting And Cleaning**

- 3.6.1 Clean exposed louvre surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- 3.6.2 Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- 3.6.3 Restore louvres damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Consultant, remove damaged units and replace with new units.
  - .1 Touch up minor abrasions in finishes with air-dried coating that matches colour and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION

## **1. GENERAL**

### **1.1 GENERAL INSTRUCTIONS**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 SUMMARY**

- 1.2.1 This Section includes the following preinstallation tests to be performed on all concrete surfaces scheduled to receive non-breathable floor finishes:
  - .1 Substrate moisture testing.
  - .2 Substrate relative humidity testing.
  - .3 Substrate alkalinity testing.
  - .4 Perform preinstallation tests on concrete floor slabs placed below, on, and above grade, including suspended floor slabs.
  - .5 Unless otherwise indicated, perform preinstallation testing for the following types of non-breathable floor finishes:
    - .1 Traffic coatings.
    - .2 Resilient sheet flooring.
    - .3 Resilient tile flooring.
    - .4 Static-control resilient flooring.
    - .5 Resinous flooring.
    - .6 Carpet tile.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project must be read as a whole, and may be directly applicable to this Section.
  - .1 Related requirements provided below are for convenience purposes only.
    - .1 Section 07 18 13 – Pedestrian Traffic Coating
    - .2 Section 07 18 16 – Vehicular Traffic Coating
    - .3 Section 09 65 18 - Resilient Linoleum Flooring.

.4 Section 09 68 13 - Carpet Tile

### **1.3 REFERENCES**

1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 – Reference Standards.

### **1.4 PRETESTING MEETING**

1.4.1 Conduct meeting at Project site. Conduct meeting with attendance and participation of the following:

- .1 Owner.
- .2 Consultant.
- .3 Interior Designer.
- .4 Contractor.
- .5 Flooring Installer(s).
- .6 Flooring manufacturer's representative.
- .7 Testing agency representative.
- .2 Review concrete substrate requirements for conditions affecting performance of flooring, including flooring manufacturer's recommendations regarding moisture, relative humidity and alkalinity tolerances and limits.
- .3 Review proposed locations and frequency of moisture, relative humidity and alkalinity tests.
- .4 Review testing agency's proposed methodology for performance of testing, and project conditions necessary to be implemented by Contractor in order to ensure optimum conditions under which tests should be performed.

### **1.5 SCHEDULING**

1.5.1 Perform initial tests only after allowing concrete to dry for a minimum of 90 days.

- .1 Ninety-day duration shall commence upon completion of curing of concrete, or upon removal of any subsequent standing water – whichever occurs last.
- .2 Provide separate line items in construction schedule to reflect the minimum 90-day drying period and the time necessary to perform the preinstallation testing.

1.5.2 Schedule testing not less than 2 or more than 4 weeks prior to scheduled flooring installation.

- 1.5.3 Comply with requirements in Division 01 Section "Construction Progress Documentation" for inclusion of concrete drying and preinstallation testing line items in Contractor's Construction Schedule.

**1.6 SUBMITTALS**

- 1.6.1 Test Reports: Submit report from Testing Agency for pre-installation tests results.
- 1.6.2 Data Loggers:
- .1 Provide manufacturer's spreadsheet for concrete relative humidity readings at a single location per grade level.
  - .2 Provide interior temperature and humidity data logger for room conditions at one location per floor.
- 1.6.3 Record Documents: Show locations of substrate moisture, relative humidity and alkalinity tests. Provide markups on floor plan indicating the location of each test and the dates tests were performed.

**1.7 QUALITY ASSURANCE**

- 1.7.1 Testing Agency Representative's Qualifications: An International Concrete Repair Institute Certified Concrete Moisture Testing Technician, Grade 1. Submit proof of qualification upon request by Consultant.

**1.8 FIELD CONDITIONS**

- 1.8.1 Areas of the building in which tests will be performed shall be maintained at the same temperature and humidity conditions as those anticipated during normal occupancy. These temperature and humidity levels shall be established and the HVAC system balanced for 48 hours prior to and during test period.
- 1.8.2 Do not perform tests until building is enclosed and weatherproof, wet work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

**2. PRODUCTS**

**2.1 TESTING MATERIALS**

- 2.1.1 Calcium Chloride Testing Kits: to ASTM F1869.
- 2.1.2 pH Meter: meeting requirements of ASTM F710.

- 2.1.3 Concrete Relative Humidity Meter: Meeting requirements of ASTM F2170.
- 2.1.4 Interior Temperature and Humidity Monitoring: Data logger system capable of documenting interior building conditions during testing periods up to 72 hours using a printable chart format.

### **3 . EXECUTION**

#### **3.1 EXAMINATION**

- 3.1.1 Examine substrates, areas, and conditions where installation of floor coverings will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for performance of preinstallation testing and comply with requirements specified.
- 3.1.2 Proceed with testing only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- 3.2.1 Mechanically remove laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair or compromise testing procedure and test results with a diamond-tooled grinder. Grind an area of at least 20 by 20-inches in the area each moisture test is to be placed.
  - .1 Tests sites shall be cleaned not less than 24 hours prior to the placement of test kits.
- 3.2.2 Broom and vacuum clean substrates to be covered immediately before installing test kits. Do not proceed with installation until unsatisfactory conditions have been corrected.

#### **3.3 PREINSTALLATION TESTING, GENERAL**

- 3.3.1 Testing shall be performed by qualified personnel of the Testing Agency.
- 3.3.2 Cost of testing shall be included in Contract Price.
- 3.3.3 Test Report Documentation:
  - .1 Provide a diagrammatic floor plan of the building indicating each test site location. Designate each test site by a unique number or letter identifier.
  - .2 Test Report Form: Use form included at the end of this Section, or substantially similar form furnished by Testing Agency. Test reports shall include the following minimum information, in tabular form:
    - .1 General Information:

- 
- .1 Name of Project.
  - .2 Name of Testing Agency.
  - .3 Name and title of Testing Agency Representative.
  - .4 Test site identifier, correlated to identifier on floor plan, and on concrete surface near test placement.
  - .5 Location of each test, by Room number designation on Drawings.
  - .2 Calcium Chloride Tests:
    - .1 Date and time of preparation of the test sites.
    - .2 Weight of moisture kits, and date and time kits were set in place.
    - .3 Date and time moisture kits were gathered, and post-weight of kit.
    - .4 Elapsed time of test duration.
    - .5 Total weight gain of each test kit.
    - .6 Moisture vapour emission rate (MVER).
  - .3 Relative Humidity Tests:
    - .1 Date and time RH test sleeves were set in place.
    - .2 Depth of hole in inches, from top of slab.
    - .3 Date and time relative humidity and temperature of ambient conditions were documented.
    - .4 Date and time relative humidity and temperature of concrete were documented.
    - .5 Make, model, and last calibration date of the instrument used to make the measurements.
  - .4 Concrete pH Tests: Record pH level of concrete surface at test site.
- 3.3.4 Provide 3 tests for the first 1,000 square feet of floor area plus one 1 additional test for each 1,000 square feet thereafter. Locate tests in various parts of the floor area including the center of the floor and sites of potential moisture such as the perimeter of the floor, joints, or cracks.
- 3.3.5 Install a data logger to record temperature and humidity during entire testing process at a minimum of one data logger per floor level.

### **3.4 SUBSTRATE MOISTURE TESTING**

- 3.4.1 General: Perform pre-installation moisture testing of the concrete slab by calcium chloride test in accordance with ASTM F1869 prior to the application of flooring products at slab on grade areas only.
- 3.4.2 Determine the change in weight of moisture-absorbing anhydrous calcium chloride and represent the amount of moisture transmitting out of the concrete slab area.



- .1 Express the value in pounds as the equivalent weight of water that is emitted from a 1,000 square foot concrete slab surface area in a 24 hour period of time.
- 3.4.3 Conduct tests by making three (3) site visits as follows:
  - .1 Site Visit No. 1 (Day 1):
    - .1 Locate and prepare test sites for:
      - .1 ASTM F1869 tests (minimum 20 inches by 20 inches)
    - .2 Remove contaminants and mechanically prepare test sites.
    - .3 Install data logger system to monitor interior temperature and relative humidity
  - .2 Site Visit No. 2 (minimum 24 hours after preparation of test sites):
    - .1 Pre-weigh test kits (maximum 20 minutes prior to setting). Scale shall report weight to 0.1 grams. Record weight and start time.
    - .2 Set moisture test kits in place and cover with dome.
    - .3 Verify operation of data logger system.
    - .4 Record ambient indoor temperature and relative humidity.
  - .3 Site Visit No. 3 (60 to 72 hours after test kits are set in place):
    - .1 Post-weigh test kits (maximum 20 minutes after removing). Scale shall report weight to 0.1 grams. Record weight and end time.
    - .2 Remove data logger system.
    - .3 Record ambient indoor temperature and relative humidity.

### **3.5 SUBSTRATE RELATIVE HUMIDITY TESTING**

- 3.5.1 Substrate Relative Humidity Testing: Perform pre-installation relative humidity testing of the concrete slab by in situ probe test, prior to the application of flooring products in accordance with ASTM F2170 at all floor levels.
- 3.5.2 Install interior room data logger to record temperature and humidity during testing process at one location per grade level.
- 3.5.3 Conduct tests by making 2 site visits over the course of 4 calendar days as follows:
  - .1 Site Visit No. 1:
    - .1 Locate and drill holes. (Approximately 15 mm in diameter to a depth of 40 percent of the slab thickness. For slabs

on grade allowed to dry from top only and a depth of 20 percent of slab thickness. For suspended slabs allow to dry from both top and bottom, (decks not in metal pan). Hole diameter shall not exceed outside diameter of the insert able test sleeve by more than 0.04 inch. Drilling operation must be dry.

- .2 Vacuum holes to remove dust and debris.
- .3 Insert a hole liner, or sleeve, to the full depth of test hole, ensuring that the liner is capped or plugged at the end protruding from the concrete surface.
- .4 Record temperature and relative humidity in hole.
- .5 Record ambient indoor air temperature and relative humidity.
- .6 Connect pre-programmed data logger unit to record readings at one RH test location per grade level. Unit shall provide readings every hour for 72 hours total.
- .2 Site Visit No. 2, 72 hours after probe placement:
  - .1 Remove sleeve cap.
  - .2 Connect probe and digital meter.
  - .3 Read and record temperature and relative humidity in concrete at the test site.
  - .4 Record alkalinity of slab surface in vicinity of test site.
  - .5 Record temperature and relative humidity in hole.
  - .6 Record ambient indoor temperature and relative humidity.
  - .7 Disconnect data logger unit and retrieve test results.
- 3.5.4 Perform tests concurrently with, and in close proximity to, the calcium chloride tests.
- 3.5.5 Mark each test location directly on concrete surface using a black marker and identify on diagrammatic floor plans.

### **3.6 QUANTIFYING ALKALINITY LEVEL**

- 3.6.1 At each substrate relative humidity test site perform alkalinity test as follows:
  - .1 Place several drops of distilled or de-ionized water or liquid recommend by tester manufacturer onto concrete surface to form a puddle approximately 1 inch in diameter.
  - .2 Allow the water to set for approximately 60 seconds.
  - .3 Expose calibrated meter tip or pH strip into liquid and allow meter to calculate pH result for 15 seconds in accordance with manufactures recommendations.

3.6.2 Record and report results to the nearest hundredth.

### **3.7 TEST REPORTS**

3.7.1 Test Reports: Prepare and submit certified written reports that include the following:

- .1 Date of issue.
- .2 Project title and number.
- .3 Name, address, and telephone number of testing agency.
- .4 Dates and locations of test sites.
- .5 Test site number, corresponding to number on diagrammatic floor plan.
- .6 Names of individuals performing tests.
- .7 Description of the test method.
- .8 Complete test data.
- .9 Test results and an interpretation of test results.
- .10 Comments or professional opinion on whether tested Work complies with the Contract Document requirements.
- .11 Name and signature of testing agency representative.
- .12 Recommendations on retesting and reinspecting.

3.7.2 Acceptable test results for all flooring products:

- .1 75% RH.
- .2 Less than 9.0 pH.
- .3 Manufacturer's tolerances may vary, notify Owner and Consultant in writing of unacceptable conditions. Installation of flooring deems acceptance of on-site conditions for a warranted installation.

3.7.3 Submit a certified written report of each test to Consultant, with copy to Contractor. Interpret tests and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

- .1 Provide test results in format shown at end of this section.

### **3.8 REPAIR AND PROTECTION**

3.8.1 General: On completion of testing, repair damaged construction and restore substrates and finishes.

- .1 Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas so that they are as invisible as possible.

3.8.2 Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for testing services.

**Regional Municipality  
of Peel  
Procurement Division**

**Document 2024-346P  
CONSTRUCTION OF THE  
DOCKSTEADER PRPS  
REPORTING STATION**

**Division 09  
09 05 65  
Preinstallation Testing  
for Flooring**

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END OF SECTION

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the CCDC 5B-2010 Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the tactile warning surfacing work specified herein. This includes, but is not necessarily limited to:
- .1 Surface-applied detectable warning indicators.
  - .2 Surface-applied detectable warning tiles.
  - .3 Carborundrum inserts.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Preinstallation Meetings**

- 1.4.1 Preinstallation Conference: Conduct conference at Project site.

### **1.5 Action Submittals**

- 1.5.1 Product Data: Submit product data in accordance with Division 01 for each type of product.
- 1.5.2 Samples for Verification: Submit samples of verification in accordance with Division 01, for each type of tactile warning surface, in manufacturer's standard sizes unless otherwise indicated, showing edge condition, truncated-dome pattern, texture, colour, and cross section; with fasteners and anchors.

### **1.6 Closeout Submittals**

- 1.6.1 Maintenance Data: Submit maintenance data in accordance with Division 01, for tactile warning surfacing, to include in maintenance manuals.

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**1.7     Quality Assurance**

1.7.1 Mock-ups: Build mock-ups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

- .1 Subject to compliance with requirements, reviewed mock-ups may become part of the completed Work if undisturbed at time of Substantial Performance of the Work.

**1.8     Warranty**

1.8.1 Provide warranty covering the Work of this Section in accordance with Supplementary Condition SC49 / GC 12.3 WARRANTY.

**2 .     PRODUCTS**

**2.1     Design And Performance Requirements**

2.1.1 Accessibility Requirements: Comply with applicable provisions in OBC, CSA B651, ISO/TC 59/SC16 N140 and AODA for tactile warning surfaces.

- .1 For tactile warning surfaces composed of multiple units, provide units that when installed provide consistent side-to-side and end-to-end dome spacing that complies with requirements.

2.1.2 Source Limitations: Obtain each type of tactile warning surfacing, joint material , setting material , anchor , and fasteners from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

2.1.3 Surface-Burning Characteristics: Per CAN/ULC-S102/S102.2 with results indicated below. Mark products with appropriate testing agency labels.

- .1 Flame-Spread Index: 25.
- .2 Smoke-Developed Index: 50 or less.

**2.2     Detectable Warning Indicators**

2.2.1 Material Tag: This item is noted as "TWS1" on Drawings and Schedules.

2.2.2 Accessible truncated-dome detectable warning indicators configured for setting in concrete surfaces, with slip-resistant surface treatment on domes and field of indicators.

- .1 Stainless-Steel Plate and Sheet: ASTM A 240/A 240M or ASTM A 666, Type 316L.
- .2 Finish and Colour: AISI #4.

- .3 Dome Spacing and Configuration: Manufacturer's standard compliant spacing to meet accessibility guidelines and as confirmed by Consultant through Shop Drawing review.
- .4 Basis-of-Design: "Small Tactile Indicators UAS-SS2218" by Urban Access Solutions or approved equivalent by Kinesik.

## **2.3 Detectable Warning Tiles**

- 2.3.1 Material Tag: This item is noted as "TWS2" on Drawings and Schedules.
- 2.3.2 Surface-Applied Detectable Warning Tiles: Accessible truncated-dome detectable warning concrete tiles configured for surface application on existing concrete walkway surfaces, with slip-resistant surface treatment on domes, field of tile, and beveled outside edges.
  - .1 Material: Cast-fibre-reinforced polymer concrete tile or Molded glass- and carbon-fibre-reinforced polyester meet fire performance criteria indicated.
  - .2 Colour: Refer to Finish Schedule on Drawings.
  - .3 Shapes and Sizes: As indicated on Drawings.
  - .4 Dome Spacing and Configuration: Manufacturer's standard compliant spacing to meet accessibility guidelines and as confirmed by Consultant through Shop Drawing review.
  - .5 Mounting: Adhered and fastened to existing concrete substrate.
  - .6 Basis-of-Design: "AccessTile FR" by Kinesik or approved equivalent by Urban Access Solutions.

## **2.4 Carborundrum Inserts**

- 2.4.1 Material Tag: This item is noted as "TWS3" on Drawings and Schedules.
- 2.4.2 Carborundrum Strips: soft textured, non-mineral, medium resilient surface bonded to a pressure-sensitive adhesive backed plastic film. For barefoot-or shoe-traffic areas.
  - .1 Colour: Contrasting colour as selected by Consultant to suit Ontario Building Code requirements.
  - .2 Size: 50 mm wide

## **2.5 Accessories**

- 2.5.1 Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of tactile warning surfaces, noncorrosive and compatible with each material joined, and complying with the following:

- .1 Fastener Heads: For nonstructural connections, use flathead or oval countersunk screws and bolts with tamper-resistant heads, colored to match tile.
- 2.5.2 Adhesive: As recommended by manufacturer for adhering tactile warning surfacing unit to concrete substrates.
- 2.5.3 Sealant: As recommended by manufacturer for sealing perimeter of tactile warning surfacing unit.

### **3 . EXECUTION**

#### **3.1 Examination**

- 3.1.1 Verify that concrete substrate is in suitable condition to begin installation according to manufacturer's written instructions. Verify that installation of tactile warning surfacing will comply with accessibility requirements upon completion.
- 3.1.2 Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 Installation Of Tactile Warning Surfacing**

- 3.2.1 Prepare substrate and install tactile warning surfacing according to manufacturer's written instructions unless otherwise indicated.
- 3.2.2 Place tactile warning surfacing units in dimensions and orientation indicated.
- 3.2.3 Tactile Warning Indicators:
  - .1 Drill hole in the substrate appropriate size for stem to fit. Clean hole of debris by air blowing.
  - .2 Ensure hole is deep enough to embed stem for entire length.
  - .3 Set indicator in adhesive as recommend by manufacturer. Inset indicator flush with surface.
  - .4 Protect installed indicators from traffic until adhesive has set.
- 3.2.4 Detectable Warning tiles:
  - .1 Lay out detectable warning tiles as indicated and mark concrete subsubstrates.
  - .2 Prepare existing surface by grinding and cleaning as recommended by manufacturer.
  - .3 Apply adhesive to back of tiles in amounts and pattern recommended by manufacturer, and set tiles in place. Firmly seat tiles in adhesive bed, eliminating air pockets and establishing full adhesion to concrete substrate. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.



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- .4 Install anchor devices through face of tiles and into concrete substrate using anchors located as recommended by manufacturer. Set heads of anchors flush with top surface of mat.
  - .5 Protect installed tiles from traffic until adhesive has set.

**3.3 Cleaning And Protection**

- 3.3.1 Remove and replace tactile warning surfacing that is broken or damaged or does not comply with requirements in this Section. Remove in complete sections from joint to joint unless otherwise approved by Consultant. Replace using tactile warning surfacing installation methods acceptable to Consultant.
- 3.3.2 Protect tactile warning surfacing from damage and maintain free of stains, discoloration, dirt, and other foreign material.

END OF SECTION

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Gypsum Board Assemblies work specified herein. This includes, but is not necessarily limited, to:
- .1 Interior gypsum board.
  - .2 Exterior gypsum board for ceilings and soffits.
  - .3 Gypsum board shaft wall assemblies.
  - .4 Non-load-bearing steel framing.
  - .5 Tile backing panels.
  - .6 Trim accessories.
  - .7 Joint treatment materials.
  - .8 Auxiliary materials.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.
- .1 Related requirements provided below are for convenience purposes only.
    - .1 Section 06 16 00, Sheathing for gypsum sheathing for exterior walls.
    - .2 Section 09 30 00, Tiling for cementitious backer units installed as substrates for ceramic tile.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Definitions**

- 1.4.1 Steel Thickness:
- .1 Base Steel Thickness: Thickness of bare steel exclusive of coatings.

- .2 Design Thickness: Target or "nominal" thickness used to determine structural properties of the cold formed Products.
- .3 Minimum Thickness: Design thickness minus minimum allowable under-tolerance required by CSA S136 (95% of design thickness) or material specification; whichever is more stringent.
- .4 Designation Thickness: For the purposes of this specification; thicknesses provided will be minimum base steel thicknesses in accordance with CSA S136 and determined by the following table:

Designation Thickness	Minimum Base Steel Thickness		Gauge No. (For reference Only)	Colour
(mils)	(in)	(mm)	Ga	
18	0.0179	0.455	25	Not Painted
33	0.0329	0.836	20	White
43	0.0428	1.087	18	Yellow
54	0.0538	1.367	16	Green
68	0.0677	1.72	14	Orange

## **1.5 Administrative Requirements**

### **1.5.1 Coordination:**

- .1 Coordinate installation of anchorages and steel weld plates and angles for casting into concrete. Supply setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

### **1.5.2 Preinstallation Meetings:** Conduct preinstallation meeting at Place of the Work prior to installation. Review requirements of Contract Documents and coordination requirements with other trades.

## **1.6 Action Submittals**

### **1.6.1 Product Data:** Submit product data in accordance with Division 01 for each type of product.

- .1 Submit manufacturer's instructions, printed product literature and data sheets for the Gypsum Board Assemblies work and include product characteristics, performance criteria, physical size, finish and limitations.

### **1.6.2 Samples:** Submit samples in accordance with Division 01 for the following products:

- .1 Trim Accessories: Full-size Sample in 300-mm- (12-inch-) long length for each trim accessory indicated in Contract Documents.
- .2 Textured Finishes: Manufacturer's standard size for each textured finish indicated in Contract Documents and on same backing for Work.
- 1.6.3 Professional Engineer's Stamped Shop Drawings and Submittals: Submit Professional Engineer's Stamped Shop Drawings and Submittals bearing Professional Engineer's seal and signature for all gypsum board assemblies 3m (9.8 ft) and over in height, and Products in this Section requiring engineering design. Include accompanying analysis data demonstrating compliance with performance requirements and design criteria.

**1.7 Informational Submittals**

- 1.7.1 Evaluation Reports: Submit evaluation reports in accordance with Division 01 for shaft wall assemblies and firestop tracks, from BMEC, CCMC, or equivalent to ICC-ES.

**1.8 Quality Assurance**

- 1.8.1 Steel Fabricator's Qualifications: Provide steel framing members from fabricator who can produce Products to meet requirements specified in this Section, and who is a member in good standing with the Canadian Sheet Steel Institute (CSSBI) or similar organization that provides verifiable code compliance program (e.g. Steel Framing Industry Association).
- 1.8.2 Mockups: Before beginning gypsum board installation, install mockups of at least 9 sq. m (100 sq. ft.) in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
  - .1 Install mockups for the following:
    - .1 Each level of gypsum board finish in this Section for use in exposed locations.
    - .2 Each texture finish indicated.
  - .2 Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
  - .3 Simulate finished lighting conditions for review of mockups.
  - .4 Reviewed mockups may become part of the completed Work if undisturbed at time of Substantial Performance of the Work.

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**1.9     Delivery, Storage And Handling**

1.9.1 Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

**1.10    Field Conditions**

1.10.1 Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

1.10.2 Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

1.10.3 Do not install panels that are wet, those that are moisture damaged, and those that are mould damaged.

.1 Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

.2 Indications that panels are mould damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

**1.11    Warranty**

1.11.1 Provide warranty covering the Work of this Section in accordance with Supplementary Condition SC49 / GC 12.3 WARRANTY.

**2 .    PRODUCTS**

**2.1     Manufacturers**

2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.

.1 Gypsum Board

.1 CertainTeed Corp.

.2 CGC Inc.

.3 Georgia-Pacific Gypsum LLC.

.4 Continental Building Products.

.2 Metal Framing:

.1 Bailey Metal Products

.2 CGC Inc.

- .3 ClarkDietrich Building Systems
- .4 Approved equivalent manufacturer who is a member in good standing with CSSBI

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

## **2.2 Performance Requirements**

- 2.2.1 Fire-Resistance-Rated Assemblies: for fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings and Schedules according to CAN/ULC-S101 or equivalent to ASTM E119 by an independent testing agency.
- 2.2.2 Seismic Performance: Provide products and systems specified in this Section to withstand the effects of earthquake motions in accordance with OBC 4.1.8.18 and CAN/CSA S832.
  - .1 Professional engineer specified in Division 01 and referenced in this Section shall be responsible for designing systems and submitting signed and sealed analysis data and Shop Drawings illustrating seismic-resistant systems.
  - .2 Refer to Structural Drawings for seismic sensitivity values.
- 2.2.3 Shaft Wall Assemblies:
  - .1 Design and size partitions surrounding elevator shafts to accommodate structural members completely within the required fire resistance rated construction, while maintaining the shaft wall rating without interruption.
  - .2 Shaftwall system for elevator shafts shall not have pointed ends of screws penetrating into shaft.
  - .3 Ensure components are compatible and tested by approved independent testing facilities acceptable to authorities having jurisdiction.
  - .4 Ensure shaftwall framing, shaftliner, gypsum board and joint treatment materials Provide fire resistance rating as noted on Drawings and Schedules according to CAN/ULC-S101 or equivalent to ASTM E119 by an independent testing agency.
- 2.2.4 STC-Rated Assemblies: for STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings and Schedules according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.
  - .1 Lightweight gypsum board is not permitted.
- 2.2.5 Moisture-resistant gypsum board: Provide moisture resistant gypsum board at all wet areas and washrooms. Provide tile backer

board at walls surrounding showers. Refer to Drawings for exact locations.

- 2.2.6 Full-height partitions: Provide full-height partitions where noted on Drawings. As a minimum, Provide full height partitions at mechanical, electrical, security, and telecommunications rooms, stairs, elevator shafts, chases and washrooms, fire-rated walls, private offices, conference rooms, and break rooms.
- 2.2.7 System Deflections: Ensure partition design can accommodate following loadings with deflection not exceeding  $L/240$  in any direction:
  - .1 Minimum Lateral Load for Partitions: 0.24 kPA (5 psf)
  - .2 Minimum Lateral Load for Firewalls: 0.51 kPA (10 psf)
  - .3 Minimum Lateral Load for Elevator Shaft Walls: 0.73 kPA (15 psf)
  - .4 Reduce deflection to  $L/360$  for partitions where tile and similar brittle finishes are indicated to be installed.
  - .5 Increase stud gauges as required to accommodate deflections criteria noted in this Section.
- 2.2.8 Gypsum Ceilings: Design suspension system to support weight of mechanical and electrical items such as air grilles and lighting fixtures and similar components with deflection limited to  $L/360$ .
  - .1 Provide adequate support to allow rotation and relocation of light fixtures.
  - .2 Design sub-framing as necessary to accommodate, and to circumvent, conflicts and interferences where ducts or other equipment prevent regular spacing of hangers.
- 2.2.9 Reinforcing: Provide in-wall reinforcing where required to support manufactured component items such as washroom accessories, casework/millwork, wall mounted equipment and similar items.

## **2.3 Interior Gypsum Board**

- 2.3.1 Gypsum Wallboard (GB or GWB):
  - .1 Commercial-grade and fire-rated type: Type X to ASTM C1396/C 1396M.
    - .1 Thickness: 15.9 mm (5/8 inch).
    - .2 Long Edges: Tapered and featured (rounded or beveled) for prefilling.
  - .3 Acceptable Products:
    - .1 "ToughRock® Fireguard or Fireguard C" by Georgia-Pacific Canada, L.P.
    - .2 "Sheetrock Firecode or Firecode C Core" by CGC Inc.

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- .3 "Drywall Type X or Type C Gypsum Board" by CertainTeed Gypsum Canada Inc.
- 2.3.2 Gypsum Ceiling Board (PSH21): ASTM C1396/C 1396M.
- .1 Thickness: 12.7 mm (1/2 inch) anti-sag sheets. Provide Type X where indicated on Drawings or required to provide fire-resistance ratings.
  - .2 Long Edges: Tapered.
  - .3 Acceptable Products:
    - .1 "Sheetrock® - Regular Gypsum Panels" or "Sheetrock® - Sag-Resistant Interior Gypsum Ceiling Board" by CGC
    - .2 "ToughRock® Gypsum Boards" or "ToughRock® CD® Ceiling Board" by Georgia-Pacific Canada, L.P.
    - .3 "Interior Ceiling Gypsum Board" by CertainTeed
- 2.3.3 Fiberglass-Mat Moisture- and Mould-Resistant Gypsum Board – Paperless (GB-MR or MRGB or GBC1): ASTM C1658/C1658M and ASTM C1396/C 1396M. With moisture- and mould-resistant core and fiberglass-mat surfaces.
- .1 Core: As shown on Drawings.
  - .2 Long Edges: Tapered.
  - .3 Mould Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274. Boards containing paper or other organic materials in their composition are not acceptable.
  - .4 Basis-of-Design Products: "SheetRock Brand Glass-Mat Panel – Mould Tough" by CGC
- 2.3.4 Impact-Resistant Gypsum Board (GB-AR or ARGB): ASTM C1629/C 1629M.
- .1 Impact resistance characteristics:
    - .1 Minimum Surface Abrasion: Level 1;
    - .2 Minimum Surface Indentation: Level 1,
    - .3 Minimum Soft body impact: Level 2.
    - .4 Minimum Hard body impact: Level 2.
  - .2 Core: As indicated on Drawings.
  - .3 Long Edges: Tapered.
  - .4 Mould Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.
  - .5 Provide for up to 1220mm on outer layer of gypsum partitions flanking corridors throughout.
  - .6 Basis-of-Design: "Fiberock® Brand AR Interior Panel" by CGC Inc.



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**2.4     Tile Backing Panels**

2.4.1 Glass-Mat, Water-Resistant Backing Board: ASTM C1178/C 1178M, with manufacturer's standard edges.

.1 Acceptable Products:

- .1 "GlasRoc Tile Backer" by CertainTeed Corp.
- .2 "DensShield Tile Backer" by Georgia-Pacific Gypsum LLC
- .3 "USG Durock™ Glass-Mat Tile Backerboard" by CGC.

.2 Core: As indicated on Drawings

.3 Mould Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274. Boards containing paper or other organic materials in their composition are not acceptable.

2.4.2 Cementitious Board - Backer Units: ANSI A118.9 and ASTM C1288 or 1325, with manufacturer's standard edges.

.1 Acceptable Products:

- .1 "FiberCement BackerBoard" by CertainTeed Corp.
- .2 "DUROCK Cement Tile Backer Board" by CGC
- .3 "PermaBase Board" by Unifix Inc.

.2 Thickness: 12.7 mm (1/2 inch).

.3 Mould Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

**2.5     Gypsum Board Shaft Wall Assemblies**

2.5.1 Fire-Resistance Rating: As indicated on Drawings and Schedules .

2.5.2 STC Rating: As indicated on Drawings and Schedules .

2.5.3 Steel Framing Members: Comply with ASTM C645 requirements for metal unless otherwise indicated on Drawings and Schedules.

.1 Protective Coating: ASTM A653/A 653M, Z180 (G60), hot-dip galvanized unless otherwise indicated on Drawings and Schedules.

.2 Studs: Manufacturer's standard profile for repetitive members, corner and end members, and fire-resistance-rated assembly indicated on Drawings and Schedules.

.1 Depth: As indicated on Drawings and Schedules .

.2 Minimum Base-Metal Thickness: 0.84 mm (20 ga - 0.033 inch; Colour: White).

.3 Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 51 mm (2 inches) long and matching studs in depth.

- .1 Minimum Base-Metal Thickness: 0.84 mm (20 ga - 0.033 inch; Colour: White).
- .4 Elevator Hoistway Entrances: Manufacturer's standard J-profile jamb strut with long-leg length of 76 mm (3 inches), matching studs in depth, and not less than 0.84 mm (20 ga - 0.033 inch; Colour: White) thick.
- 2.5.4 Gypsum Shaftliner Board, Moisture- and Mold-Resistant Type X: ASTM C1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with moisture- and mold-resistant core and surfaces.
  - .1 Acceptable Products:
    - .1 "ProRoc Moisture and Mold Resistant Shaftliner" by CertainTeed Corp.
    - .2 "Dens-Glass Ultra Shaftliner" by Georgia-Pacific Gypsum LLC
    - .3 "Firecheck Moldcheck Type X Shaftliner" by Continental Building Products.
    - .4 "Pabcore Mold Curb Shaftliner Type X" by PABCO Gypsum
    - .5 "Sheetrock Brand Mold Tough Gypsum Liner Panel" by CGC Inc.
  - .2 Thickness: 25.4 mm (1 inch).
  - .3 Long Edges: Double bevel.
  - .4 Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.
- 2.5.5 Room-Side Finish: Gypsum board.
- 2.5.6 Shaft-Side Finish: Gypsum shaftliner board, Type X.
- 2.5.7 Insulation: Sound attenuation blankets.

## **2.6 Framing Systems**

- 2.6.1 Framing Members, General: Comply with ASTM C754 for conditions indicated on Drawings and Schedules.
  - .1 Steel Sheet Components: Comply with ASTM C645 requirements for metal unless otherwise indicated. Galvannealed products are not acceptable.
  - .2 Protective Coating: ASTM A653/A 653M, Z180 (G60), hot-dip galvanized unless otherwise indicated.
    - .1 Provide ASTM A653/A653M, G90 (Z275) in heavy moisture environments such as pools, showers and similar locations.
- 2.6.2 Studs and Runners: ASTM C645. Cold-formed galvanized-steel C-studs studs and runners or dimpled steel studs and runners.

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- .1 Steel Studs and Runners:
    - .1 Minimum Base-Metal Thickness: 0.45 mm (25 ga - 0.018 inch), unless otherwise indicated. Provide heavier thicknesses where required at unrestrained heights, to frame openings or for abuse/impact resistance requirements.
      - .1 Where studs are supporting abuse- and impact-resistant partitions, provide minimum 0.836 mm (20 ga - 0.032 inch).
      - .2 At framed openings, provide manufacturer's proprietary framed opening system as specified in this Section.
      - .3 Where stud gauges are required to be increased for unrestrained heights, provide specialty high capacity studs as specified herein.
    - .2 Ensure runners are of depth and base-metal thickness to match studs, unless indicated otherwise.
    - .3 Depth: As indicated on Drawings.
  - .2 Specialty High Capacity Studs:
    - .1 Cold-formed galvanized-steel C-studs as per ASTM C645 with minimum equivalent strength of 227 MPa (33 ksi) but acoustic characteristics equivalent to 0.45 mm (25 ga - 0.018 inch) studs.
    - .2 Ensure runners are of depth and base-metal thickness to match studs, unless indicated otherwise.
    - .3 Depth: As indicated on Drawings.
    - .4 Basis-of-Design: "B18 (Hard Board) Stud" by Bailey Metal Products or approved equivalent.
- 2.6.3 Slip-Type Head Joints: Where indicated on Drawings and Schedules as "deflection tracks", provide one of the following:
- .1 Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated on Drawings and Schedules for studs and in width to accommodate depth of studs.
    - .1 Acceptable Products:
      - .1 "Multi-Slot Track complete with Bailey Top Deflection Clip (TDC)" by Bailey
      - .2 "Blazeframe DSL or MaxTrak Slotted Deflection Track" by Dietrich Metal Framing
      - .3 VertiClip SLD or VertiTrack VTD Series" by Steel Network Inc. (The)

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- .4 “Vertical Slip Track or Vertical Slip Track II” by Tell-  
ing Industries
  - .5 Approved equivalent.
- 2.6.4 Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated on Drawings and Schedules; in thickness not less than indicated on Drawings and Schedules for studs and in width to accommodate depth of studs.
- .1 Location: Provide at head-of-wall firestopping.
  - .2 Acceptable Products:
    - .1 "SERIES TTG Track Top Gasket" by Specified Technologies
    - .2 “CFS-TTS Firestop Top Track Seal” by Hilti or approved equivalent.
    - .3 Approved equivalent.
- 2.6.5 Metal Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated on Drawings and Schedules.
- .1 Minimum Base-Metal Thickness: 1.37 mm (16 ga - 0.054 inch)
  - .2 Location: Provide for blocking and bracing as required for fixture attachment.
  - .3 Basis-of-Design: “Backer Plate” by Bailey or approved equivalent.
- 2.6.6 Cold-Rolled Channel Bridging: Steel, 0.836 mm (20 ga - 0.032 inch) minimum base-metal thickness, with minimum 13-mm- (1/2-inch-) wide flanges.
- .1 Depth: Manufacturer’s standard but not less than 38 mm (1-1/2 inches).
  - .2 Location: As required for lateral bracing.
  - .3 Basis-of-Design: “Spazzer 9200 Bridging and Spacing Bar” by ClarkDietrich Building Systems or approved equivalent.
- 2.6.7 Cold-Rolled Furring Channels: 1.34-mm (16 ga - 0.053-inch; Colour: Green) uncoated-steel thickness, with minimum 13-mm- (1/2-inch-) wide flanges.
- .1 Depth: As indicated on Drawings.
- 2.6.8 Framed Openings: Manufacturer's proprietary shape used to form header beams and jambs, columns or posts, of web depths indicated, unpunched, with stiffened flanges and as follows:
- .1 Header and Jamb: Galvanized-steel, one-piece header and jamb studs complying with or exceeding requirements of ASTM C754.

- .2 Header Clip: Header bracket (HDSC). Provide attachment screw pattern per manufacturer's written instructions.
- .3 Header Flange Length: 76-mm (3-inch)
- .4 Jamb Flange Length: 76-mm (3-inch)
- .5 Minimum Yield Strength: 227 MPa (33 ksi).
- .6 Minimum Base-Steel Thickness: 1.087 mm (43 mils - 0.0428 inch - 18 ga – Colour: Yellow)
- .7 Basis-of-Design: “RedHeader PRO and Header Bracket (HDSC)” by Bailey Metal Products or approved equivalent.

## **2.7      Suspension Systems**

- 2.7.1 Tie Wire: ASTM A641/A 641M, Class 1 zinc coating, soft temper, 1.59-mm- (0.062-inch-) diameter wire, or double strand of 1.21-mm- (0.048-inch-) diameter wire.
- 2.7.2 Hanger Attachments to Concrete:
  - .1 Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, required loadings with appropriate safety factors as appropriate for the substrate.
  - .1 Uses: Securing hangers to structure.
  - .2 Type: Torque-controlled, expansion anchor
- 2.7.3 Wire Hangers: ASTM A641/A 641M, Class 1 zinc coating, soft temper, 4.12 mm (8ga - 0.16 inch; Colour: Orange) in diameter.
- 2.7.4 Flat Hangers: Steel sheet, minimum 25 by 5 mm (1 by 3/16 inch) by length required.
- 2.7.5 Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 1.34 mm (0.053 inch) and minimum 13-mm- (1/2-inch-) wide flanges.
  - .1 Depth: As required for loadings, but not less than 38 mm (1-1/2 inch)
- 2.7.6 Furring Channels (Furring Members):
  - .1 Cold-Rolled Channels: 1.34-mm (16 ga - 0.053-inch; Colour: Green) uncoated-steel thickness, with minimum 13-mm- (1/2-inch-) wide flanges, 19 mm (3/4 inch) deep.
  - .2 Steel Studs and Runners: ASTM C645.
    - .1 Minimum Base-Metal Thickness: Not less than 0.45 mm (25 ga - 0.018 inch).
    - .2 Depth: As indicated on Drawings
- 2.7.7 Grid Suspension System for Gypsum Board Ceilings: At Contractor's option, following system may be used in lieu of traditional gypsum framing.

- .1 Provide ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.
  - .1 Acceptable Products:
    - .1 "Drywall Grid Systems" by Armstrong World Industries, Inc.
    - .2 "Drywall Grid System" by Chicago Metallic Corporation
    - .3 "Drywall Suspension System" by CGC Inc.

## **2.8 Auxiliary Materials**

- 2.8.1 Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- 2.8.2 Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- 2.8.3 Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- 2.8.4 Isolation Strip at Exterior Walls:
  - .1 Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 3.2 mm (1/8 inch) thick, in width to suit steel stud size.

## **2.9 Accessories**

- 2.9.1 Interior Trim: ASTM C1047.
  - .1 Material: paper-faced galvanized steel sheet.
  - .2 Shapes:
    - .1 Cornerbead.
    - .2 Bullnose bead.
    - .3 LC-Bead: J-shaped; exposed long flange receives joint compound.
    - .4 L-Bead: L-shaped; exposed long flange receives joint compound.
    - .5 U-Bead: J-shaped; exposed short flange does not receive joint compound.
    - .6 Expansion (control) joint.
    - .7 Curved-Edge Cornerbead: With notched or flexible flanges.
- 2.9.2 Exterior Trim: ASTM C1047.
  - .1 Material: Hot-dip galvanized steel sheet, plastic, or rolled zinc.
  - .2 Shapes:

- .1 Cornerbead.
  - .2 LC-Bead: J-shaped; exposed long flange receives joint compound.
  - .3 Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.
- 2.9.3 Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
- .1 Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B221M (ASTM B221), Alloy 6063-T5.
  - .2 Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.
  - .3 Acceptable Manufacturers:
    - .1 Fry Reglet Corporation.
    - .2 Gordon, Inc.
    - .3 Pittcon Industries.

## **2.10 Joint Treatment Materials**

2.10.1 General: Comply with ASTM C475/C 475M.

2.10.2 Joint Tape:

- .1 Interior Gypsum Board: Paper.
- .2 Exterior Gypsum Soffit Board: Paper.
- .3 Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
- .4 Tile Backing Panels: As recommended by panel manufacturer.

2.10.3 Joint Compound for Interior Gypsum Board: for each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

- .1 Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
- .2 Embedding and First Coat: for embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
  - .1 Use setting-type compound for installing paper-faced metal trim accessories.
- .3 Fill Coat: for second coat, use drying-type, all-purpose compound.
- .4 Finish Coat: for third coat, use drying-type, all-purpose compound.

- .5 Skim Coat: for final coat of Level 5 finish, use drying-type, all-purpose compound or high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

2.10.4 Joint Compound for Exterior Applications:

- .1 Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
- .2 Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

2.10.5 Joint Compound for Tile Backing Panels:

- .1 Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
- .2 Cementitious Backer Units: As recommended by backer unit manufacturer.
- .3 Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

**2.11 Acoustical Components**

2.11.1 Sound Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

- .1 Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- .2 One of the following types are acceptable:
  - .1 Mineral Wool (in fire-rated partitions): CAN/ULC-S702.1/S702.2, Type 1; ASTM C553 (Type VII) and non-combustible in accordance with requirements of CAN/ULC-S114. Acceptable Products:
    - .1 "Rockwool AFB® evo" by Rockwool A/S
    - .2 "Thermafiber SAFB FF" Mineral Wool Insulation
    - .3 Approved equivalent.
  - .2 Mineral Glass Fibre (in non-fire-rated partitions): CAN/ULC-S702, Type 1; ASTM C553 (TYPE VII) and non-combustible in accordance with requirements of ULC CAN/ULC-S114. Acceptable Products:
    - .1 "EcoTouch™ QuietZone® PINK™ FiberGlas® Acoustical Batts" by Owens Corning Canada LP
    - .2 "Noise Reducer Sound Attenuation Insulations" by CertainTeed.
    - .3 "Sound-Shield Formaldehyde-Free Fiber glass Insulation" by Johns Manville.



.4 Approved equivalent.

2.11.2 Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90.

.1 Acceptable Products (gun-applied):

- .1 "Smoke N Sound Acoustical Sealant" by Specified Technologies, Inc.
- .2 "SHEETROCK Acoustical Sealant" by CGC Inc.
- .3 "QuietZone Acoustic Sealant" by Owens-Corning Canada Inc.
- .4 "Tremstop Acrylic Acoustical Sealant" by Tremco Ltd.
- .5 "SilentFX® Noise Proofing Sealant by CertainTeed Inc.
- .6 "QuietSeal Pro" by Pabco Gypsum.
- .7 "CP506 – Smoke and Acoustic Sealant" by Hilti (Canada) Limited
- .8 "Tecsound CLG 5900" by Soprema Canada

.2 Acceptable Products (sprayed-on):

- .1 "CP572 – Smoke and Acoustic Spray" by Hilti or approved equivalent.

### **3 . EXECUTION**

#### **3.1 Examination**

3.1.1 Gypsum Board Assemblies:

- .1 Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.
- .2 Examine panels before installation. Reject panels that are wet, moisture damaged, and mould damaged.

3.1.2 Shaft Walls:

- .1 Examine substrates to which gypsum board shaft wall assemblies attach or abut, with Installer present, including hollow-metal frames, elevator hoistway door frames, cast-in anchors, and structural framing. Examine for compliance with requirements for installation tolerances and other conditions affecting performance.

- .2 Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.

### **3.2 Preparation**

3.2.1 Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

- .1 Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.2.2 Sprayed Fire-Resistive Materials:

- .1 Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 610 mm (24 inch) o.c.
- .2 Coordinate with gypsum board shaft wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft wall assemblies to comply with requirements specified in Section 07 81 00.
- .3 After sprayed fire-resistive materials are applied, remove only to extent necessary for installation of gypsum board assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated on Drawings and Schedules. Where excessive to material has been damaged, Provide additional material to reinstate require fire-ratings. Protect adjacent fire-resistive materials from damage.

### **3.3 Installing Framed Assemblies**

3.3.1 Installation Standard: Comply with ASTM C754.

- .1 Gypsum Plaster Assemblies: Also comply with requirements in ASTM C841 that apply to framing installation.
- .2 Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C1063 that apply to framing installation.
- .3 Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C844 that apply to framing installation.
- .4 Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.

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- 3.3.2 Install framing and accessories plumb, square, and true to line, with connections securely fastened.
  - 3.3.3 Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
  - 3.3.4 Install bracing at terminations in assemblies.
  - 3.3.5 Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.
  - 3.3.6 Install framing system components in accordance with spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
    - .1 Single-Layer Application: As indicated on Drawings or required by horizontal deflection performance requirements unless otherwise indicated.
    - .2 Multilayer Application: As indicated on Drawings or required by horizontal deflection performance requirements unless otherwise indicated.
    - .3 Tile Backing Panels: As indicated on Drawings or required by horizontal deflection performance requirements unless otherwise indicated.
  - 3.3.7 Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
  - 3.3.8 Install studs so flanges within framing system point in same direction.
  - 3.3.9 Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
    - .1 Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
    - .2 Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
      - .1 Install two studs at each jamb unless otherwise indicated.
      - .2 Install cripple studs at head adjacent to each jamb stud, with a minimum 13-mm (1/2-inch) clearance from jamb

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stud to allow for installation of control joint in finished assembly.

- .3 Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
- .3 Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
- .4 Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
  - .1 Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
- .5 Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- .6 Curved Partitions:
  - .1 Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
  - .2 Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 152 mm (6 inches) o.c.

3.3.10 Direct Furring:

- .1 Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 600 mm o.c.

3.3.11 Z-Shaped Furring Members:

- .1 Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 600 mm o.c.
- .2 At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 300 mm from corner and cut insulation to fit.

3.3.12 Installation Tolerance: Install each framing member so fastening surfaces vary not more than 3 mm (1/8 inch) from the plane formed by faces of adjacent framing.

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**3.4 Installing Ceiling Suspension Systems**

- 3.4.1 Install suspension system components in accordance with spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- .1 Hangers: 1200 mm o.c. minimum
  - .2 Carrying Channels (Main Runners): 1200 mm o.c. minimum
  - .3 Furring Channels (Furring Members): 400 mm o.c., unless otherwise indicated on Drawings.
- 3.4.2 Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- 3.4.3 Suspend hangers from building structure as follows:
- .1 Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
    - .1 Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - .2 Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
    - .1 Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
    - .2 Limit deflection to  $L/360$  unless otherwise required by loading requirements.
  - .3 Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  - .4 Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  - .5 Do not attach hangers to steel roof deck.
  - .6 Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.

- .7 Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
- .8 Do not connect or suspend steel framing from ducts, pipes, or conduit.
- 3.4.4 Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- 3.4.5 Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- 3.4.6 Installation Tolerances: Install suspension systems that are level to within 3 mm in 3.6 m (1/8 inch in 12 feet) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

### **3.5 Installing Drywall Penetration Barrier Mesh**

- 3.5.1 Install drywall-penetration barrier mesh as follows:
  - .1 Install barrier-mesh sheets with diamond running in direction most suitable.
  - .2 Install barrier-mesh clips to secure mesh to framing members.
  - .3 Join staggered mesh joints that occur on framing members.
  - .4 Overlapping mesh joints to achieve tie-in is acceptable.
  - .5 Install barrier-mesh sheets to join, begin, and terminate on framing members.
  - .6 Wire tie barrier-mesh sheets not joining on framing member shall with 18-gauge steel tie wire.
  - .7 Wire tying shall be no less frequent than mesh clip installation.

### **3.6 Applying And Finishing Panels, General**

- 3.6.1 Comply with ASTM C840.
- 3.6.2 Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- 3.6.3 Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1.5 mm (1/16 inch) of open space between panels. Do not force into place.
- 3.6.4 Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite

sides of partitions. Do not make joints other than control joints at corners of framed openings.

- 3.6.5 Form control and expansion joints with space between edges of adjoining gypsum panels.
- 3.6.6 Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
  - .1 Unless concealed application is indicated on Drawings and Schedules or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 0.7 sq. m (8 sq. ft.) in area.
  - .2 Fit gypsum panels around ducts, pipes, and conduits.
  - .3 Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 6.4- to 9.5-mm- (1/4- to 3/8-inch-) wide joints to install sealant.
- 3.6.7 Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 6.4- to 12.7-mm- (1/4- to 1/2-inch-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- 3.6.8 Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- 3.6.9 STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- 3.6.10 Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

### **3.7 Applying Interior Gypsum Board**

- 3.7.1 Install interior gypsum board in the following locations:
  - .1 Regular Wallboard Type: Vertical surfaces unless otherwise indicated.
  - .2 Type X: Where required for fire-resistance-rated assembly and where noted on Drawings.

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- .3 Flexible Type: Apply in double layer at curved assemblies.
  - .4 Ceiling Type: Ceiling surfaces unless otherwise indicated.
  - .5 Abuse-Resistant and Impact-Resistant Type: As indicated on Drawings.
  - .6 Moisture- and Mould-Resistant Type: In wet locations, and for a minimum 2.4 m (8 ft) of a plumbing fixture. Provide tile backer where tile installation is scheduled.
  - .7 Acoustically Enhanced Type: Provide in lieu of regular gypsum board where 20 ga studs are scheduled to be installed. Do not provide in lieu of abuse-resistant or impact-resistant type.
- 3.7.2 Single-Layer Application:
- .1 On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
  - .2 On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated on Drawings and Schedules or required by fire-resistance-rated assembly, and minimize end joints.
    - .1 Stagger abutting end joints not less than one framing member in alternate courses of panels.
    - .2 Where ceiling height is greater than 2.46 m (8' – 1") or wall is 1220 mm (4 ft.) wide or less, install panels using parallel application (i.e. vertically) unless otherwise indicated on Drawings and Schedules or required by fire-resistance-rated assembly.
  - .3 On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
  - .4 Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- 3.7.3 Multilayer Application:
- .1 On ceilings, apply gypsum board indicated on Drawings and Schedules for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 400 mm (16 inches) minimum, from parallel base-layer joints, unless otherwise indicated on Drawings and Schedules or required by fire-resistance-rated assembly.
  - .2 On partitions/walls, apply gypsum board indicated on Drawings and Schedules for base layers and face layers vertically (parallel to framing) with joints of base layers located



over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated on Drawings and Schedules or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.

- .3 On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
  - .4 Fastening Methods: Fasten base layers and face layers separately to supports with screws.
- 3.7.4 Laminating to Substrate: Where gypsum panels are indicated on Drawings and Schedules as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.
- 3.7.5 Curved Surfaces:
- .1 Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 300-mm- (12-inch-) long straight sections at ends of curves and tangent to them.
  - .2 Fasten base layer to studs with screws 400 mm (16 inches) o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 300 mm (12 inches) o.c.

### **3.8 Applying Exterior Gypsum Panels For Ceilings And Soffits**

- 3.8.1 Apply panels perpendicular to supports, with end joints staggered and located over supports.
- .1 Install with 6.4-mm (1/4-inch) open space where panels abut other construction or structural penetrations.
  - .2 Fasten with corrosion-resistant screws.

### **3.9 Applying Tile Backing Panels**

- 3.9.1 Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at showers, tubs, and locations indicated on Drawings and Schedules to receive tile. Install with 6.4-mm (1/4-inch) gap where panels abut other construction or penetrations.
- 3.9.2 Cementitious Backer Units: ANSI A108.11, at showers, tubs, and where indicated on Drawings and Schedules.

- 3.9.3 Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

**3.10 Installing Shaft Walls**

- 3.10.1 General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated on Drawings and Schedules, manufacturer's written installation instructions, and ASTM C754 other than stud-spacing requirements.
- 3.10.2 Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.
- 3.10.3 Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.
- .1 Elevator Hoistway: At elevator hoistway-entrance door frames, provide jamb struts on each side of door frame.
  - .2 Reinforcing: Where handrails directly attach to gypsum board shaft wall assemblies, provide galvanized steel reinforcing strip with 20 ga (33 mil) minimum thickness of base metal (uncoated), accurately positioned and secured behind at least one layer of face panel.
- 3.10.4 Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.
- 3.10.5 Isolate perimeter of gypsum panels from building structure to prevent cracking of panels, while maintaining continuity of fire-rated construction.
- 3.10.6 Firestop Tracks: Where indicated on Drawings and Schedules, install to maintain continuity of fire-resistance-rated assembly indicated on Drawings and Schedules.
- 3.10.7 Control Joints: Install control joints according to ASTM C840 and in specific locations approved by Consultant while maintaining fire-resistance rating of gypsum board shaft wall assemblies.
- 3.10.8 Sound-Rated Shaft Wall Assemblies: Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly.

- 3.10.9 Cant Panels: At projections into shaft exceeding 102 mm (4 inches), install 13- or 16-mm- (1/2- or 5/8-inch-) thick gypsum board cants covering tops of projections.
- .1 Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 610 mm (24 inches) o.c. with screws fastened to shaft wall framing.
  - .2 Where steel framing is required to support gypsum board cants, install framing at 610 mm (24 inches) o.c. and extend studs from the projection to shaft wall framing.
- 3.10.10 Installation Tolerance: Install each framing member so fastening surfaces vary not more than 3 mm (1/8 inch) from the plane formed by faces of adjacent framing.

**3.11 Installing Trim Accessories**

- 3.11.1 General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- 3.11.2 Control Joints: Install control joints according to ASTM C840 and in specific locations approved by Consultant for visual effect.
- 3.11.3 Interior Trim: Install in the following locations:
- .1 Cornerbead: Use at outside corners unless otherwise indicated on Drawings and Schedules.
  - .2 LC-Bead: Use at exposed panel edges.
  - .3 Curved-Edge Cornerbead: Use at curved openings.
- 3.11.4 Exterior Trim: Install in the following locations:
- .1 Cornerbead: Use at outside corners.
  - .2 LC-Bead: Use at exposed panel edges.
- 3.11.5 Aluminum Trim: Install in locations indicated on Drawings.

**3.12 Finishing Gypsum Board**

- 3.12.1 General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- 3.12.2 Prefill open joints, rounded or beveled edges, and damaged surface areas.
- 3.12.3 Apply joint tape over gypsum board joints, except for trim products specifically indicated on Drawings and Schedules as not intended to receive tape.

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- 3.12.4 Gypsum Board Finish Levels: Finish panels to levels indicated on Drawings and Schedules below and according to ASTM C840:
- .1 Level 1: Ceiling plenum areas, concealed areas, and where indicated on Drawings and Schedules.
  - .2 Level 2: Panels that are substrate for tile.
  - .3 Level 4: At panel surfaces that will be exposed to view unless otherwise indicated on Drawings and Schedules .
- 3.12.5 Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.
- 3.12.6 Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.
- 3.12.7 Cementitious Backer Units: Finish according to manufacturer's written instructions.

**3.13     Protection**

- 3.13.1 Protect adjacent surfaces from gypsum board compound and promptly remove from floors and other non-gypsum board surfaces. Repair surfaces stained, marred, or otherwise damaged during gypsum board application.
- 3.13.2 Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- 3.13.3 Remove and replace panels that are wet, moisture damaged, and mould damaged.
- .1 Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - .2 Indications that panels are mould damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

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## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Tiling work specified herein. This includes, but is not necessarily limited, to:

- .1 Tile materials,
- .2 Trims and edging,
- .3 Mortar, adhesive and grout materials,

- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

- .1 Related requirements provided below are for convenience purposes only.
  - .1 Section 03 35 10 – Concrete Floor Finishing
  - .2 Section 05 51 00 – Metal Stairs
  - .3 Section 06 10 00 – Rough Carpentry
  - .4 Section 07 92 00 – Joint Sealers: for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
  - .5 Section 09 21 16 – Gypsum Board Assemblies.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Definitions**

- 1.4.1 General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A326.3 apply to Work of this Section unless otherwise specified.
- 1.4.2 ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5,

ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."

- 1.4.3 Face Size: Actual tile size, excluding spacer lugs.
- 1.4.4 Module Size: Actual tile size plus joint width indicated.
- 1.4.5 Small Format Tile: Tiles having dimensions less than 100 mm x 100 mm.
- 1.4.6 Standard Format Tile: Tiles having dimensions from 100 mm x 100 mm and less than 400 mm x 400 mm.
- 1.4.7 Large Format Tile: Tiles having dimensions 400 mm x 400 mm and larger or weighing over 25 kg/sq.m (5 psf).
- 1.4.8 Gauged Porcelain Tiles/Panels: tiles with thickness ranging from 3 to 6.5mm. Gauged Porcelain Tiles are defined as tiles that measure less than 1m x 1m, while Gauged Porcelain Panels are equal to or larger than 1m x 1m.
- 1.4.9 Dry location or area: A location not normally subject to dampness.
- 1.4.10 Damp/wet location or area: Exterior or interior location that is normally or periodically subject to condensation of moisture in, on, or adjacent to, Work of this Section. This includes location in which water or other liquid can drip, splash, or flow on or against Work of this Section. This includes, but is not limited to, showers, drying areas, change rooms, kitchen areas, washrooms, and associated vestibules and corridors.

## **1.5 Administrative Requirements**

- 1.5.1 Preconstruction Meeting:
  - .1 Arrange a preconstruction meeting in accordance with Division attended by Contractor, Consultant, tile installer and tile supplier, mortar and grout representative, waterproofing membrane representative to discuss the following:
    - .1 Substrate and backing surfaces flatness requirements
    - .2 Installation techniques associated with specified materials
    - .3 Compatibility between specified materials and between adjacent materials
    - .4 Concerns arising from site conditions
    - .5 Concerns of the installer or supplier arising from as-constructed conditions
- 1.5.2 Coordination: Coordinate requirements for floor recesses and provide depth of required slab depressions to Division 03 before

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placement of concrete accounting for mortar bed, bond coat and tile thickness where finished tile surfaces are indicated on Drawings and Schedules as being installed flush with adjacent floor finishes

**1.6     Action Submittals**

- 1.6.1 Product Data: Submit manufacturer's product data for each type of product specified; indicate compliance with specification and installation recommendations of manufacturer of products being used.
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for the Tiling work and include product characteristics, performance criteria, physical size, finish and limitations.
- 1.6.2 Shop Drawings: Submit shop drawings indicating the following:
  - .1 Special tile patterns or conditions affecting installation
  - .2 Locations transitions and intersections between differing materials
  - .3 Widths, details, and locations of expansion and contraction joints, and control and isolation joints in tile substrates and finished tile surfaces
- 1.6.3 Samples for Initial Selection: Submit samples for initial selection by Consultant:
  - .1 Tile: Manufacturer's colour charts consisting of actual tiles or sections of tiles showing the full range of colours, textures, and patterns available for each type and composition of tile indicated. Include Samples of accessories involving colour selection.
  - .2 Grout: Manufacturer's colour charts consisting of actual sections of grout showing the full range of colours available for each type of grout indicated.
- 1.6.4 Samples for Verification: Submit samples for verification to Consultant including sample sets showing full range of variations expected where products involve normal colour and texture variations:
  - .1 Trims: Submit full size units of each type of trim and accessory in each colour required for installation; minimum 150 mm lengths].
  - .2 Tiles: Submit two (2) pieces of each tile specified
  - .3 Panels: Submit 300 mm x 300 mm sized panel using specified material including coloured grout mounted on 19 mm thick plywood backer; include sample installation of perimeter

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accessories, control or movement joints, and trims where applicable

**1.7 Informational Submittals**

1.7.1 Provide the following submittals during the course of the work

- .1 Certificates: Submit written statements from manufacturers indicating compatibility with respect to other manufacturer's materials where more than one manufacturer's products form a part of a single tile assembly
- .2 Master Grade Certificates: Submit for each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

**1.8 Project Closeout Submittals**

1.8.1 Operations and Maintenance Data: Submit four (4) copies of TTMAC Maintenance Guide in accordance with Division 01, and additional information as follows:

- .1 Provide specific warning of any maintenance practice or materials that may damage or disfigure the finished Work.
- .2 Provide manufacturer's maintenance data sheets for floor sealers and other non tile maintenance materials and accessories

**1.9 Maintenance Materials Submittals**

1.9.1 Provide additional materials supplied to the installation in accordance with Division 01, and as follows:

- .1 Tile Maintenance Materials: Deliver 2% of total for each tile material used for the project, packaged neatly in original containers to prevent damage, from the same lot or batch with a minimum of 1 (one) box pieces of each colour and type use for the project; clearly marked to identify the following:
  - .1 Manufacturer and distributor's name.
  - .2 Material series name and stocking number
  - .3 Material description, including colour and pattern

**1.10 Quality Assurance**

1.10.1 Qualifications: Provide proof of qualifications when requested by Consultant:

- .1 Project Quality Standard: Tile Installation Manual published by the TTMAC, together with authorized additions and amendments will be used as a reference standard and forms part of this project specification.
- .2 Installer: Execute Work of this Section using a company employing qualified personnel skilled in ceramic tile installation,



that is a member in good standing of TTMAC at time of Bidding, having a minimum of five (5) years proven experience and having completed tile installations similar in material, design, and extent to that indicated for this Project

- .3 Supplier: Obtain each specified material from one source with resources to provide products from the same production run for each contiguous area consistent in quality, appearance and physical properties

#### 1.10.2 Mock-Ups

- .1 Provide required Mock-ups in accordance with Division 01, and as follows:
- .2 Construct mock-ups for each form of construction and finish required to verify selections made under Sample submittals and to demonstrate aesthetic effects and qualities of materials and execution
- .3 Mock-up one (1) typical washroom indicating tile pattern, grout colour and accessories indicated:
  - .1 Mock-up will be used to coordinate placement of miscellaneous specialties and other related components as well as clearances to adjacent appurtenances (electrical and mechanical fixtures) and finishes.
  - .2 Consultant will require modifications pertaining to aesthetics and placement of components that interfere with other materials or fixtures.
  - .3 When identified modifications to the mock-up are completed, reviewed, and accepted by the Consultant, they will form the standard of acceptance for the remainder of the Work.
- .4 Locate mock-ups where directed on site in the location and of the size indicated or, if not indicated, as directed by Consultant.
- .5 Notify Consultant seven (7) days in advance of the dates and times when mock-ups will be constructed.
- .6 Obtain Consultant's acceptance of mock-ups before proceeding with final unit of Work.
- .7 Accepted mock-ups in an undisturbed condition at the time of Substantial Performance may become part of the completed Work.

#### 1.10.3 Single Source Responsibility:

- .1 Source Limitations for Tile: Obtain tile of each type and colour or finish from single source or producer.

- .1 Obtain tile of each type and colour or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- .2 Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
  - .1 Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
  - .2 Obtain waterproofing membrane, except for sheet products, from manufacturer of setting and grouting materials.
- .3 Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
  - .1 Stone thresholds.
  - .2 Waterproofing membrane.
  - .3 Crack isolation membrane.
  - .4 Cementitious backer units.
  - .5 Metal edge strips.

#### **1.11 Delivery, Storage, And Handling**

##### **1.11.1 Packaging Requirements: Packaging is required to list the following:**

- .1 Markings: Manufacturer's mark or trademark, product name and country of origin; also include on edge or back side of tile.
- .2 Quality: Indication of First Quality.
- .3 Type of Tile: Indicate tile type as described by relevant reference standard.
- .4 Dimensions: Tile sizing indicating nominal dimensions and working size, and whether sizing is modular or non-modular.
- .5 Surface: Indicating glazed or unglazed surface finish.
- .6 Additional Preparation: Indication of whether tiles require any site preparation or surface treatments.
- .7 Weight: Total dry weight that tile and packaging is not to exceed.

##### **1.11.2 Delivery and Acceptance Requirements: Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use in accordance with ANSI A108.1 for labelling sealed tile packages.**

- 1.11.3 Storage and Handling Requirements: Store materials to prevent damage or contamination to materials by water, freezing, foreign matter, and other causes; store cementitious materials in a dry area, and blocked off floor and ground surfaces.

**1.12 Site Conditions**

- 1.12.1 Ambient Conditions: Apply tile after completion of work by other Sections is complete; to surfaces sufficiently dry, clean, firm, level, plumb and free from oil or wax or any other material harmful to tile adhesion and as follows:

- .1 Temperature: Maintain tile materials and substrate temperature between TTMAC recommended minimum and maximum temperature range; unless indicated otherwise by manufacturer, as follows:

- .1 Tile and Cementitious Materials: Install tiles between 12 deg C (54 deg F) and 38 deg C (100 deg F), meeting installation material manufacturer's written recommendations.

- .2 Epoxy Materials: Install epoxy mortar and grouts between 18 deg C (65 deg F) and 35 deg C (95 deg F), meeting installation material manufacturer's written recommendations.

- .3 Curing Time: Maintain temperature range for 48 hours before and during installation and maintain temperature range until materials are fully set and cured in accordance with manufacturer's recommendations, and as follows:

- .1 Provide additional heat when there is a risk that surface temperatures may drop below minimum recommended temperatures.
- .2 Provide cooling or wait until temperature range is below maximum recommended temperatures; do not install materials when temperature is at or above maximum recommended temperature.

- 1.12.2 Ventilation: Maintain adequate ventilation where Work of this Section generates toxic gases or where there is a risk of raising relative humidity to levels that could damage building finishes and assemblies

**1.13 Warranty**

- 1.13.1 Provide warranty covering the Work of this Section in accordance with Supplementary Condition SC49 / GC 12.3 WARRANTY.

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## **2 .     PRODUCTS**

### **2.1     Manufacturers**

- 2.1.1 Acceptable Mortar and Grout Manufacturers: tile mortar and grout materials from the following listed manufacturers are considered acceptable for use in this project:
- .1 Ardex Engineered Cements.
  - .2 Flextile Ltd.
  - .3 Kiesel GmbH.
  - .4 Laticrete International Inc.
  - .5 Mapei Inc.
  - .6 Proma Adhesives Inc.
  - .7 Custom Building Products
- 2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

### **2.2     Performance Requirements**

- 2.2.1 Provide tile products manufactured and tested in accordance with ANSI A108.1, ANSI A326.3, ANSI A137.3 or ISO 10545 as appropriate to the Basis-of-Design Materials listed on the Drawings.
- 2.2.2 Slip Resistance: Provide materials having a minimum Dynamic Coefficient of Friction (DCOF) of 0.42 wet in accordance with ANSI A326.3 when tested using the BOT 3000 Digital Tribometer.
- 2.2.3 Floor Traffic Load Bearing Performance: Provide installations rated for the following load bearing performance in accordance with ASTM C627 for ceramic tile installed on walkway surfaces:
- .1 Extra Heavy: Passes cycles 1 through 14
  - .2 Heavy: Passes cycles 1 through 12
  - .3 Moderate: Passes cycles 1 through 10
  - .4 Light: Passes cycles 1 through 6
  - .5 Residential: Passes cycles 1 through 3
- 2.2.4 Substrate and Backing Surface Flatness Tolerances: Section 03 35 10 establishes a flatness requirement for FF25 for slabs on grade for in place concrete and is considered as the starting flatness for work of this Section; final measurement for flatness and level using mortar bed or self levelling screed materials provided by this Section will be measured in same manner as specified in Section 03 35 10 to achieve the following:
- .1 Small Format Floor Tile: floor flatness as specified in Section 03 35 10.

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- .2 Standard Format Floor Tile: floor flatness measured to a minimum FF35; equivalent to 5 mm with no more than 2 gaps under a 3000 mm straightedge measurement.
  - .3 Large Format Floor Tile: floor flatness measured to a minimum of FF50; equivalent to 3 mm with no more than 2 gaps under 3000 mm straightedge measurement
  - .4 Wall Tiles: Provide wall levelling similar to that specified for floors for tiles having similar sizes listed above.
- 2.2.5 Factory Blending: For tile exhibiting colour variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colours as those taken from other packages and match Samples reviewed by Consultant.
  - 2.2.6 Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
- 2.3 Tile Materials (TL-#)**
- 2.3.1 Material Tag: This item is noted as "TL-#" on Drawings and Schedules.
  - 2.3.2 Basis-of-Design: Refer to Finish Schedule on Drawings.
- 2.4 Trims And Edging**
- 2.4.1 Trims: Provide tile trim shapes and profiles to match colour and finish of adjoining tile. Provide trims coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
    - .1 Size: Coordinated with sizes and coursing of adjoining flat tile where applicable.
    - .2 Provide base cove, base cap, stair nosings, wainscot cap, external corners, internal corners and tapered transition as required.
  - 2.4.2 Straight Edge and Transition Strips: clear satin anodized edge strips, with height as required to suit tile installation; with integral perforated anchoring leg for setting the strip into the setting material and as follows:
    - .1 Same-height Transitions: Provide L-shaped profile with 3 mm (1/8") wide visible surface, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
      - .1 Acceptable Products: "Schluter-SCHIENE" by Schlüter Systems or approved equivalent.
    - .2 Varying-height (Sloped) Transitions: ADA compliant-type. Provide minimum width to height ratio to conform to barrier-free

requirements specified in CSA B651. Following types are acceptable:

- .1 Unless otherwise indicated, Provide profile with sloped exposed surface, 4 mm (5/32") tall leading edge, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
    - .1 Acceptable Products: "Schluter-RENO-U" by Schlüter Systems or approved equivalent.
  - .2 Ramps: Provide ramp profile with textured, sloped exposed surface, tapered leading edge, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
    - .1 Acceptable Products: "Schluter-RENO-RAMP/-K" by Schlüter Systems or approved equivalent.
  - .3 Tile-to-Carpet Transitions: Provide profile with sloped exposed surface, 6 mm (1/4") deep channel below exposed surface, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
    - .1 Acceptable Products: "Schluter®-RENO-TK" by Schlüter Systems or approved equivalent.
  - .3 Trims and edge-protection profiles (Outside corners - vertical applications – normal duty): Provide L-shaped aluminum profile with 3 mm (1/8") wide top section, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
    - .1 Acceptable Products: "Schluter-JOLLY" by Schlüter Systems or approved equivalent.
  - .4 Trims and edge-protection profiles (Outside corners vertical applications – heavy duty): Provide roll-formed stainless steel V-shaped profile with 37 mm (1-15/32") wide exposed surfaces joined by a symmetrically rounded corner, with integrated trapezoid-perforated anchoring legs.
    - .1 Acceptable Products: "Schluter-ECK-E" by Schlüter Systems or approved equivalent.
- 2.4.3 Thresholds: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes; honed finish on exposed surfaces, size to suit door opening and frame width and as follows:
- .1 Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1.5 mm (1/16 inch) above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 12.7 mm (1/2 inch) or less above adjacent floor surface.

2.4.4 Prefabricated Movement Joints: purpose made, having a Shore A Hardness of 35 or greater and elasticity of plus or minus 25% when used in accordance to TTMAC Detail 301MJ-2019/2021 and as follows:

- .1 Acceptable Products: "Schlüter – DILEX Series" by Schlüter Systems or approved equivalent. Specific profile as recommended by manufacturer.

## **2.5 Mortar, Adhesive And Grout Materials**

2.5.1 Primer: Low VOC, low viscosity primer as recommended by manufacturer to suit substrate and site conditions; provide proof of bonding ability of setting system where manufacturer recommends that a primer is not necessary to installation.

2.5.2 Surface Preparation Materials: Provide following underlayment materials:

- .1 Cementitious Mortar Bed or Leveling Screed: cement mortar screed for interior concrete floor preparation, repair and levelling from 19 mm (3/4") to 38 mm (1-1/2") thickness
  - .1 "ARDEX A38 Rapid Set Screed" by Ardex Engineered Cements.
- .2 Self Levelling and Smoothing Underlayment: Cementitious self levelling smoothing underlayment meeting or exceeding requirements of ANSI A108.1, Type 2 for levelling up to 50 mm (2 inch) and as follows:
  - .1 "ARDEX Liquid Backer Board" by Ardex Engineered Cements
  - .2 "Flex-Flo Plus" by Flextile Ltd.
  - .3 "Servoplan S 111" (40 mm) or "Servoplan E600" (80 mm) with "Servoplan Ki 1" by Kiesel GmbH.
  - .4 "NXT Level" with "NXT Primer" by Laticrete International Ltd.
  - .5 "Ultraplan 1 Plus" by Mapei Inc.
  - .6 "Pro Plan LC" or "Pro Plan CG" (for faster curing/setting) by Proma Adhesives Inc.
  - .7 "Tech Level 150" by Custom Building Products.

2.5.3 Wall Tile Systems: Provide the following setting materials:

- .1 Thin Set Interior Installation: Dry set mortar meeting or exceeding requirements of ANSI A118.4, or ANSI A118.11 sag-resistant formulated for thin and medium set applications, factory sanded mortar consisting of Portland cement, sand and additives requiring only addition of potable water for installation complete with bond enhancing latex additive and as follows:

- .1 "ARDEX X 5 Thin Set Mortar" by Ardex Engineered Cements
- .2 "56SR Non-Sag Mortar" by Flextile Ltd.
- .3 "Servolight S2 SuperTec" (walls and floors), "Servolight" (walls), "Servoflex Trio SuperTec" (floors only) by Kiesel GmbH.
- .4 "4XLT" by Laticrete International Ltd.
- .5 "Keraflex Plus" by Mapei Inc.
- .6 "Pro Flex SF" or "Pro P151 SF" by Proma Adhesives Inc.
- .7 "VersaBond LFT" Custom Building Products.
- .2 Large/Heavy Format Tile or Gauged Porcelain Panel Interior Installation: Dry set mortar meeting or exceeding requirements of ANSI A118.15, sag-resistant formulated for thin set applications, factory sanded mortar consisting of Portland cement, sand and additives requiring only addition of potable water for installation complete with bond enhancing latex additive and as follows:
  - .1 "ARDEX X77 Microtec™", with "ARDEX E90 additive™" where needed by Ardex Engineered Cements.
  - .2 "66 Flexlite Premium Wall and Floor Lightweight Mortar" by Flextile Ltd with the addition of water and equal parts "43 Acrylic latex mortar additive" by Flextile Ltd.
  - .3 "Servolight S2 SuperTec" by Kiesel GmbH.
  - .4 "Multimax Lite" (mixed with water only) by Laticrete International Ltd.
  - .5 "Kerabond T/Keralastic" (for 2-component:cement with latex additive) or "Ultralite S2" (for single component: water) by Mapei.
  - .6 "ProLite LFT" by Custom Building Products.
- .3 Glass Tile Interior Installation: mortar meeting or exceeding requirements of ANSI A118.4, sag-resistant formulated for thin and medium set applications, factory sanded mortar consisting of Portland cement, sand and additives requiring only addition of potable water for installation complete with bond enhancing latex additive and as follows:
  - .1 "ARDEX S48™" by Ardex Engineered Cements
  - .2 "66 Flexlite Premium Wall and Floor Lightweight Mortar" by Flextile Ltd.
  - .3 "ServoStar 3000 white" (normal set), "Servostar 4000 White" (fast set); non-sag or "Servolight S2 SuperTec"



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light grey,walls and floors, "Servoflex Trio SuperTec"  
(floors only), light grey by Kiesel GmbH.

- .4 "Glass Adhesive Mortar" by Laticrete
- .5 "Adesilex P10" by Mapei Inc.
- .6 "Pro HPX White" by Proma Adhesives Inc.
- .7 "Glass Tile Premium Thin set" by Custom Building Products

2.5.4 Adhesive Systems: Provide the following materials:

- .1 Epoxy Adhesive: Thin set adhesive system using 100% solids epoxy resin and epoxy hardener meeting or exceeding the requirements for ANSI A108.1; stain proof, chemical resistant and having high temperature resistance and water cleanable, and as follows:
  - .1 "ARDEX WA" by Ardex Engineered Cements
  - .2 "Flex-Epoxy 100 setting mortar" by Flextile Ltd.
  - .3 "Okapox royal" walls and floors by Kiesel GmbH.
  - .4 "Latapoxy 300" by Laticrete International, Inc.,
  - .5 "Kerapoxy 410" by Mapei Inc.
  - .6 "Pro Grout Xtreme" By Proma Adhesives Inc.
  - .7 "EBM – Lite" by Custom Building Products

2.5.5 Tile Grout Systems: Provide the following materials:

2.5.6 Material Tag: This item is noted as "GR-#" on Drawings and Schedules

- .1 Colours: Colours will be selected from manufacturer's full range.
- .2 Grout Sealer: Penetrating sealer as recommended by grout manufacturer to suit grout selected.
  - .1 "Bullet Proof StoneTech" by Laticrete or approved equivalent.
- .3 Sanded Polymer Modified Grout: Factory blended stain resistant polymer modified portland cement meeting or exceeding requirements of ANSI A118.7, specifically formulated for joints greater than 3 mm in width and as follows:
  - .1 "ARDEX FL Grout" by Ardex Engineered Cements
  - .2 "Flextile 600 Series Polymer Modified Grout" by Flextile Ltd.
  - .3 "Servoperl royal" universal, high performance grout by Kiesel GmbH.

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- .4 "Permacolor Grout" or "Permacolor Select" by Laticrete International Inc.
  - .5 "Ultracolor® PlusFA " (Fast Set) by Mapei Inc.
  - .6 "Pro Grout Sanded" by Proma Adhesives Inc.
  - .7 "Poly Blend Sanded" by Custom Building Products
  - .4 Unsanded Polymer Modified Grout: Factory blended stain resistant polymer modified portland cement meeting or exceeding requirements of ANSI A118.7, specifically formulated for joints less than or equal to 3 mm in width and as follows:
    - .1 "ARDEX FG-C Grout" by Ardex Engineered Cements
    - .2 "Flextile 500 Series Polymer Modified Grout" by Flextile Ltd.
    - .3 "Servoperl royal" universal, high performance grout by Kiesel GmbH.
    - .4 "Permacolor Select unsanded" by Laticrete International Inc.
    - .5 "Keracolor-U" or "Ultracolor® Plus" (Fast Set) by Mapei Inc.
    - .6 "Pro Grout Unsanded" by Proma Adhesives Inc.
    - .7 "Poly Blend Unsanded" by Custom Building Products
  - .5 Chemical-Resistant Epoxy Grout: Water cleanable, chemical resistant, factory blended modified portland cement compound with 100% epoxy additives and hardeners meeting or exceeding requirements of ANSI A118.3 and as follows:
    - .1 "ARDEX WA" by Ardex Engineered Cements
    - .2 "Epoxy Grout Flex-Epoxy 100" by Flextile Ltd.,
    - .3 "Okapox royal " wall and floor by Kiesel GmbH.
    - .4 "SPECTRALock Pro Gout" by Laticrete International, Inc.
    - .5 "Kerapoxy CQ" by Mapei Inc.
    - .6 "Pro Grout Xtreme" by Proma Adhesives Inc.
    - .7 "CEG – Lite" by Custom Building Products
  - .6 RTU Grout: colour consistent, no efflorescence and stain resistant acrylic based grout meeting or exceeding specific tests of ANSI A118.3 and as follows
    - .1 "ColourMax Plus Grout" by Flextile Ltd.
    - .2 "READY-TO-USE" by Laticrete International Ltd.
    - .3 "Pro Grout Xtreme" by Proma Adhesives Inc.
    - .4 "Flexcolor CQ" by Mapei Inc.

- .5 "Fusion Pro" by Custom Building Products

## **2.6 Accessories**

2.6.1 Crack Isolation Membranes: Load bearing, membrane meeting requirements of ANSI A118.12; thickness as recommended by manufacturer to accommodate in-plane substrate movement of 10 mm (1/8 inch) in thin set applications meeting or exceeding requirements of ANSI A108.1 and as follows:

- .1 Acceptable premanufactured self-adhering membranes:
  - .1 "1000 Flexilastic Crack Isolation Membrane" by Flextile Ltd.
  - .2 "Blue 929 " waterproofing membrane system with "fiberglass cloth reinforcement" by Laticrete International, Inc.
  - .3 "Pro MBR XD" by Proma Adhesives Inc.
  - .4 "Crack Buster Pro" by Custom Building Products
- .2 Acceptable liquid applied, lightweight fabric reinforced membranes:
  - .1 "ARDEX 8+9 Waterproofing & Crack Isolation Membrane with SK Mesh" by Ardex Engineered Cements
  - .2 "WP-980 Waterproofing & Crack Isolation Membrane with Reinforcing Fabric" by Flextile Ltd.
  - .3 "Servoflex DMS 1K SuperTec and Crack Isolation Membrane" by Kiesel GmbH.
  - .4 "Hydro Ban" or "Fracture Ban SC" waterproofing membrane system with Laticrete's fiberglass cloth reinforcement by Laticrete International, Inc.
  - .5 "Mapelastix CI" by Mapei Inc.
  - .6 "Custom 9240 Waterproofing Antifracture Membrane" by Custom Building Products

2.6.2 Waterproofing Membranes: Load bearing, membrane meeting requirements of ANSI A118.10; thickness as recommended by manufacturer to accommodate in-plane substrate movement of 3 mm (1/8 inch) in thin set applications meeting or exceeding requirements of ANSI A108.1 and as follows:

- .1 Acceptable liquid applied, lightweight fabric reinforced membranes (commercial applications):
  - .1 "ARDEX 8+9 Waterproofing & Crack Isolation Membrane with SK Mesh" by Ardex Engineered Cements
  - .2 "Flextile WP-980 Waterproofing & Crack Isolation Membrane with Reinforcing Fabric" by Flextile Ltd.

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- .3 “Servoflex DMS 1K SuperTec and Crack Isolation Membrane” by Kiesel GmbH.
  - .4 “Laticrete 9235” waterproofing membrane system with Laticrete's fiberglass cloth reinforcement by Laticrete International, Inc.
  - .5 “Mapelastic™ 315” by Mapei Inc.
  - .6 “Pro MBR XD” by Proma Adhesives Inc.
  - .7 “Custom 9240 Waterproofing Antifracture Membrane” by Custom Building Products
  - .2 Acceptable liquid applied membranes (residential applications):
    - .1 “ARDEX SK1 Waterproofing & Crack Isolation Membrane” by Ardex Engineered Cements
    - .2 “WP-900 Hydro-Bloc Waterproofing & Crack Isolation Membrane” by Flextile Ltd.
    - .3 “Servoflex DMS 1K SuperTec” by Kiesel GmbH.
    - .4 “Hydro Ban” by Laticrete International, Inc.,
    - .5 “Aqua Defense” by Mapei Inc.
    - .6 “Custom 9240 Waterproofing Antifracture Membrane” or “Redgard” by Custom Building Products
  - 2.6.3 Uncoupling Membranes (for all large-format tiles): Load bearing, pre-manufactured membrane meeting requirements of ANSI A118.12; thickness as recommended by manufacturer to accommodate in-plane substrate movement of 3 mm (1/8 inch) in thin set applications meeting or exceeding requirements of ANSI A108.1 and as follows:
    - .1 “Flexbone” by Ardex Engineered Cements
    - .2 “FlexMat” by Flextile Ltd.
    - .3 “Strata Mat” or “Strata Mat XT” by Laticrete International, Inc
    - .4 “Schluter 'DITRA XL'” Schluter Systems.
    - .5 “Mapeguard UM” by Mapei, Inc.
    - .6 “Redgard Uncoupling Mat” by Custom Building Products
  - 2.6.4 Latex Additive: Formulated for use in Portland cement mortars and grouts.
  - 2.6.5 Water: Potable, clean and free of chemicals and contaminants detrimental to mortar or grout mixes.
  - 2.6.6 Joint Sealant: As specified in Section 07 92 00
  - 2.6.7 Sealer: Meeting or exceeding requirements of CAN/CGSB 25.20, Type as recommended by tile manufacturer.

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**2.7     Mixes**

2.7.1 Mix premanufactured mortars and grouts in accordance with referenced standards, and mortar and grout manufacturers' written instructions; mix site mixed materials as follows:

- .1 Scratch Coat (by volume): Mix 1 part Portland cement, 4 parts sand, and latex additive where required by TTMAC Detail

2.7.2 Site mix proportioned mortar and grout materials as follows:

- .1 Bond Coat (by volume): Mix 1 part Portland cement, 4 parts sand, and latex additive where required by TTMAC Detail.
- .2 Slurry Bond Coat: Mix Portland cement and water to a creamy paste consistency. Include latex additive where required by TTMAC Detail.
- .3 Mortar Bed for Walls (by volume): Mix 1 part Portland cement, 4 parts sand, and latex additive where required by TTMAC Detail.
- .4 Leveling Coat (by volume): Mix 1 part Portland cement, 4 parts sand, and latex additive where required by TTMAC Detail.
- .5 Mortar Bed for Floors: 1 part Portland cement, 4 parts sand, and latex additive where required by TTMAC Detail; when mixed with water the mortar bed shall be of such a consistency and workability that will allow maximum compaction during tamping of the mortar bed, and achieve a minimum compressive strength of 15 MPa after 28 days. A stronger mix can be achieved by adding latex to the water

2.7.3 Adjust water volume depending on moisture content of sand to obtain consistency and workability

**3 .     EXECUTION**

**3.1     Examination**

3.1.1 Examine materials ordered for the project before delivering to the site; open boxes and confirm that materials match accepted samples, are free from defects and breakage detrimental to final appearance and installation, and as follows:

- .1 Consultant will only accept Grade 1 Standard, materials appearing on site factory marked as seconds or discounted or that are not consistent with materials submitted for review will be rejected.
- .2 Replace unacceptable materials at no additional cost to the Owner; order replacement materials using most expedient delivery method to minimize effect on construction schedule.

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3.1.2 Examine substrates, areas, and conditions where tile will be installed for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile and confirm the following:

- .1 Verify that substrates for bonding tile are firm; dry; clean; free from oil, waxy films, and curing compounds; and are within starting flatness tolerances as specified in Section 03 35 10, and are ready for application of levelling materials specified in this Section.
- .2 Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of Work, and similar items located in or behind tile have been completed before installing tile.
- .3 Verify that joints and cracks in tile substrates are coordinated with tile joint locations; adjust joints in consultation with Consultant where joints are not coordinated
- .4 Notify Consultant in writing of any conditions that are not acceptable; do not proceed with installation until unsatisfactory conditions have been corrected.

## **3.2 Preparation**

3.2.1 Protection: Protect surrounding work from damage or disfiguration arising from work of this Section.

3.2.2 Surfaces: Thoroughly clean substrate surfaces receiving tile finishes to remove grease, oil or dust film, and other contaminants affecting bond of materials within bonding systems and as follows:

- .1 Clean back of each tile before installation to remove surface contaminants and cutting residue, firing release dust and other debris detrimental to bond and final surface appearance.

3.2.3 Blending: For tile exhibiting colour variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colours as those taken from other packages and match approved Samples reviewed by Consultant. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.2.4 Surface Levelling: Fill cracks, holes, and depressions in concrete substrates for tile floors with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

- .1 Apply Levelling Bed Mortar or Self Levelling Mortar to make backing surfaces flat and true to tolerances in plane listed for performance requirements with additional requirements as follows:

- .1 Install levelling materials wherever a slight substrate irregularity exists.
- .2 Use self levelling materials for thicknesses less than 8 mm where thin set tile methods are used.
- .3 Use mortar bed levelling materials for thicknesses 8 mm and greater.

### **3.3 Installation Of Tile Backing Panel**

- 3.3.1 Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use polymer-modified dry-set mortar for bonding material unless otherwise directed in manufacturer's written instructions.

### **3.4 Installation Of Waterproofing Membrane**

- 3.4.1 Prepare substrates to receive waterproofing membrane by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1:50 (1/4 inch per foot) toward drains.
- 3.4.2 Install waterproofing membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproofing membrane of uniform thickness that is bonded securely to substrate.
- 3.4.3 Allow waterproofing membrane to cure and verify by testing that it is watertight before installing tile or setting materials over it.
- 3.4.4 Membranes: Apply waterproofing membranes in accordance with TTMAC and manufacturer's instructions. Provide waterproofing membrane to decks, floors, walls, steps and ramps to tiles applied in the following locations:
  - .1 kitchens, laundry areas, and other wet locations as noted on Drawings.

### **3.5 Installation Of Uncoupling Membrane**

- 3.5.1 Install uncoupling membrane to comply with manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.
- 3.5.2 Allow uncoupling membrane to cure before installing tile or setting materials over it.
- 3.5.3 Provide uncoupling membrane to decks, floors, steps and ramps to tiles applied in the following conditions:
  - .1 Large format tile and other locations as noted on Drawings.

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### **3.6     Installation Of Tile**

3.6.1 Install tiling in accordance with requirements of TTMAC Tile Installation Manual 2019/2021 (TMAC- Specification Guide 09 30 00;) and parts of ANSI A108 Series of tile installation standards that apply to types of bonding and grouting materials, and to methods required for complete tile installation.

3.6.2 Extend tile work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions:

- .1     Terminate Work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- .2     Make cut edges smooth, even and free from chipping.
- .3     Do not split tile.
- .2     Accurately form intersections and returns; perform cutting and drilling of tile without marring visible surfaces:
  - .1     Cut, drill, and fit tile to accommodate work of other trades penetrating or abutting work of this Section.
  - .2     Carefully grind cut edges of tile abutting trim, finish, or built in items for straight aligned joints.
  - .3     Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so that plates, collars, or covers overlap tile and to provide a uniform joint appearance.
- .3     Lay tile in pattern indicated on Drawings and as follows:
  - .1     Align joints when adjoining tiles on floor, base, walls, and trim are the same size.
  - .2     Lay out tile Work and center tile sites in both directions in each space or on each wall area.
  - .3     Centre tile patterns between control and movement joints; notify Consultant for further instructions where tile patterns do not align with control or movement joints.
  - .4     Cut tile accurately and without damage.
  - .5     Smooth exposed cut edges with abrasive stone, where exposed
  - .6     Chipped or split edges are not acceptable.
  - .7     Minimum tile width is half unit size unless specifically indicated otherwise on Drawings.
  - .8     Adjust tile layout to minimize tile cutting.
  - .9     Provide uniform joint widths.



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- .10 Make joints between tile sheets the same width as joints within tile sheets so joints between sheets are not apparent in finished Work.
  - .11 Slope floor tile towards floor drains in thick-bed mortar installations.
  - .12 Lay out tile wainscots to next full tile beyond dimensions indicated on Drawings and Schedules.
  - .4 Bonding Bed: Set tile in place while bond coat is wet and tacky and as follows:
    - .1 Adjust amount of bonding materials placed on substrates based on temperature and humidity to prevent skinning over of bonding materials.
    - .2 Use sufficient bond coat to provide a minimum 80% contact for tiles smaller than 300 mm x 300 mm and areas having Residential or Light Load Bearing Performance requirements with bonding material evenly dispersed and pressed into back of tile; refer to back buttering requirements for larger materials and installations having Moderate or higher Load Bearing Performance requirements.
    - .3 Notch bond coat in horizontal straight lines and set on freshly placed bonding material while moving (sliding) tile back and forth at 90° to notches.
    - .4 Verify that corner and edges are fully supported by bonding material.
    - .5 Set tiles to prevent lippage greater than 1 mm over a 3 mm grout joint.
    - .6 Keep two-thirds of grout joint depth free of bonding materials.
    - .7 Clean excess bonding materials from tile surface prior to final set.
    - .8 Sound tiles after bonding materials have cured and replace hollow sounding tile before grouting.
  - .5 Back Buttering: Obtain 100% mortar coverage in accordance with applicable requirements for back buttering of tile in referenced TTMAC and ANSI A108 series of tile installation standards for the following applications:
    - .1 Glass tile
    - .2 Exterior tile
    - .3 Tile in wet areas including, but not limited to:
      - .1 Showers
      - .2 Laundries
    - .4 Tile installed with chemical resistant mortars and grouts.
    - .5 Tile having tiles 300 mm or larger in any direction.
    - .6 Tile having tiles with raised or textured backs.

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- .7 Tile having tile installation rated for Heavy or Extra Heavy Duty.
  - .8 All porcelain tiles with more than 20% of the tile backs covered with firing release.
  - .6 Install prefabricated edge strips and control joints at locations indicated on Drawings and Schedules or where exposed edge of floor tile meets different flooring materials and exposed substrates
  - .7 Protect exposed edges of floor tile with properly sized transition strips, use sloped reducer strips where uneven transitions between 6 mm and 13 mm occur.
  - .8 Control and Movement Joints: Install control joints and expansion joints in tile work in accordance with TTMAC Detail 301MJ-2019/2021; keep control and expansion joints free of bonding materials and as follows:
    - .1 Cut tiles to establish line of joints; sawn joints after installation of tiles will not be acceptable to Consultant.
    - .2 Locate joints in tile surfaces directly above joints in concrete substrates.
    - .3 Provide floor control joints over structural control joints.
    - .4 Install prefabricated joint profiles in accordance with manufacturer's written instructions, set with top surface of joint profile slightly below top surface of tile.
    - .5 Prepare joints and apply sealants in accordance with requirements of Section 07 92 00.
    - .6 Keep control and movement joints free from setting materials.
    - .7 Form an open joint for sealant in tile wherever a change in backing material occurs, at all vertical interior corners, around penetrating pipes and fixtures, and where tile abuts other materials or fixtures.

Environment	Minimum	Maximum	Joint Width
Interior/Shaded	4800 mm	6100 mm	6 mm min.
Interior/Sunlight	2400 mm	3700 mm	6 mm min.
Exterior/Normal	2400 mm	3700 mm	10 mm min.
Exterior/Excessive	2400 mm	3000 mm	13 mm min.

- .9 Grouting: Install grout in accordance with manufacturer's written instructions, the requirements of TTMAC, and as follows:
  - .1 Allow proper setting time before application of grout.
  - .2 Pre-seal or wax tiles requiring protection from grout staining.
  - .3 Force grout into joints to a smooth, dense finish.
  - .4 Remove excess grout in accordance with manufacturer's written instructions and polish tile with clean cloths

- .10 Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
  - .1 Pressed Floor Tile: 3.2 mm (1/8 inch).
  - .2 Glazed Wall Tile: 3.2 mm (1/8 inch).
  - .3 Porcelain Tile (unless indicated otherwise): 3.2 mm (1/8 inch).
  - .4 Porcelain Tile (with rectified edges): 1.6 mm (1/16 inch)
- .11 Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
- .12 Floor Sealer: Apply floor sealer to grout joints in tile floors according to floor-sealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

### **3.7 Cleaning And Protection**

3.7.1 Cleaning: Clean tile surfaces so they are free of foreign matter using manufacturer recommended cleaning products and methods after completion of placement and grouting and as follows:

- .1 Remove grout residue from tile as soon as possible.
- .2 Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's written instructions, but no sooner than 10 days after installation; protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning.
- .3 Flush surface with clean water before and after cleaning.
- .4 Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to brick and grout manufacturer; trap and remove coating to prevent it from clogging drains.

3.7.2 Protection: Leave finished installation clean and free of cracked, chipped, broken, unbonded, or other tile deficiencies as follows:

- .1 Protect finished areas from traffic until setting materials have sufficiently cured in accordance with TTMAC requirements.
- .2 Protect floor areas from traffic after grouting is completed in accordance with manufacturer's written instructions.

### **3.8 Interior Ceramic Tile Installation Schedule**

3.8.1 Interior Floor Installations, Concrete Subfloor: 311F-2019/2021

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- .1 Provide waterproofing membrane over concrete where indicated on Drawings or where required. Provide tile bonded to concrete where membrane is not indicated or required.
  - .2 Provide uncoupling membrane over concrete where indicated on Drawings or where required. Provide tile bonded to concrete where membrane is not indicated or required.
  - .3 If required by tile manufacturer and tile size, provide medium bed mortar installation in accordance with 310F-2019/2021

**3.8.2 Interior Floor Installations, Large Format Tile: 329LFT-2019/2021**

- .1 Provide uncoupling membrane over substrate at all locations.
- .2 Provide waterproofing membrane over substrate where indicated on Drawings or where required. Provide tile bonded to substrate where membrane is not indicated or required.

**3.8.3 Interior Wall Installations, Masonry or Concrete: 303W-2019/2021**

- .1 Provide waterproofing membrane over concrete where indicated on Drawings or where required. Provide tile bonded to concrete where membrane is not indicated or required.

**3.8.4 Interior Wall Installations, Studs or Furring:**

- .1 Gypsum Board (Dry Areas): 304W-2019/2021
- .2 Cementitious Backer Unit (Wet or Dry Areas): 305W-2019/2021 (unless indicated otherwise); 306W-2019/2021 (tub enclosures)
- .3 Fibreglass Mat Gypsum Board (Wet or Dry Areas): 305W-2019/2021 (unless indicated otherwise); 306W-2019/2021 (tub enclosures)
- .4 Large Format Tile: 330LFTW-2019/2021
- .5 Provide waterproofing membrane over substrate where indicated on Drawings or where required. Provide tile bonded to substrate where membrane is not indicated or required.

**3.8.5 Shower Receptor Installations: 319SR-2019/2021.**

- .1 Provide waterproofing membrane over substrate where indicated on Drawings or where required. Provide tile bonded to substrate where membrane is not indicated or required.

**END OF SECTION**

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Acoustical Panel Ceilings work specified herein. This includes, but is not necessarily limited, to:
- .1 Acoustical panels
  - .2 Metal suspension systems
  - .3 Accessories
  - .4 Metal edge moldings and trims
  - .5 Acoustical sealants
  - .6 Auxiliary materials required for a complete installation..
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.
- .1 Related requirements provided below are for convenience purposes only.
    - .1 Section 05 50 00, Metal Fabrications for additional supports and reinforcing for ceiling assemblies.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Preinstallation Meetings**

- 1.4.1 Preinstallation Conference: Conduct conference at Project site.

### **1.5 Action Submittals**

- 1.5.1 Product Data: Submit product data in accordance with Division 01 for each type of product indicated.
- .1 Submit manufacturer's instructions, printed product literature and data sheets for the Acoustical Panel Ceilings work and

include product characteristics, performance criteria, physical size, finish and limitations

- 1.5.2 Samples: Submit samples in accordance with Division 01 for each exposed product and for each colour and texture specified, 150 mm (6 inches) in size.
- .1 Samples for Initial Selection: For components with factory-applied finishes.
  - .2 Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:
    - .1 Acoustical Panels: Set of 150-mm- (6-inch-) square Samples of each type, colour, pattern, and texture.
    - .2 Exposed Suspension-System Members, Moldings, and Trim: Set of 150-mm- (6-inch-) long Samples of each type, finish, and colour.
    - .3 Clips: Full-size seismic clips.
- 1.5.3 Professional Engineer's Stamped Shop Drawings and Submittals: Submit Professional Engineer's Stamped Shop Drawings and Submittals in accordance with Division 01 for seismic restraints for ceiling systems.
- .1 Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

## **1.6 Informational Submittals**

- 1.6.1 Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
- .1 Ceiling suspension-system members.
  - .2 Structural members to which suspension systems will be attached.
  - .3 Method of attaching hangers to building structure.
    - .1 Supply layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
  - .4 Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
  - .5 Size and location of initial access modules for acoustical panels.
  - .6 Items penetrating finished ceiling and ceiling-mounted items including the following:

- .1 Lighting fixtures.
- .2 Diffusers.
- .3 Grilles.
- .4 Speakers.
- .5 Sprinklers.
- .6 Access panels.
- .7 Perimeter moldings.
- .7 Show operation of hinged and sliding components covered by or adjacent to acoustical panels.

1.6.2 Certificates:

- .1 Submit independent test data and design tables for each type of insert to be employed on this Project for hanger supports.
- .2 Obtain approval of electrical utility authorities having jurisdiction for support of light fixtures, by ceiling grid and supports, to satisfy requirements of electrical inspection department of local electrical authority. Adjust grid, fixing devices and support hangers as required to obtain approval.
- .3 Submit written confirmations to Divisions 22, 23 and 26, when requested by Consultant, that suspended ceiling is capable of supporting additional weight of mechanical and electrical fixtures.

**1.7 Closeout Submittals**

- 1.7.1 Maintenance Data: Submit maintenance data in accordance with Division 01 for finishes to include in maintenance manuals.

**1.8 Maintenance Material Submittals**

- 1.8.1 Supply extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - .1 Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.
  - .2 Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.

**1.9 Quality Assurance**

- 1.9.1 Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.
- 1.9.2 Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

- 1.9.3 Mock-ups: Build mock-ups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
- .1 Build mockup of typical ceiling area as shown on Drawings.
  - .2 Approval of mock-ups does not constitute approval of deviations from the Contract Documents contained in mock-ups unless Consultant specifically approves such deviations in writing.
  - .3 Subject to compliance with requirements, reviewed mock-ups may become part of the completed Work if undisturbed at time of Substantial Performance of the Work.

**1.10 Delivery, Storage, And Handling**

- 1.10.1 Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- 1.10.2 Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

**1.11 Field Conditions**

- 1.11.1 Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- .1 Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

**1.12 Warranty**

- 1.12.1 Provide warranty covering the Work of this Section in accordance with Supplementary Condition SC49 / GC 12.3 WARRANTY.

**2. PRODUCTS**

**2.1 Manufacturers**

- 2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.
- .1 Armstrong World Industries Canada Ltd.; [www.armstrong.com](http://www.armstrong.com)
  - .2 CGC/USG Inc.; [www.cgcinc.com](http://www.cgcinc.com)



- .3 CertainTeed Canada; [www.certainteed.com](http://www.certainteed.com)
- .4 Rockfon; [www.rockfon.com](http://www.rockfon.com)

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

## **2.2 Performance Requirements**

- 2.2.1 Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- 2.2.2 Design suspension system to support safely and without distortion entire ceiling system and superimposed loads of:
  - .1 lighting fixtures,
  - .2 Air supply diffusers, boots, fire alarm grilles and exhaust and return air grilles;
- 2.2.3 Coordinate installation and cooperate with Mechanical and Electrical Subcontractors, to accommodate mechanical and electrical items, or any other work required to be incorporated in or coordinated with the ceiling system.
- 2.2.4 Seismic Performance: Provide products and systems specified in this Section to withstand the effects of earthquake motions in accordance with OBC 4.1.8.18 and CAN/CSA S832.
  - .1 Professional engineer specified in Division 01 and referenced in this Section shall be responsible for designing systems and submitting signed and sealed analysis data and Shop Drawings illustrating seismic-resistant systems.
  - .2 Refer to Structural Drawings for seismic sensitivity values.
- 2.2.5 Surface-Burning Characteristics: Comply with CAN/ULC-S102/S102.2 or equivalent to ASTM E84 (subject to approval by authorities having jurisdiction); testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - .1 Flame-Spread Index: Class A (25) according to ASTM E1264.
  - .2 Smoke-Developed Index: 50 or less.

## **2.3 Acoustical Panels - Smooth, Lightly Textured**

- 2.3.1 Material Tag: This item is noted as "ACT-#" on Drawings and Schedules.
- 2.3.2 Type and Form: Type IV, mineral base with membrane-faced overlay; Form 2 or Type XX.
- 2.3.3 Colour: White.
- 2.3.4 Light Reflectance (LR): Not less than 0.85.

- 2.3.5 Ceiling Attenuation Class (CAC): Not less than 35.
- 2.3.6 Noise Reduction Coefficient (NRC): Not less than 0.90
- 2.3.7 Edge/Joint Detail: Beveled, kerfed, and rabbeted long edges and square, butt-on short edges
- 2.3.8 Modular Size: Refer to Drawings.
- 2.3.9 Basis-of-Design Products: Refer to Drawings.

## **2.4 Metal Suspension System**

- 2.4.1 Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635/C635M and designated by type, structural classification, and finish indicated.
  - .1 High-Humidity Finish: In locations subject to high moisture such as pools and showers, provide coating tested and classified for "severe environment performance" according to ASTM C635/C635M.
- 2.4.2 Wide Face, Standard Exposed Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, hot-dip galvanized with prefinished 24-mm- (15/16-inch-) wide metal caps on flanges.
  - .1 Structural Classification: Heavy-duty system.
  - .2 End Condition of Cross Runners: Override (stepped) or butt-edge type.
  - .3 Cap Finish: Painted to match colour of acoustical unit.
  - .4 Acceptable Products:
    - .1 "DONN DX Quick Release" by CGC/USG Inc,
    - .2 "Prelude XL" by Armstrong World Industries,
    - .3 "Chicago Metallic 1200 System" by Rockfon,
    - .4 "Classic Stab System" by CertainTeed Canada.
  - .5 Acceptable Products (Fire-rated Systems):
    - .1 "Series DXL Fire-Rated Systems" by CGC Inc.,
    - .2 "Prelude XL Fireguard" by Armstrong World Industries,
    - .3 "Chicago Metallic 1250 Fire-Front" by Rockfon.
    - .4 "Firesecure Stab System" by CetainTeed Canada

## **2.5 Accessories**

- 2.5.1 Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

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- .1 Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, loads imposed by ceiling construction as determined by limit states design, as determined by testing according to ASTM E488/E488M or ASTM E1512 as applicable, conducted by a qualified testing and inspecting agency.
  - .1 Corrosion Protection: Carbon-steel components zinc plated according to ASTM B633, Class SC 1 (mild) service condition.
  - .2 Corrosion Protection: Stainless-steel components complying with ASTM F593 and ASTM F594, Group 1 Alloy 304 or 316.
- 2.5.2 Wire Hangers, Braces, and Ties: Provide wires as follows:
- .1 Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
  - .2 Stainless-Steel Wire: ASTM A580/A580M, Type 304, nonmagnetic.
  - .3 Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 2.69-mm- (0.106-inch-) diameter wire.
- 2.5.3 Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- 2.5.4 Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- 2.5.5 Angle Hangers: Angles with legs not less than 22 mm (7/8 inch) wide; formed with 1-mm- (0.04-inch-) thick, galvanized-steel sheet complying with ASTM A653/A653M, Z275 (G90) coating designation; with bolted connections and 8-mm- (5/16-inch-) diameter bolts.
- 2.5.6 Hold-Down Clips: Manufacturer's standard hold-down.
- 2.5.7 Impact Clips: Manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.
- 2.5.8 Seismic Clips: Manufacturer's standard seismic clips designed to Seismic
- 2.5.9 Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- 2.5.10 Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
- 2.5.11 Clean-Room Gasket System: Where indicated, provide manufacturer's standard system, including manufacturer's standard

antimicrobial gasket and related adhesives, tapes, seals, and retention clips, designed to seal out foreign material from and maintain positive pressure in clean room.

## **2.6      Metal Edge Moldings And Trim**

2.6.1 Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and colour as that used for exposed flanges of suspension-system runners.

- .1 Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
- .2 For lay-in panels with reveal edge details, provide stepped edge moulding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
- .3 For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
- .4 Acceptable Products:
  - .1 "Compasso Trim" by USG/CGC Inc.
  - .2 "AXIOM" by Armstrong World Industries.
  - .3 "Infinity Trim" by Rockfon.
  - .4 "Terminus Perimeter Trim" by CertainTeed Canada

2.6.2 Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements.

- .1 Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
- .2 Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 0.04 mm (1.5 mils). Comply with ASTM C635/C635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
- .3 Acceptable Products:
  - .1 "Compasso Trim" by USG/CGC Inc.
  - .2 "AXIOM" by Armstrong World Industries.
  - .3 "Infinity Trim" by Rockfon.

- .4 "Terminus Straight Perimeter Trim" by CertainTeed Canada

### **3 . EXECUTION**

#### **3.1 Examination**

- 3.1.1 Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- 3.1.2 Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- 3.1.3 Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 Preparation**

- 3.2.1 Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- 3.2.2 Layout openings for penetrations centered on the penetrating items.

#### **3.3 Installation**

- 3.3.1 Install acoustical panel ceilings according to ASTM C636/C636M , and ASTM E580 for seismic design requirements, and manufacturer's written instructions.
- 3.3.2 Suspend ceiling hangers from building's structural members and as follows:
- .1 Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
  - .2 Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - .3 Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.

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- .4 Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
  - .5 Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
  - .6 Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, or anchors that extend through forms into concrete.
  - .7 When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
  - .8 Do not attach hangers to steel deck tabs.
  - .9 Do not attach hangers to steel roof deck. Attach hangers to structural members.
  - .10 Space hangers not more than 1200 mm (48 inches) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 200 mm (8 inches) from ends of each member.
  - .11 Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- 3.3.3 Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with anchors.
- 3.3.4 Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
- .1 Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
  - .2 Screw attach moldings to substrate at intervals not more than 400 mm (16 inches) o.c. and not more than 75 mm (3 inches) from ends. Miter corners accurately and connect securely.
  - .3 Do not use exposed fasteners, including pop rivets, on moldings and trim.

- 3.3.5 Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- 3.3.6 Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
  - .1 Arrange directionally patterned acoustical panels as follows:
    - .1 As indicated on reflected ceiling plans.
  - .2 For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
  - .3 For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
  - .4 For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
  - .5 Paint cut edges of panel remaining exposed after installation; match colour of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
  - .6 Install seismicclips in areas indicated; space according to panel manufacturer's written instructions unless otherwise indicated.
  - .7 Install clean-room gasket system in areas indicated, sealing each panel and fixture as recommended by panel manufacturer's written instructions.
  - .8 Protect lighting fixtures and air ducts according to requirements indicated for fire-resistance-rated assembly.

### **3.4 Erection Tolerances**

- 3.4.1 Suspended Ceilings: Install main and cross runners level to a tolerance of 3 mm in 3.6 m (1/8 inch in 12 feet), non-cumulative.
- 3.4.2 Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 3 mm in 3.6 m (1/8 inch in 12 feet), non-cumulative.

### **3.5 Field Quality Control**

- 3.5.1 Testing Agency: Contractor must engage a qualified testing agency to perform tests and inspections.
  - .1 Testing agency will perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages and when

installation of ceiling suspension systems on each floor has reached 20 percent completion, but no panels have been installed. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.

- .1 Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 890 N (200 lbf) of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 1957 N (440 lbf) of tension.
- .2 When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
- .2 Acoustical panel ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.
- .3 Prepare test and inspection reports.

### **3.6 Cleaning**

- 3.6.1 Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- 3.6.2 Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION



## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Acoustical Wood Ceiling Assemblies work specified herein. This includes, but is not necessarily limited, to:
- .1 Linear wood grille ceiling systems
  - .2 Metal suspension systems
  - .3 Accessories
  - .4 Metal edge moldings and trims
  - .5 Acoustical sealants
  - .6 Auxiliary materials required for a complete installation..
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.
- .1 Related requirements provided below are for convenience purposes only.
    - .1 Section 05 50 00, Metal Fabrications for additional supports and reinforcing for ceiling assemblies.
    - .2 Section 09 51 13, for ceilings consisting of mineral-base acoustical ceilings.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Preinstallation Meetings**

- 1.4.1 Preinstallation Conference: Conduct conference at Project site.

### **1.5 Action Submittals**

- 1.5.1 Product Data: Submit product data in accordance with Division 01 for each type of product indicated.

- .1 Submit manufacturer's instructions, printed product literature and data sheets for the Acoustical Wood Ceiling Assemblies work and include product characteristics, performance criteria, physical size, finish and limitations
  - .2 Certificates for Credit MR 7: Chain-of-custody certificates certifying that products specified to be made from certified wood comply with forest certification requirements. Include evidence that mill is certified for chain of custody by an FSC-accredited certification body.
    - .1 Include statement indicating costs for each certified wood product.
- 1.5.2 Samples: Submit samples in accordance with Division 01 for each exposed product and for each colour and texture specified, 150 mm (6 inches) in size.
- .1 Samples for Initial Selection: For components with factory-applied finishes.
  - .2 Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:
    - .1 Acoustical wood panel ceilings: Set of 150-mm- (6-inch-) square Samples of each type, colour, pattern, and texture.
    - .2 Exposed Suspension-System Members, Moldings, and Trim: Set of 150-mm- (6-inch-) long Samples of each type, finish, and colour.
- 1.5.3 Professional Engineer's Stamped Shop Drawings and Submittals: Submit Professional Engineer's Stamped Shop Drawings and Submittals in accordance with Division 01 for seismic restraints for ceiling systems.
- .1 Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

## **1.6 Informational Submittals**

- 1.6.1 Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
- .1 Ceiling suspension-system members.
  - .2 Structural members to which suspension systems will be attached.
  - .3 Method of attaching hangers to building structure.

- .1 Supply layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
  - .4 Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
  - .5 Size and location of initial access modules for acoustical wood panel ceilings.
  - .6 Items penetrating finished ceiling and ceiling-mounted items including the following:
    - .1 Lighting fixtures.
    - .2 Diffusers.
    - .3 Grilles.
    - .4 Speakers.
    - .5 Sprinklers.
    - .6 Access panels.
    - .7 Perimeter moldings.
  - .7 Show operation of hinged and sliding components covered by or adjacent to acoustical wood panel ceilings.
- 1.6.2 Certificates:
- .1 Submit independent test data and design tables for each type of insert to be employed on this Project for hanger supports.
  - .2 Obtain approval of electrical utility authorities having jurisdiction for support of light fixtures, by ceiling grid and supports, to satisfy requirements of electrical inspection department of local electrical authority. Adjust grid, fixing devices and support hangers as required to obtain approval.
  - .3 Submit written confirmations to Divisions 22, 23 and 26, when requested by Consultant, that suspended ceiling is capable of supporting additional weight of mechanical and electrical fixtures.

**1.7 Closeout Submittals**

- 1.7.1 Maintenance Data: Submit maintenance data in accordance with Division 01 for finishes to include in maintenance manuals.

**1.8 Maintenance Material Submittals**

- 1.8.1 Supply extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- .1 Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.
- .2 Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.

**1.9 Quality Assurance**

- 1.9.1 Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.
- 1.9.2 Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- 1.9.3 Mock-ups: Build mock-ups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - .1 Build mockup of typical ceiling area as shown on Drawings or directed by Consultant on site.
  - .2 Approval of mock-ups does not constitute approval of deviations from the Contract Documents contained in mock-ups unless Consultant specifically approves such deviations in writing.
  - .3 Subject to compliance with requirements, reviewed mock-ups may become part of the completed Work if undisturbed at time of Substantial Performance of the Work.

**1.10 Delivery, Storage, And Handling**

- 1.10.1 Deliver acoustical wood panel ceilings, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- 1.10.2 Before installing acoustical wood panel ceilings, permit them to reach room temperature and a stabilized moisture content.

**1.11 Field Conditions**

- 1.11.1 Environmental Limitations: Do not install acoustical wood panel ceiling ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
  - .1 Ensure HVAC system is operating and maintaining temperature between 16 and 32 deg C (60 and 90 deg F) and relative

humidity between 25 and 55 percent during the remainder of the construction period.

- .2 Conform to requirements of North American Architectural Woodwork Standards (NAAWS) Section 2.

#### **1.12 Warranty**

- 1.12.1 Warrant work of this Section for period of 3 years against defects and deficiencies in accordance with General Conditions of the Contract. Promptly correct defects or deficiencies which become apparent within warranty period, to satisfaction of Consultant and at no additional expense. Defects include but are not limited to: buckling, opening of seams, bond failure and extensive colour fading.

## **2 . PRODUCTS**

### **2.1 Manufacturers**

- 2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.
  - .1 9Wood;
  - .2 ACGI;
  - .3 Architectural Components Group, Inc;
  - .4 Armstrong World Industries Canada Ltd.;
  - .5 Atkar North America
  - .6 CertainTeed;
  - .7 CGC/USG Inc.;
  - .8 Geometrik;
  - .9 Topakustik;
- 2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

### **2.2 Performance Requirements**

- 2.2.1 Design suspension system to support safely and without distortion entire ceiling system and superimposed loads of:
  - .1 lighting fixtures,
  - .2 Air supply diffusers, boots, fire alarm grilles and exhaust and return air grilles;
- 2.2.2 Coordinate installation and cooperate with Mechanical and Electrical Subcontractors, to accommodate mechanical and

electrical items, or any other work required to be incorporated in or coordinated with the ceiling system.

- 2.2.3 Professional Engineer's Design and Certification: Employ the services of a Professional Engineer licensed to practice in the Province of Ontario carrying professional liability insurance, and who is experienced in providing engineering services of similar kind, scope and complexity; to design and certify seismic restraints for ceiling systems.
- 2.2.4 Seismic Performance: Provide products and systems specified in this Section to withstand the effects of earthquake motions in accordance with OBC 4.1.8.18 and CAN/CSA S832.
  - .1 Professional engineer specified in Division 01 and referenced in this Section shall be responsible for designing systems and submitting signed and sealed analysis data and Shop Drawings illustrating seismic-resistant systems.
  - .2 Refer to Structural Drawings for seismic sensitivity values.
- 2.2.5 Surface-Burning Characteristics: Comply with CAN/ULC-S102/S102.2 or equivalent to ASTM E84 (subject to approval by authorities having jurisdiction); testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - .1 Flame-Spread Index: 25 or less on any surface exposed by cutting through in any direction.
  - .2 Smoke-Developed Index: 50 or less.
- 2.2.6 Provide materials that comply with requirements of AWMAC's North American Architectural Woodwork Standards (NAAWS) for each type of woodwork and quality grade specified, unless otherwise indicated on Drawings and Schedules.
  - .1 Grade: Premium.

## **2.3 Materials**

- 2.3.1 Core: Medium-density fiberboard panels or manufacturer's equivalent cores complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 50 or less per CAN/ULC-S102/S102.2 or equivalent to ASTM E 84.
- 2.3.2 Wood Veneer: Minimum 0.8 mm (0.03") thick, Grade A or Grade AA in accordance with requirements of AWMAC AWS Section 4 to match approved samples and containing no open joints, face depression, glue stain, patches, plastic repair or other manufacturing irregularities or defects.
  - .1 Species: As specified in this Section.

2.3.3 High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated on Drawings and Schedules or, if not indicated on Drawings and Schedules, as required by woodwork quality standard.

- .1 Basis-of-Design: As specified in this Section.
- .2 Acceptable Manufacturers: Products from the following manufacturers may be acceptable for inclusion into The Work:
  - .1 Arborite; Division of ITW Canada, Inc.
  - .2 Formica Corporation.
  - .3 Nevamar Company, LLC; Decorative Products Div.
  - .4 Panolam Industries International Incorporated.
  - .5 Wilsonart International; Div. of Premark International, Inc

## **2.4 Linear Wood Grille Ceiling System**

2.4.1 Material Tag: This item is noted as "APN-1" on Drawings and Schedules.

2.4.2 Core: Fire-retardant MDF core or manufacturer's standard fire-retardant equivalent core

2.4.3 Facing:

- .1 High-Pressure Decorative Laminate (PLAM): Grade HGP.
  - .1 Colours, Patterns, and Finishes: Refer to Finish Schedule on Drawings.

2.4.4 Configuration: Wood Backer.

- .1 Where radial applications are indicated on Drawings, Provide manufacturer's standard radiused backer.

2.4.5 Module size: not less than 305 mm wide by 2.4 m long (12" x 96 inches)

- .1 Blade Width: not less than 25 mm (1 inch)
- .2 Blade Height: Not less than 100 mm (4 inches)
- .3 Provide blades in one continuous length. Finger joints are not permitted.

2.4.6 Edge Profile: As selected by Consultant during Shop Drawing Review.

2.4.7 Fire Performance: Class A, as specified in this Section.

2.4.8 Noise Reduction Coefficient (NRC): Not less than 0.8

2.4.9 Finish: Manufacturer's standard protective clear coat.

2.4.10 Acoustic Insulation: Black-coated, unfaced, glass-fiber or mineral wool insulation complying with ASTM C 553, not less than 25-kg/cu. m (1.5-lb/cu. ft.) density, treated to be nondusting, and as follows:

- .1 Thickness: Not less than 25 mm (1 inch)
- .2 Basis-of-Design: "SelectSound Black Acoustic Blanket" by Owens Corning or approved equivalent.

2.4.11 Basis-of-Design: Refer to Finish Schedule on Drawings.

## **2.5 Metal Suspension System**

2.5.1 Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635/C635M and designated by type, structural classification, and finish indicated.

2.5.2 Wide Face, Standard Exposed Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, hot-dip galvanized with prefinished 24-mm- (15/16-inch-) wide metal caps on flanges.

- .1 Structural Classification: Heavy-duty system.
- .2 End Condition of Cross Runners: Override (stepped) or butt-edge type.
- .3 Cap Finish: Painted to match colour of acoustical unit.
- .4 Acceptable Products:
  - .1 "DONN DX Quick Release" by CGC/USG Inc,
  - .2 "Prelude XL" by Armstrong World Industries,
  - .3 "Chicago Metallic 1200 System" by Rockfon,
  - .4 "Classic Stab System" by CertainTeed Canada.

## **2.6 Accessories**

2.6.1 Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

- .1 Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, loads imposed by ceiling construction as determined by limit states design, as determined by testing according to ASTM E488/E488M or ASTM E1512 as applicable, conducted by a qualified testing and inspecting agency.
  - .1 Corrosion Protection: Carbon-steel components zinc plated according to ASTM B633, Class SC 1 (mild) service condition.

2.6.2 Wire Hangers, Braces, and Ties: Provide wires as follows:

- .1 Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.



- .2 Stainless-Steel Wire: ASTM A580/A580M, Type 304, nonmagnetic.
- .3 Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 2.69-mm- (0.106-inch-) diameter wire.
- 2.6.3 Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- 2.6.4 Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- 2.6.5 Angle Hangers: Angles with legs not less than 22 mm (7/8 inch) wide; formed with 1-mm- (0.04-inch-) thick, galvanized-steel sheet complying with ASTM A653/A653M, Z275 (G90) coating designation; with bolted connections and 8-mm- (5/16-inch-) diameter bolts.
- 2.6.6 Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical wood panel ceilings in place during a seismic event.
- 2.6.7 Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- 2.6.8 Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

## **2.7 Metal Edge Moldings And Trim**

- 2.7.1 Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and colour as that used for exposed flanges of suspension-system runners.
  - .1 Edge moldings shall fit acoustical wood panel ceiling edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
  - .2 For lay-in panels with reveal edge details, provide stepped edge moulding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
  - .3 For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
  - .4 Acceptable Products:
    - .1 "Compasso Trim" by USG/CGC Inc.
    - .2 "AXIOM" by Armstrong World Industries.

- .3 "Infinity Trim" by Rockfon.
- 2.7.2 Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements.
  - .1 Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
  - .2 Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 0.04 mm (1.5 mils). Comply with ASTM C635/C635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
  - .3 Acceptable Products:
    - .1 "Compasso Trim" by USG/CGC Inc.
    - .2 "AXIOM" by Armstrong World Industries.
    - .3 "Infinity Trim" by Rockfon.
    - .4 "Terminus Straight Perimeter Trim" by CertainTeed Canada

### **3 . EXECUTION**

#### **3.1 Examination**

- 3.1.1 Examine substrates, areas, and conditions, including structural framing to which acoustical wood panel ceiling ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical wood panel ceiling ceilings.
- 3.1.2 Examine acoustical wood panel ceilings before installation. Reject acoustical wood panel ceilings that are wet, moisture damaged, or mold damaged.
- 3.1.3 Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 Preparation**

- 3.2.1 Measure each ceiling area and establish layout of acoustical wood panel ceilings to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.

3.2.2 Layout openings for penetrations centered on the penetrating items.

**3.3 Installation**

3.3.1 Install acoustical wood panel ceiling ceilings according to ASTM C636/C636M and manufacturer's written instructions.

.1 Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.

3.3.2 Suspend ceiling hangers from building's structural members and as follows:

- .1 Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
- .2 Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
- .3 Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
- .4 Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
- .5 Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
- .6 Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, or anchors that extend through forms into concrete.
- .7 When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
- .8 Do not attach hangers to steel deck tabs.
- .9 Do not attach hangers to steel roof deck. Attach hangers to structural members.

- .10 Space hangers not more than 1200 mm (48 inches) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 200 mm (8 inches) from ends of each member.
- .11 Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- 3.3.3 Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with anchors.
- 3.3.4 Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical wood panel ceilings.
  - .1 Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
  - .2 Screw attach moldings to substrate at intervals not more than 400 mm (16 inches) o.c. and not more than 75 mm (3 inches) from ends. Miter corners accurately and connect securely.
  - .3 Do not use exposed fasteners, including pop rivets, on moldings and trim.
- 3.3.5 Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- 3.3.6 Install acoustical wood panel ceilings with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
  - .1 Arrange directionally patterned acoustical wood panel ceilings as follows:
    - .1 As indicated on reflected ceiling plans.
  - .2 Seal cut edges of panel remaining exposed after installation; match colour of exposed panel surfaces using coating recommended in writing for this purpose by acoustical wood panel ceiling manufacturer.
  - .3 Protect lighting fixtures and air ducts according to requirements indicated for fire-resistance-rated assembly.

### **3.4 Erection Tolerances**

- 3.4.1 Suspended Ceilings: Install main and cross runners level to a tolerance of 3 mm in 3.6 m (1/8 inch in 12 feet), non-cumulative.

- 3.4.2 Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 3 mm in 3.6 m (1/8 inch in 12 feet), non-cumulative.

**3.5 Cleaning**

- 3.5.1 Clean exposed surfaces of acoustical wood panel ceiling ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- 3.5.2 Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

## **1 . GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Resilient Base And Accessories work specified herein. This includes, but is not necessarily limited, to:
- .1 Thermoplastic-rubber base.
  - .2 Rubber stair accessories.
  - .3 Rubber moulding accessories.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Action Submittals**

- 1.4.1 Product Data: Submit product data in accordance with Division 01 for each type of product.
- .1 Submit manufacturer's instructions, printed product literature and data sheets for the Resilient Base And Accessories work and include product characteristics, performance criteria, physical size, finish and limitations
- 1.4.2 Samples: Submit samples in accordance with Division 01 for each exposed product and for each colour and texture specified, not less than 300 mm (12 inches) long.

### **1.5 Maintenance Material Submittals**

- 1.5.1 Supply extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- .1 Supply not less than 3 linear m (10 linear feet) for every 150 linear m (500 linear feet) or fraction thereof, of each type, colour, pattern, and size of resilient product installed.

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**1.6     Quality Assurance**

- 1.6.1 Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
- .1 Coordinate mockups in this Section with mockups specified in other Sections.

**1.7     Delivery, Storage, And Handling**

- 1.7.1 Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 10 deg C (50 deg F) or more than 32 deg C (90 deg F).

**1.8     Field Conditions**

- 1.8.1 Maintain ambient temperatures within range recommended by manufacturer, but not less than 21 deg C (70 deg F) or more than 35 deg C (95 deg F), in spaces to receive resilient products during the following time periods:
- .1 48 hours before installation.
- .2 During installation.
- .3 48 hours after installation.
- 1.8.2 After installation and until Substantial Performance of the Work, maintain ambient temperatures within range recommended by manufacturer, but not less than 13 deg C (55 deg F) or more than 35 deg C (95 deg F).
- 1.8.3 Install resilient products after other finishing operations, including painting, have been completed.

**1.9     Warranty**

- 1.9.1 Provide warranty covering the Work of this Section in accordance with Supplementary Condition SC49 / GC 12.3 WARRANTY.

**2 .     PRODUCTS**

**2.1     Manufacturers**

- 2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.
- .1 AB; American Biltrite.
- .2 Armstrong World Industries, Inc.
- .3 Flexco.
- .4 Johnsonite; A Tarkett Company.

- .5 Mondo Rubber International, Inc.
- .6 Nora Systems, Inc.
- .7 Roppe Corporation, USA.

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

## **2.2 Performance Requirements**

2.2.1 Provide Products free from blisters, cracks, chipped edges and corners, embedded foreign matter or other defects as required to complete flooring installation and to meet following minimum requirements:

- .1 Chemical resistance (ASTM F925): Pass
- .2 Fire-Test-Response Characteristics:
  - .1 Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm per ASTM E648.

## **2.3 Thermoplastic-Rubber Base (RB-1)**

2.3.1 Material Tag: This item is noted as "RB-1" on Drawings and Schedules.

2.3.2 Product Standard: ASTM F1861, Type TP (rubber, thermoplastic).

- .1 Group: I (solid, homogeneous).
- .2 Style and Location:
  - .1 Style A, Straight: Provide in areas with carpet.
  - .2 Style B, Cove: Provide in areas with resilient flooring.
  - .3 Style D, Sculptured: Provide in areas indicated.

2.3.3 Thickness: Not less than 3.2 mm (0.125 inch).

2.3.4 Height: 102 mm (4 inches).

2.3.5 Lengths: Cut lengths 1219 mm (48 inches) long or coils in manufacturer's standard length.

2.3.6 Outside Corners: Job formed or preformed.

2.3.7 Inside Corners: Job formed or preformed.

2.3.8 Colours: Refer to Finish Schedule on Drawings.

2.3.9 Basis-Of-Design: Refer to Finish Schedule on Drawings.

## **2.4 Flooring Transition Trim**

2.4.1 Material Tag: This item is noted as "TR-#" on Drawings and Schedules.

2.4.2 Locations: Transitions between flooring types where indicated on Drawings and Schedules.



2.4.3 Colours and Patterns: Refer to Finish Schedule on Drawings.

2.4.4 Basis-of-Design: Refer to Finish Schedule on Drawings.

## **2.5 Installation Materials**

2.5.1 Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

2.5.2 Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

2.5.3 Stair-Tread Nose Filler: Two-part epoxy compound recommended by resilient stair-tread manufacturer to fill nosing substrates that do not conform to tread contours.

2.5.4 Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.

## **3 . EXECUTION**

### **3.1 Examination**

3.1.1 Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

.1 Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

3.1.2 Proceed with installation only after unsatisfactory conditions have been corrected.

.1 Installation of resilient products indicates acceptance of surfaces and conditions.

### **3.2 Preparation**

3.2.1 Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

3.2.2 Ensure substrates are permanently dry, clean, smooth, and structurally sound. Surfaces must be free of dust, loose particles, solvents, paint, grease, oil, wax, alkali, sealing/curing compounds, old adhesive, and any other foreign material, which could affect the installation and adhesive bond to substrate.

- 3.2.3 Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F710.
- .1 Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - .2 Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
  - .3 Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
  - .4 Moisture Testing: Proceed with installation only after substrates pass testing according to manufacturer's written recommendations, but not less stringent than the following:
    - .1 Perform anhydrous calcium chloride test according to ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapour emission rate of 1.36 kg of water/92.9 sq. m (3 lb of water/1000 sq. ft.) in 24 hours.
    - .2 Perform relative humidity test using in situ probes according to ASTM F2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level.
- 3.2.4 Fill cracks, holes, depressions and similar irregularities in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- 3.2.5 Do not install resilient products until they are the same temperature as the space where they are to be installed.
- .1 At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- 3.2.6 Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

### **3.3 Resilient Base Installation**

- 3.3.1 Comply with manufacturer's written instructions for installing resilient base.
- 3.3.2 Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

- 3.3.3 Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- 3.3.4 Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates. Use manufacturer's recommended adhesives and trowels for substrates encountered.
- 3.3.5 Do not stretch resilient base during installation.
- 3.3.6 On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- 3.3.7 Preformed Corners: Install preformed corners before installing straight pieces.
- 3.3.8 Job-Formed Corners:
  - .1 Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 76 mm (3 inches) in length.
    - .1 Form without producing discoloration (whitening) at bends.
  - .2 Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 76 mm (3 inches)() in length.
    - .1 Miter or cope corners to minimize open joints.

### **3.4 Resilient Accessory Installation**

- 3.4.1 Comply with manufacturer's written instructions for installing resilient accessories.
- 3.4.2 Resilient Stair Accessories:
  - .1 Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
  - .2 Tightly adhere to substrates throughout length of each piece.
  - .3 For treads installed as separate, equal-length units, install to produce a flush joint between units.
- 3.4.3 Resilient Moulding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed. Center transitions in cased openings and under door leafs at door openings unless indicated otherwise.

### **3.5 Cleaning And Protection**

- 3.5.1 Comply with manufacturer's written instructions for cleaning and protecting resilient products.

- 3.5.2 Perform the following operations immediately after completing resilient-product installation:
  - .1 Remove adhesive and other blemishes from exposed surfaces.
  - .2 Sweep and vacuum horizontal surfaces thoroughly.
  - .3 Damp-mop horizontal surfaces to remove marks and soil.
- 3.5.3 Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- 3.5.4 Cover resilient products subject to wear and foot traffic until Substantial Performance of the Work.

END OF SECTION

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Resilient Linoleum Flooring work specified herein. This includes, but is not necessarily limited, to:
- .1 Linoleum sheet flooring.
  - .2 Prefabricated cove base.
  - .3 Auxiliary materials required for a complete installation.
  - .4 Reducing strips and thresholds at junction with adjacent finishes.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only.
- .1 Section 09 65 13, Resilient Base and Accessories for resilient base, reducer strips, and other accessories installed with linoleum floor covering.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Administrative Requirements**

- 1.4.1 Pre-Installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation and floor care recommendations and manufacturer's warranty requirements.

### **1.5 Submittals**

- 1.5.1 Product Data: Submit product data in accordance with Division 01 for each type of product indicated.

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- .1 Submit manufacturer's instructions, printed product literature and data sheets for the Resilient Linoleum Flooring work and include product characteristics, performance criteria, physical size, finish and limitations
  - 1.5.2 Shop Drawings: Submit Shop Drawings in accordance with Division 01 for each type of linoleum flooring.
    - .1 Include flooring layouts, locations of seams, coving details, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
    - .2 Show details of special patterns.
    - .3 Show treatment where flooring meets dissimilar materials and all other special conditions.
    - .4 Submit diagram of areas and results showing location and results of each preconstruction test.
  - 1.5.3 Samples: Submit samples in accordance with Division 01 for the following:
    - .1 Each exposed product and for each colour and pattern specified in manufacturer's standard size, but not less than 150 mm (6-inch) square sections.
    - .2 Heat-Welding Bead: Include manufacturer's standard-size Samples, but not less than 230 mm (9 inches) long, of each colour required.
  - 1.6 **Closeout Submittals**
    - 1.6.1 Maintenance Data: Submit maintenance data in accordance with Division 01 for each type of floor covering to include in maintenance manuals.
  - 1.7 **Maintenance Material Submittals**
    - 1.7.1 Supply extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
      - .1 Floor Tile: Supply one box for every 50 boxes or fraction thereof, of each type, colour, and pattern of floor tile installed.
      - .2 Sheet Flooring: Supply not less than 3 linear m (10 linear feet) for every 150 linear m (500 linear feet) or fraction thereof, in roll form and in full roll width for each type, colour, and pattern of sheet flooring installed.
      - .3 Accessories: No less than 3 linear m (10 linear feet) for each 500 linear feet or fraction thereof each different type and color installed.

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**1.8 Quality Assurance**

- 1.8.1 Installer Qualifications: An entity that employs installers and supervisors who are trained or certified by flooring manufacturer and who are competent in techniques required by manufacturer for flooring installation and seaming methods indicated with not less than five years' experience.
- .1 Submit proof of training upon request.
- 1.8.2 Single Source Responsibility: Ensure primary materials provided in this Section are obtained from one source by a single manufacturer and secondary materials are obtained from sources recommended by primary materials manufacturers.
- 1.8.3 Mock-ups: Build mock-ups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
- .1 Coordinate mock-ups in this Section with mock-ups specified in other Sections.
- .1 Size: Minimum 10 sq. m (100 sq. ft.) for each type, colour, and pattern in locations directed by Consultant.
- .2 Approval of mock-ups does not constitute approval of deviations from the Contract Documents contained in mock-ups unless Consultant specifically approves such deviations in writing.
- .3 Subject to compliance with requirements, reviewed mock-ups may become part of the completed Work if undisturbed at time of Substantial Performance of the Work.

**1.9 Delivery, Storage, And Handling**

- 1.9.1 Deliver and store materials undamaged in original wrappings or containers, with manufacturer's labels and seals intact. Store materials in warm and dry area.
- 1.9.2 Store flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 18 deg C (65 deg F) or more than 32 deg C (90 deg F).
- .1 Floor Tile: Store on flat surfaces.
- .2 Sheet Flooring: Store rolls upright.

**1.10 Field Conditions**

- 1.10.1 Maintain ambient temperatures within range recommended by manufacturer, but not less than 21 deg C (70 deg F) or more than 35 deg C (95 deg F), in spaces to receive flooring during the following periods:
- .1 7 days before installation.

- .2 During installation.
- .3 7 days after installation.
- 1.10.2 After installation and until Substantial Performance of the Work, maintain ambient temperatures within range recommended by manufacturer, but not less than 18 deg C (65 deg F) or more than 35 deg C (95 deg F).
- 1.10.3 Close spaces to traffic during flooring installation.
- 1.10.4 Close spaces to traffic for 72 hours after flooring installation.
- 1.10.5 Install flooring after other finishing operations, including painting, have been completed.
- 1.10.6 Do not begin substrate evaluation and preparation until stable, conditioned environments have been established as described in this section.
- 1.10.7 Areas to receive flooring must have adequate lighting to allow for proper inspection and preparation of the substrate, installation of the flooring and final inspection.
- 1.10.8 Field Measurements: Verify actual measurements and openings by field measurements before fabrication. Show recorded measurements on Shop Drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

## **1.11 Warranty**

- 1.11.1 Extended Warranty: Provide manufacturer's full system warranty which includes repair or replacement of flooring installations that fail in materials or workmanship within specified warranty period.
  - .1 Warranty Period:
    - .1 Flooring Material Warranty: 10 years from date of Substantial Performance of the Work.
    - .2 Workmanship Warranty: 5 years from date of Substantial Performance of the Work.
    - .3 Prefabricated cove base: 15 years from date of Substantial Performance of the Work.
  - .2 Failures include, but not limited to, tearing, cracking, separation, deterioration or loosening from substrate, seam failure, ripples, bubbling or puckering. Upon notification of such installation deficiencies, within warranty period, make necessary repairs or replacement at no cost to Owner.



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## **2 . PRODUCTS**

### **2.1 Manufacturers**

2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.

- .1 Forbo Flooring, Inc.;
- .2 Gerflor Canada (previously Armstrong World Industries, Inc);
- .3 Tarkett Inc.;

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

### **2.2 Performance Requirements**

2.2.1 Provide Products free from blisters, cracks, chipped edges and corners, embedded foreign matter or other defects as required to complete flooring installation and to meet design requirements.

2.2.2 Use sheet flooring from consecutive manufacturing process to maintain consistent colour match between adjacent sheets. Replace installed products in areas showing undue colour variation, in the opinion of the Owner or Consultant.

2.2.3 Fire-Test-Response Characteristics: Provide linoleum flooring with fire-test-response characteristics as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.

- .1 Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- .2 Flammability & Smoke (CAN/ULC S102.2): not more than 300 (Flame Spread) and not more than 500 (Smoke Developed)

### **2.3 Linoleum Sheet Flooring**

2.3.1 Material Tag: This item is noted as "MRM-#" on Drawings and Schedules.

2.3.2 Linoleum Sheet Flooring: homogeneous linoleum composition complete with high performance double layered surface finish conforming to ASTM F2034, Type I, linoleum sheet with backing or Type III, linoleum sheet with special backing.

- .1 Roll Size: In manufacturer's standard length, but not less than 2 m (6' – 6") by maximum length available to minimize seams.

2.3.3 Thickness: Minimum 2.5 mm (0.10 inch).

2.3.4 Heat-Welding Bead: For seamless installation, solid-strand product of linoleum flooring manufacturer.

- .1 Colours: As selected by Consultant from manufacturer's full range to contrast with or match linoleum flooring.

2.3.5 Backing: Jute

2.3.6 Colours and Patterns: Refer to Finish Schedule on Drawings.

2.3.7 Topcoat: Provide pre-sealed and pre-finished UV-cured, protective, liquid floor coating as standard by linoleum flooring manufacturer which does not require additional sealing after installation.

2.3.8 Basis-of-Design: Refer to Finish Schedule on Drawings.

## **2.4 Installation Materials**

2.4.1 Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by linoleum flooring manufacturer for applications indicated. Do not use gypsum-based materials.

2.4.2 Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit products and substrate conditions indicated.

- .1 Use adhesives that have a VOC content of not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- .2 Acceptable Products:

- .1 For substrates with internal relative humidity up to 80%: Forbo 660 Adhesive or approved equivalent as recommended in writing by manufacturer.
- .2 For substrates with internal relative humidity up to 85%: as recommended in writing by manufacturer.
- .3 For substrates with internal relative humidity up to 95%: as recommended in writing by manufacturer.

2.4.3 Prefabricated-Flash-Cove-Base: Fabricated from same sheet flooring material and dye lots in maximum practical lengths.

- .1 Cove Strip: 25 mm (1 inch) radius provided or approved by manufacturer with 38 mm x 38 mm (1-1/2 inch x 1-1/2 inch) formed puncture resisting aluminum reinforcing bonded to back of base.
- .2 Cap Strip: Square resilient cap as selected by Consultant.
- .3 Riser: As indicated on Drawings
- .4 Toe: to be selected by Consultant during Shop Drawing review.
- .5 Acceptable Manufacturers: FlashCove Prefabricated Cove Bases Inc; or approved equivalent.

2.4.4 MVE-Control System: ASTM F3010-qualified, fluid-applied, two-component, epoxy-resin, membrane-forming system; formulated for

application on concrete substrates to reduce MVER to level required for installation of floor coverings indicated and acceptable to manufacturers of floor covering products indicated, including adhesives.

- .1 MVE-Control System Capabilities: Capable of suppressing MVE without failure where installed on concrete that exhibits the following conditions:
    - .1 Relative Humidity: Up to 100 percent when tested according to ASTM F2170 using in situ probes.
  - .2 Substrate Primer: Provide MVE-control system manufacturer's concrete-substrate primer if required for system indicated by substrate conditions.
  - .3 Acceptable Products: Approved proprietary moisture control system recommended in writing by floor covering manufacturer and approved by Consultant in order to authenticate floor covering warranties.
- 2.4.5 Resilient Edge Strips: Provide resilient cap for cove resilient floor covering, nosings for resilient floor covering, reducer strips, and transition strips with tapered or bull nose edge not less than 25 mm (1") wide, colored to match flooring or as selected by Consultant from available colours.
- 2.4.6 Metal Edge Strips: Strips shall be of width shown and of required thickness to protect the exposed edge of the flooring with units in maximum length available to minimize the number of joints.

### **3 .     EXECUTION**

#### **3.1     Examination**

- 3.1.1 Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
  - .1 Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of flooring.
- 3.1.2 Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2     Preparation**

- 3.2.1 Prepare substrates according to linoleum flooring manufacturer's written instructions to ensure adhesion of flooring.
- 3.2.2 Concrete Substrates: Prepare according to ASTM F710.

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- .1 Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - .2 Remove substrate coatings and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by linoleum flooring manufacturer. Do not use solvents.
  - .3 Concrete substrates must be cured per the concrete manufacturer's recommendations with minimum compressive strength of 21 MPa (3,000 psi) and minimum dry density of 2400 kg/cu. m (150 lbs/cu. ft). Refer to Division 3 for patching, repairing crack materials and leveling compounds with Portland cement-based compounds and for cast-in-place concrete, concrete toppings, and cementitious underlayments.
  - .4 Alkalinity and Adhesion Testing: Perform tests recommended by linoleum flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 10 pH.
  - .5 Bond Testing: Conduct testing in accordance with the manufacturer's recommendations in various locations throughout area where flooring is to be installed. Perform sufficient tests to evaluation of entire area where material will be installed.
  - .6 Substrate Porosity Testing: Conduct testing in accordance with ASTM F3131 and manufacturer's recommendations in various locations throughout area where flooring is to be installed. Perform sufficient tests to evaluation of entire area where material will be installed.
    - .1 Evaluation of results: Water must penetrate into substrate within 5 to 20 minutes to be considered acceptable. If water penetrates too rapidly or too slowly, make adjustments to substrate to provide proper surface profile.
    - .2 Where substrates are determined to be overly porous, dusty or generally insufficient, provide primer according to the manufacturer's recommendations to regulate porosity level of substrate.
  - .7 Moisture Testing:
    - .1 Perform tests so that each test area does not exceed 93 sq. m (1000 sq. ft.), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - .2 Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have

maximum moisture-vapour emission rate of 1.36 kg of water/93 sq. m (3 lb of water/1000 sq. ft.) in 24 hours.

- .3 Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
  - .4 Do not proceed with installation until moisture problems have been corrected.
- 3.2.3 Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
  - 3.2.4 Do not install flooring until materials are the same temperature as space where they are to be installed.
    - .1 At least 72 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.
  - 3.2.5 Immediately before installation, sweep and vacuum clean substrates to be covered by flooring.

### **3.3 Application Of Mve-Control System**

- 3.3.1 Apply MVE-control system to all basement slabs and slabs-on-grades (regardless of pre-installation moisture testing results). At other location, apply MVE-control system where moisture contents are above those recommended by manufacturer at time of installation.
- 3.3.2 Prepare and clean substrates according to MVE-control system manufacturer's written instructions to ensure adhesion of system to concrete.
- 3.3.3 Remove coatings and other substances that are incompatible with MVE-control system and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by MVE-control system manufacturer. Do not use solvents.
- 3.3.4 Provide concrete surface profile complying with ICRI 310.2R or CSP 3 by shot blasting using apparatus that abrades the concrete surface with shot, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
- 3.3.5 After shot blasting, repair damaged and deteriorated concrete according to MVE-control system manufacturer's written instructions.
- 3.3.6 Protect substrate voids and joints to prevent resins from flowing into or leaking through them.
- 3.3.7 Fill surface depressions and irregularities with patching and leveling material.

- 3.3.8 Fill surface cracks, grooves, control joints, and other nonmoving joints with crack-filling material.
- 3.3.9 Allow concrete to dry, undisturbed, for period recommended in writing by MVE-control system manufacturer after surface preparation, but not less than 24 hours.
- 3.3.10 Before installing MVE-control systems, broom sweep and vacuum prepared concrete.
- 3.3.11 Install MVE-control system according to ASTM F3010 and manufacturer's written instructions to produce a uniform, monolithic surface free of surface deficiencies such as pin holes, fish eyes, and voids.

### **3.4     Installation, General**

- 3.4.1 Comply with manufacturer's product technical data, including product technical bulletins, installation recommendations and floor care recommendations.
- 3.4.2 Scribe and cut flooring to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, thresholds, door frames, and nosings.
- 3.4.3 Extend flooring into toe spaces, door reveals, closets, and similar openings.
- 3.4.4 Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on flooring as marked on substrates. Use chalk or other nonpermanent marking device.
- 3.4.5 Install flooring on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of colour and pattern between pieces of flooring installed on covers and adjoining flooring. Tightly adhere flooring edges to substrates that abut covers and to cover perimeters.
- 3.4.6 Adhere flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
  - .1 Immediately roll the flooring in all directions using a 45 kg (100 lb) roller to ensure proper adhesive transfer. Additional rolling may be required during adhesive setup to the material is flat and fully adhered.
  - .2 Use three-section wall roller or steel seam roller at walls, under toe kicks or anywhere where full weight of 45 kg (100 lb) roller cannot access or be applied.
- 3.4.7 Heat-Welded Seams: For seamless installation, comply with ASTM F1516. Rout joints and heat weld with welding bead to fuse sections permanently into a seamless flooring installation. Prepare,

weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.

### **3.5 Linoleum Sheet Flooring Installation**

- 3.5.1 Unroll linoleum sheet flooring and allow it to stabilize before cutting and fitting.
- 3.5.2 Lay out linoleum sheet flooring as follows:
  - .1 Maintain uniformity of flooring direction.
  - .2 Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 152 mm (6 inches) away from parallel joints in flooring substrates.
  - .3 Match edges of flooring for colour shading at seams.
  - .4 Avoid cross seams.
  - .5 Eliminate deformations that result from hanging method used during drying process (stove bar marks).
- 3.5.3 Installation of Prefabricated Base:
  - .1 Before installing base, fill cracks and irregularities with a filler recommended by base manufacturer.
  - .2 Dry-fit prefabricated cove base and cap. Cut and fit material to required lengths. Mitre-cut inside and outside corners.
  - .3 Scribe glue line on walls and floor at edge of prefabricated cove base material.
  - .4 Apply adhesive in full spread (100% coverage on 2 surfaces) for full length of prefabricated cove base material. Apply prefabricated cove base to wall surface straight and level.
  - .5 Slide metal base cap behind prefabricated cove base material.
  - .6 Hand roll prefabricated cove base material onto wall and floor surface removing bumps, ripples and fishmouths. Remove excess adhesive.
  - .7 Heat weld seams (vertical and horizontal) in prefabricated cove base material.

### **3.6 Cleaning And Protection**

- 3.6.1 Comply with manufacturer's written instructions for cleaning and protecting linoleum flooring.
- 3.6.2 Perform the following operations immediately after completing linoleum flooring installation:
  - .1 Remove adhesive and other blemishes from surfaces.
  - .2 Sweep and vacuum surfaces thoroughly.
  - .3 Damp-mop surfaces to remove marks and soil.

- 3.6.3 Protect linoleum flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- 3.6.4 After allowing drying room film (yellow film caused by linseed oil oxidation) to disappear, cover linoleum flooring until Substantial Performance of the Work.

**3.7 Field Quality Control**

- 3.7.1 Manufacturer's Field Services: Provide manufacturer's field service consisting of product use recommendations and periodic site visit for inspection of product installation in accordance with manufacturer's recommendations.

**3.8 Demonstration And Training**

- 3.8.1 Engage manufacturer to demonstrate cleaning and maintenance procedures to Owner in accordance with requirements of Section 01 70 00. Review methods and procedures related to floor care and warranty requirements.
- 3.8.2 Include in Contract Price, cost for initial maintenance procedures, and execute procedures after flooring installation as recommended by flooring manufacturer. Initial maintenance to be conducted by installer or floor care professionals who are certified by manufacturer.

END OF SECTION



## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Resilient Athletic Flooring work specified herein. This includes, but is not necessarily limited, to:
  - .1 Interlocking, rubber floor tile.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.
  - .1 Related requirements provided below are for convenience purposes only.
    - .1 Section 09 65 13 "Resilient Base and Accessories" for wall base and accessories installed with resilient athletic flooring.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Administrative Requirements**

- 1.4.1 Pre-Installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation and floor care recommendations and manufacturer's warranty requirements.
- 1.4.2 Coordination: Coordinate layout and installation of flooring with floor inserts for gymnasium equipment.

### **1.5 Submittals**

- 1.5.1 Product Data: Submit product data in accordance with Division 01 for each type of product indicated.
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for the Resilient Athletic Flooring work and

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include product characteristics, performance criteria, physical size, finish and limitations

1.5.2 Shop Drawings: Submit Shop Drawings in accordance with Division 01 for each type of resilient athletic flooring. Show installation details and locations of the following:

- .1 Border tiles.
- .2 Floor patterns.
- .3 Locations of floor inserts for athletic equipment installed through flooring.

1.5.3 Samples: Submit samples in accordance with Division 01 for the following:

- .1 For each exposed product and for each type, colour, and pattern specified, 150-mm- (6-inch-) square in size and of the same thickness indicated for the Work.

**1.6 Closeout Submittals**

1.6.1 Maintenance Data: Submit maintenance data in accordance with Division 01 for each type of floor covering to include in maintenance manuals.

**1.7 Maintenance Material Submittals**

1.7.1 Supply extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- .1 Floor Tile: Supply no fewer than 1 box for each 50 boxes or fraction thereof, of each type, colour, pattern, and size of floor tile installed.

**1.8 Quality Assurance**

1.8.1 Flooring Installer Qualifications: An experienced installer who has completed flooring installations using methods indicated for this Project and similar in material, design, and extent to that indicated for this Project; who is acceptable to manufacturer; and whose work has resulted in installations with a record of successful in-service performance.

- .1 Submit proof of training upon request.

1.8.2 Single Source Responsibility: Ensure primary materials provided in this Section are obtained from one source by a single manufacturer and secondary materials are obtained from sources recommended by primary materials manufacturers.

1.8.3 Mock-ups: Build mock-ups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

- .1 Coordinate mock-ups in this Section with mock-ups specified in other Sections.
  - .1 Size: Minimum 10 sq. m (100 sq. ft.) for each type, colour, and pattern in locations directed by Consultant.
- .2 Approval of mock-ups does not constitute approval of deviations from the Contract Documents contained in mock-ups unless Consultant specifically approves such deviations in writing.
- .3 Subject to compliance with requirements, reviewed mock-ups may become part of the completed Work if undisturbed at time of Substantial Performance of the Work.

**1.9 Delivery, Storage, And Handling**

- 1.9.1 Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storing.
- 1.9.2 Store materials to prevent deterioration.
  - .1 Store tiles on flat surfaces.
  - .2 Store rolls upright.

**1.10 Field Conditions**

- 1.10.1 Adhesively Applied Products:
  - .1 Maintain temperatures during installation within range recommended in writing by manufacturer, but not less than 21 deg C (70 deg F) or more than 35 deg C (95 deg F), in spaces to receive flooring 48 hours before installation, during installation, and 48 hours after installation unless longer period is recommended in writing by manufacturer.
  - .2 After postinstallation period, maintain temperatures within range recommended in writing by manufacturer, but not less than 18 deg C (65 deg F) or more than 35 deg C (95 deg F).
  - .3 Close spaces to traffic during flooring installation.
  - .4 Close spaces to traffic for 48 hours after flooring installation unless manufacturer recommends longer period in writing.
- 1.10.2 Install flooring after other finishing operations, including painting, have been completed.
- 1.10.3 Do not begin substrate evaluation and preparation until stable, conditioned environments have been established as described in this section.
- 1.10.4 Areas to receive flooring must have adequate lighting to allow for proper inspection and preparation of the substrate, installation of the flooring and final inspection.

- 1.10.5 Field Measurements: Verify actual measurements and openings by field measurements before fabrication. Show recorded measurements on Shop Drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

**1.11 Warranty**

- 1.11.1 Extended Warranty: Provide manufacturer's full system warranty which includes repair or replacement of flooring installations that fail in materials or workmanship within specified warranty period.

.1 Warranty Period:

- .1 Flooring Material Warranty: 10 years from date of Substantial Performance of the Work.
- .2 Workmanship Warranty: 5 years from date of Substantial Performance of the Work.
- .2 Failures include, but not limited to, tearing, cracking, separation, deterioration or loosening from substrate, seam failure, ripples, bubbling or puckering. Upon notification of such installation deficiencies, within warranty period, make necessary repairs or replacement at no cost to Owner.

**2 . PRODUCTS**

**2.1 Manufacturers**

- 2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.

.1 INTERLOCKING, RUBBER FLOOR TILE

- .1 Johnsonite/Tarkett;
- .2 Mondo America
- .3 Edgewood Flooring
- .4 Pliteq

- 2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

**2.2 Performance Requirements**

- 2.2.1 Provide Products free from blisters, cracks, chipped edges and corners, embedded foreign matter or other defects as required to complete flooring installation and to meet design requirements.
- 2.2.2 Fire-Test-Response Characteristics: Provide flooring with fire-test-response characteristics as determined by testing identical products

according to ASTM E648 or NFPA 253 by a qualified testing agency.

- .1 Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

## **2.3     Interlocking Rubber Floor Tiles**

- 2.3.1 Material Tag: This item is noted as "RSF-1" on Drawings and Schedules.
- 2.3.2 Description: Resilient floor interlocking tile system with interdependent ring impact pedestals.
- 2.3.3 Material: Rubber or Recycled-rubber compound.
- 2.3.4 Tile Interlock: Hidden
- 2.3.5 Traffic-Surface Texture: Smooth
- 2.3.6 Size: 610 mm x 610 mm (24 inches x 24 inches)
- 2.3.7 Thickness: 32mm (1-1/4 inch)
- 2.3.8 Tile Weight: 10kg (22 lb) per tile
- 2.3.9 Colour and Pattern: Refer to Finish Schedule on Drawings.
- 2.3.10 Basis-of-Design: Refer to Finish Schedule on Drawings.

## **2.4     Accessories**

- 2.4.1 Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient rubber flooring manufacturer for applications indicated. Do not use gypsum-based materials.
- 2.4.2 Adhesives: Water-resistant type recommended in writing by manufacturer for substrate and conditions indicated.
  - .1 Provide two-part, solvent-free, low VOC polyurethane adhesive "PU 105" by Mondo America Inc. or approved equivalent recommended in writing by floor covering manufacturer and approved by Consultant in order to authenticate floor covering warranties.
- 2.4.3 Game-Line and Marker Paint: Complete system including primer, if any, compatible with flooring and recommended in writing by flooring and paint manufacturers for use indicated.
- 2.4.4 MVE-Control System: ASTM F3010-qualified, fluid-applied, two-component, epoxy-resin, membrane-forming system; formulated for application on concrete substrates to reduce MVER to level required for installation of floor coverings indicated and acceptable to manufacturers of floor covering products indicated, including adhesives.

- .1 MVE-Control System Capabilities: Capable of suppressing MVE without failure where installed on concrete that exhibits the following conditions:
  - .1 Relative Humidity: Up to 100 percent when tested according to ASTM F2170 using in situ probes.
- .2 Substrate Primer: Provide MVE-control system manufacturer's concrete-substrate primer if required for system indicated by substrate conditions.
- .3 Acceptable Products: Approved proprietary moisture control system recommended in writing by floor covering manufacturer and approved by Consultant in order to authenticate floor covering warranties.

### **3 . EXECUTION**

#### **3.1 Examination**

- 3.1.1 Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance of the Work.
  - .1 Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
  - .2 Minimum tolerance required prior to application is 3 mm in 3 m (1/8 inch in 10-foot radius) using straight edge measurements.
- 3.1.2 Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 Preparation**

- 3.2.1 Prepare substrates according to manufacturer's written instructions to ensure adhesion of flooring.
- 3.2.2 Concrete Substrates: Prepare according to ASTM F710.
  - .1 Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - .2 Remove substrate coatings and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by resilient rubber flooring manufacturer. Do not use solvents.
  - .3 Concrete substrates must be cured per the concrete manufacturer's recommendations with minimum compressive strength of 21 MPa (3,000 psi) and minimum dry density of

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- 2400 kg/cu. m (150 lbs/cu. ft). Refer to Division 3 for patching, repairing crack materials and leveling compounds with Portland cement-based compounds and for cast-in-place concrete, concrete toppings, and cementitious underlayments.
- .4 Bond Testing: Conduct testing in accordance with the manufacturer's recommendations in various locations throughout area where flooring is to be installed. Perform sufficient tests to evaluation of entire area where material will be installed.
  - .5 Alkalinity Testing: Perform pH testing according to ASTM F710. Proceed with installation only if pH readings are not less than 7.0 and not greater than 8.5.
    - .1 Perform tests so that each test area does not exceed 93 sq. m (1000 sq. ft.), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - .2 Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapour emission rate of 1.36 kg of water/92.9 sq. m (3 lb of water/1000 sq. ft) in 24 hours, unless otherwise recommended in writing by floor covering manufacturer.
    - .3 Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement, unless otherwise recommended in writing by floor covering manufacturer.
    - .4 Do not proceed with installation until moisture problems have been corrected.
- 3.2.3 Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by manufacturer. Do not use solvents.
- 3.2.4 Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.
- 3.2.5 Move flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation unless manufacturer recommends a longer period in writing.
- .1 Do not install flooring until it is the same temperature as space where it is to be installed.
- 3.2.6 Sweep and vacuum clean substrates to be covered by flooring immediately before installation. After cleaning, examine substrates

for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.3 Application Of Mve-Control System**

- 3.3.1 Apply MVE-control system to all basement slabs and slabs-on-grades (regardless of pre-installation moisture testing results) and to other locations where moisture contents are above those recommended by manufacturer at time of installation.
- 3.3.2 Prepare and clean substrates according to MVE-control system manufacturer's written instructions to ensure adhesion of system to concrete.
- 3.3.3 Remove coatings and other substances that are incompatible with MVE-control system and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by MVE-control system manufacturer. Do not use solvents.
- 3.3.4 Provide concrete surface profile complying with ICRI 310.2R or CSP 3 by shot blasting using apparatus that abrades the concrete surface with shot, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
- 3.3.5 After shot blasting, repair damaged and deteriorated concrete according to MVE-control system manufacturer's written instructions.
- 3.3.6 Protect substrate voids and joints to prevent resins from flowing into or leaking through them.
- 3.3.7 Fill surface depressions and irregularities with patching and leveling material.
- 3.3.8 Fill surface cracks, grooves, control joints, and other nonmoving joints with crack-filling material.
- 3.3.9 Allow concrete to dry, undisturbed, for period recommended in writing by MVE-control system manufacturer after surface preparation, but not less than 24 hours.
- 3.3.10 Before installing MVE-control systems, broom sweep and vacuum prepared concrete.
- 3.3.11 Install MVE-control system according to ASTM F3010 and manufacturer's written instructions to produce a uniform, monolithic surface free of surface deficiencies such as pin holes, fish eyes, and voids.

### **3.4 Flooring Installation, General**

- 3.4.1 Comply with manufacturer's product technical data, including product technical bulletins, installation recommendations and floor care recommendations.



- 3.4.2 Scribe, cut, and fit flooring to butt neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.
- 3.4.3 Extend flooring into toe spaces, door reveals, closets, and similar openings unless otherwise indicated.
- 3.4.4 Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating subfloor markings on flooring. Use nonpermanent, nonstaining marking device.

### **3.5 Floor Tile Installation**

- 3.5.1 Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
  - .1 Lay tiles square with room axis or in pattern indicated on Drawings.
- 3.5.2 Discard broken, cracked, chipped, or deformed tiles.
- 3.5.3 Tile Matching: Match tiles for colour and pattern by selecting tiles from cartons in same sequence as manufactured and packaged if so numbered.
- 3.5.4 Adhered Floor Tile: Adhere products to substrates using a full spread of adhesive applied to substrate to comply with adhesive and flooring manufacturers' written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.
  - .1 Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- 3.5.5 Free-Lay Tile: Place flooring at locations indicated with units securely interconnected and fully seated on substrate to form a smooth, level surface.

### **3.6 Field Quality Control**

- 3.6.1 Manufacturer's Field Services: Provide manufacturer's field service consisting of product use recommendations and periodic site visit for inspection of product installation in accordance with manufacturer's recommendations.

### **3.7 Demonstration And Training**

- 3.7.1 Engage manufacturer to demonstrate cleaning and maintenance procedures to Owner in accordance with requirements of Section 01 70 00. Review methods and procedures related to floor care and warranty requirements.

- 3.7.2 Include in Contract Price, cost for initial maintenance procedures, and execute procedures after flooring installation as recommended by flooring manufacturer. Initial maintenance to be conducted by installer or floor care professionals who are certified by manufacturer.

**3.8 Cleaning And Protection**

- 3.8.1 Perform the following operations immediately after completing flooring installation:
- .1 Remove adhesive and other blemishes from flooring surfaces.
  - .2 Sweep and vacuum flooring thoroughly.
  - .3 Damp-mop flooring to remove marks and soil after time period recommended in writing by manufacturer.
- 3.8.2 Protect flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.
- .1 Do not move heavy and sharp objects directly over flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Tile Carpeting work specified herein. This includes, but is not necessarily limited, to,:
  - .1 carpet tile.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only.
  - .1 Section 09 65 13, Resilient Base and Accessories for resilient wall base and accessories installed with carpet tile.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Preinstallation Meetings**

- 1.4.1 Pre-installation Meetings: Schedule, and conduct pre-installation meeting at Project Site, in order to coordinate work of this Section, with work of related Subcontractors.
  - .1 Ensure attendance of Subcontractor performing work of this Section and representatives of manufacturers and fabricators involved in, or affected by, installation and coordination with other materials and installations that have preceded or will follow. Advise Consultant and Owner in advance of scheduled meeting dates.
  - .2 Agenda: Review progress of other construction activities and preparations for the particular activity under consideration.
  - .3 Record significant discussions, agreements, and disagreements, including required corrective measures and actions.

- .4 Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
- .5 Review methods and procedures related to carpet tile installation including, but not limited to, the following:
  - .1 Review delivery, storage, and handling procedures.
  - .2 Review ambient conditions and ventilation procedures.
  - .3 Review subfloor preparation procedures.

## **1.5      Action Submittals**

1.5.1 Product Data: Submit product data in accordance with Division 01 for each type of product.

- .1 Submit manufacturer's instructions, printed product literature and data sheets for the Tile Carpeting work and include product characteristics, performance criteria, physical size, finish and limitations
- .2 Include manufacturer's written data on physical characteristics, durability, and fade resistance.
- .3 Include installation recommendations for each type of substrate.

1.5.2 Shop Drawings: Show the following:

- .1 Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
- .2 Carpet tile type, colour, and dye lot.
- .3 Type of subfloor.
- .4 Type of installation.
- .5 Pattern of installation.
- .6 Pattern type, location, and direction.
- .7 Pile direction.
- .8 Type, colour, and location of insets and borders.
- .9 Type, colour, and location of edge, transition, and other accessory strips.
- .10 Transition details to other flooring materials.

1.5.3 Samples: Submit samples in accordance with Division 01 for each of the following products and for each colour and texture required. Label each Sample with manufacturer's name, material description, colour, pattern, and designation indicated on Drawings and in schedules.

- .1 Carpet Tile: Full-size Sample.
- .2 Exposed Edge, Transition, and Other Accessory Stripping: 300-mm- (12-inch-) long Samples.

- 1.5.4 Product Schedule: Submit product schedule in accordance with Division 01 for carpet tile. Use same designations indicated on Drawings.

**1.6 Informational Submittals**

- 1.6.1 Product Test Reports: Submit product test reports in accordance with Division 01 for carpet tile, for tests performed by a qualified testing agency.
- 1.6.2 Sample Warranty: Submit sample warranty in accordance with Division 01 for special warranty.

**1.7 Closeout Submittals**

- 1.7.1 Maintenance Data: Submit maintenance data in accordance with Division 01 for carpet tiles to include in maintenance manuals. Include the following:
- .1 Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
  - .2 Precautions for cleaning materials and methods that could be detrimental to carpet tile.

**1.8 Maintenance Material Submittals**

- 1.8.1 Supply extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- .1 Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 8.3 sq. m (10 sq. yd.).

**1.9 Quality Assurance**

- 1.9.1 Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.
- 1.9.2 Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.
- 1.9.3 Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
- .1 Build mockups at locations and in sizes shown on Drawings.
  - .2 The following Products may be acceptable for inclusion into The Work, approved mockups may become part of the

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completed Work if undisturbed at time of Substantial Performance of the Work.

**1.10 Delivery, Storage, And Handling**

1.10.1 Comply with CRI 104.

**1.11 Field Conditions**

1.11.1 Comply with CRI 104 for temperature, humidity, and ventilation limitations.

1.11.2 Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.

1.11.3 Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

1.11.4 Where demountable partitions or other items are indicated on Drawings and Schedules for installation on top of carpet tiles, install carpet tiles before installing these items.

**1.12 Warranty**

1.12.1 Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

.1 Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.

.2 Failures include, but are not limited to, more than 10 percent edge raveling, snags, runs, loss of face fiber, and delamination.

.3 Warranty Period: 10 years from date of Substantial Performance of the Work.

**2 . PRODUCTS**

**2.1 Carpet Tile**

2.1.1 Material Tag: This item is noted as "CPT-1A" and "CPT-1B " on Drawings and Schedules.

2.1.2 Colour and Pattern: Refer to Finish Schedule on Drawings.

2.1.3 Fiber Content: 100 percent nylon 6.

2.1.4 Pile Characteristic: Level-loop pile.

- 2.1.5 Pile Thickness: 1.8mm (0.07 inch) for finished carpet tile
- 2.1.6 Stitches: 10.8 per inch
- 2.1.7 Gage: 5/64
- 2.1.8 Total Weight: 3115.1 g/sq m (91.9 oz/sq yd) for finished carpet tile.
- 2.1.9 Primary Backing/Backcoating: Manufacturer's standard composite materials.
- 2.1.10 Secondary Backing: Manufacturer's standard material.
- 2.1.11 Underlayment: For CPT-1A, manufacturers standard 12.5mm (1/2 inch) acoustic/shock absorbing underlayment.
- 2.1.12 Size: 610 by 610 mm (24 by 24 inches).

## **2.2 Installation Accessories**

- 2.2.1 Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- 2.2.2 Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
  - .1 Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - .2 Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- 2.2.3 Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

## **3 . EXECUTION**

### **3.1 Examination**

- 3.1.1 Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, colour, pattern, and potential defects.

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- 3.1.2 Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
- .1 Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
  - .2 Subfloor finishes comply with requirements specified in Section 03 30 00, Cast-in-Place Concrete for slabs receiving carpet tile.
  - .3 Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- 3.1.3 For wood subfloors, verify the following:
- .1 Underlayment over subfloor complies with requirements specified in Section 06 10 00, Rough Carpentry.
  - .2 Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.
- 3.1.4 For metal subfloors, verify the following:
- .1 Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.
- 3.1.5 For painted subfloors, verify the following:
- .1 Perform bond test recommended in writing by adhesive manufacturer.
- 3.1.6 For raised access flooring systems, verify the following:
- .1 Access floor substrate is compatible with carpet tile and adhesive if any.
  - .2 Underlayment surface is flat, smooth, evenly planed, tightly jointed, and free of irregularities, gaps greater than 3 mm (1/8 inch), protrusions more than 0.8 mm (1/32 inch), and substances that may interfere with adhesive bond or show through surface.
- 3.1.7 Proceed with installation only after unsatisfactory conditions have been corrected.

## **3.2 Preparation**

- 3.2.1 General: Comply with CRI 104, Section 6.2, Site Conditions; Floor Preparation, and with carpet tile manufacturer's written installation instructions for preparing substrates indicated on Drawings and Schedulesto receive carpet tile installation.



- 3.2.2 Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 3 mm (1/8 inch) wide or wider and protrusions more than 0.8 mm (1/32 inch)() unless more stringent requirements are required by manufacturer's written instructions.
- 3.2.3 Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
- 3.2.4 Clean metal substrates of grease, oil, soil and rust, and prime if directed by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.
- 3.2.5 Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

### **3.3 Installation**

- 3.3.1 General: Comply with CRI 104, Section 14, Carpet Modules, and with carpet tile manufacturer's written installation instructions.
- 3.3.2 Installation Method: As recommended in writing by carpet tile manufacturer.
- 3.3.3 Maintain dye lot integrity. Do not mix dye lots in same area.
- 3.3.4 Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- 3.3.5 Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- 3.3.6 Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- 3.3.7 Install pattern parallel to walls and borders.
- 3.3.8 Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

### **3.4 Cleaning And Protection**

- 3.4.1 Perform the following operations immediately after installing carpet tile:

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- .1 Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
  - .2 Remove yarns that protrude from carpet tile surface.
  - .3 Vacuum carpet tile using commercial machine with face-beater element.
- 3.4.2 Protect installed carpet tile to comply with CRI 104, Section 16, Protecting Indoor Installations.
- 3.4.3 Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated on Drawings and Schedules or recommended in writing by carpet tile manufacturer.

END OF SECTION

## **1 . GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Sound Absorbing Wall And Ceiling units work specified herein. This includes, but is not necessarily limited, to:
  - .1 Sound-absorbing ceiling panels.
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.
  - .1 Section 05 50 00 - Metal Fabrications
  - .2 Section 07 21 00 - Thermal Insulation
  - .3 Section 09 21 16 - Gypsum Board Assemblies
  - .4 Section 09 51 13 - Acoustical Panel Ceilings

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Submittals**

- 1.4.1 Product Data: Submit product data for each type of fabric facing, panel edge, core material, and mounting indicated.
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for the Sound Absorbing Wall And Ceiling units work and include product characteristics, performance criteria, physical size, finish and limitations

1.4.2 Product Disclosure and Transparency:

- .1 Environmental Product Declarations (EPD): When available, submit Product-specific Type III EPD or industry-wide (generic) EPD conforming to ISO 14025 or other recognized environmental product declaration framework.
- .2 Material Ingredient Reporting: When available, submit documentation demonstrating chemical inventory of materials to at least 0.1% (1000ppm) and conforming to one of the following:
  - .1 Health Product Declaration open Standard,
  - .2 Cradle to Cradle v2 Basic level or Cradle to Cradle v3 Bronze level,
  - .3 International Living Future Institute Declare
  - .4 Other approved framework.
- .3 When multiple Products are specified, give preference to Products with compliant documentation.

1.4.3 Shop Drawings: Submit Shop Drawings for sound-absorbing wall units. Include mounting devices and details; details at panel head, base, joints, and corners; and details at ceiling, floor base, and wall intersections. Indicate panel edge and core materials.

- .1 Include elevations showing panel sizes and direction of fabric weave and pattern matching.

1.4.4 Samples : Submit samples for verification for the following products, prepared on Samples of size indicated below:

- .1 Fabric: Full-width by approximately 900-mm- (36-inch-) long Sample, but not smaller than required to show complete pattern repeat, from dye lot to be used for the Work, and with specified treatments applied. Mark top and face of fabric.
- .2 Assembled Panels: Approximately 900 by 900 mm (36 by 36 inches), including joints and mounting methods.

**1.5 Quality Assurance**

1.5.1 Source Limitations: Obtain sound-absorbing wall units from single source from single manufacturer.

1.5.2 Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials, fabrication, and installation.

- .1 Build mockup of typical wall area as directed by Consultant. Include intersection of wall and ceiling, corners, and perimeters.

- .2 Review of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Consultant specifically approves such deviations in writing.

**1.6 Delivery, Storage, And Handling**

- 1.6.1 Comply with fabric and sound-absorbing wall unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- 1.6.2 Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

**1.7 Project Conditions**

- 1.7.1 Environmental Limitations: Do not install sound-absorbing wall units until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated on Drawings and Schedules for Project when occupied for its intended use.
- 1.7.2 Lighting: Do not install sound-absorbing wall units until a permanent level of lighting is provided on surfaces to receive the units.
- 1.7.3 Air-Quality Limitations: Protect sound-absorbing wall units from exposure to airborne odors, such as tobacco smoke, and install units under conditions free from odor contamination of ambient air.
- 1.7.4 Field Measurements: Verify locations of sound-absorbing wall units and actual dimensions of openings and penetrations by field measurements before fabrication.

**1.8 Warranty**

- 1.8.1 Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sound-absorbing wall units that fail in materials or workmanship within specified warranty period.
  - .1 Failures include, but are not limited to the following:
    - .1 Acoustical performance.
    - .2 Fabric sagging, distorting, or releasing from panel edge.
    - .3 Warping of core.
  - .2 Warranty Period: Two years from date of Substantial Performance of the Work.

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## **2 . PRODUCTS**

### **2.1 Performance Requirements**

- 2.1.1 Fire-Test-Response Characteristics: Provide sound-absorbing wall units meeting the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
- .1 Surface-Burning Characteristics: As determined by testing per CAN/ULC-S102/S102.2.
    - .1 Flame-Spread Index: 25 or less.
    - .2 Smoke-Developed Index: 450 or less.
- 2.1.2 Seismic Performance: Provide products and systems specified in this Section to withstand the effects of earthquake motions in accordance with OBC 4.1.8.18 and CAN/CSA S832.
- .1 Professional engineer specified in Division 01 and referenced in this Section shall be responsible for designing systems and submitting signed and sealed analysis data and Shop Drawings illustrating seismic-resistant systems.
  - .2 Refer to Structural Drawings for seismic sensitivity values.

### **2.2 Sound-Absorbing Ceiling Units**

- 2.2.1 Material Tag: This item is noted as "ACP-2" on Drawings and Schedules.
- 2.2.2 Manufacturer's standard panel construction consisting of facing material laminated to front face, edges, and back edge border of core.
- .1 Mounting: Back mounted with manufacturer's standard suspension system, secured to substrate.
  - .2 Core: Manufacturer's standard.
  - .3 Acoustical Performance: Sound absorption NRC of not less than 0.75 according to ASTM C423 for Type A mounting according to ASTM E795.
  - .4 Edge Construction: Manufacturer's standard chemically hardened core with no frame.
  - .5 Thickness: 27 mm 1 (1-1/16 inches)
  - .6 Finish: manufacturers standard acoustically transparent textured coating.
  - .7 Basis-of-Design Product: Refer to Finish Schedule on Drawings.

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**2.3     Fabrication**

- 2.3.1 Use manufacturer's standard construction except as otherwise indicated on Drawings and Schedules; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warpage and damage.
- 2.3.2 Dimensional Tolerances of Finished Units: Plus or minus 1.6 mm (1/16 inch) for the following:
- .1 Thickness.
  - .2 Edge straightness.
  - .3 Overall length and width.
  - .4 Squareness from corner to corner.
  - .5 Chords, radii, and diameters.

**3 .     EXECUTION**

**3.1     Examination**

- 3.1.1 Examine fabric, fabricated units, substrates, areas, and conditions, for compliance with requirements, installation tolerances, and other conditions affecting performance of sound-absorbing wall units.
- 3.1.2 Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2     Installation - Ceilings**

- 3.2.1 Install sound-absorbing ceiling units in locations indicated with edges in alignment with walls and other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- 3.2.2 Comply with sound-absorbing ceiling unit manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.
- 3.2.3 Align fabric pattern and grain with adjacent units.
- 3.2.4 Provide seismic bracing as required.

**3.3     Installation Tolerances**

- 3.3.1 Variation from Plumb and Level: Plus or minus 1.6 mm (1/16 inch).
- 3.3.2 Variation of Panel Joints from Hairline: Not more than 1.6 mm (1/16 inch) wide.

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**3.4     Cleaning**

- 3.4.1   Clip loose threads; remove pills and extraneous materials.
- 3.4.2   Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION



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**1. GENERAL**

**1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

**1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Exterior Painting work specified herein. This includes, but is not necessarily limited, to:
- .1 Painting of all exterior exposed elements noted on Room Finish Schedule and noted on Drawings including following substrates:
    - .1 Concrete
    - .2 Steel.
    - .3 Galvanized metal.
    - .4 Aluminum (not anodized or otherwise coated).
    - .5 Wood.
    - .6 Fibre-cement board.
  - .2 Where an item or surface is not specifically mentioned on Drawings, and is not excluded, Provide same finish as similar adjacent materials or surfaces.
  - .3 Do not paint excluded components indicated herein.
- 1.2.2 Work Excluded:
- .1 Do not paint pre-finished metal.
  - .2 Do not paint chrome, stainless steel, vinyl, plastic laminate and aluminum surfaces throughout unless specified otherwise.
  - .3 Do not paint equipment furnished completely prime- and finish painted by manufacturer unless required to have field painting over factory finish in order to produce common corporate colour as identified in room finish schedule.
  - .4 Do not paint over ULC, FM or other code required labels or equipment identification plates.
- 1.2.3 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only.

- .1 Section 05 12 00, Structural Steel Framing for shop priming of metal substrates with primers specified in this Section.
- .2 Section 09 91 23, Interior Painting for surface preparation and the application of paint systems on interior substrates.

### **1.3     References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4     Definitions**

- 1.4.1 Gloss Level 1 (Flat or Matte): Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
- 1.4.2 Gloss Level 2 (Velvet): Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- 1.4.3 Gloss Level 3 (Eggshell): 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- 1.4.4 Gloss Level 4 (Satin): 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
- 1.4.5 Gloss Level 5 (Semi-gloss): 35 to 70 units at 60 degrees, according to ASTM D523.
- 1.4.6 Gloss Level 6 (Gloss): 70 to 85 units at 60 degrees, according to ASTM D523.
- 1.4.7 Exposed: This refers to items visible in completed Work.
- 1.4.8 Surface Preparation: This refers to means of cleaning or treating of surface to be painted to ensure best possible bond between surface and painting applied. Surface preparation methods include, but are not limited to:
  - .1 Ensure preparation and workmanship conforms to MPI Painting Manual requirements
  - .2 Removal of surface contaminants that will affect performance of painting including but not limited to: oil, grease, salts, dust, dirt, rust, rust scale, mill scale, and old coatings where applicable.
  - .3 Removal of surface imperfections including without limitations: weld spatter, sharp edges, burrs, silvers, laminations, pits, porosities and crevices.
  - .4 Preparation of surfaces to Provide anchor profile or surface profile to improve mechanical bonding of coating to prepared surface by increasing surface area.

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**1.5     Action Submittals**

- 1.5.1 Product Data: Submit product data in accordance with Division 01 for each type of product. Include preparation requirements and application instructions.
- .1 Submit manufacturer's instructions, printed product literature and data sheets for the Exterior Painting work and include product characteristics, performance criteria, physical size, finish and limitations
- 1.5.2 Samples: Submit samples in accordance with Division 01 for each type of paint system and in each colour and gloss of topcoat.
- .1 Submit full range colour sample chips to indicate where colour availability is restricted.
  - .2 Submit Samples (brushouts) on rigid backing, 200 mm (8 inches) square.
    - .1 3 mm (1/8 inch) plate steel for finishes over metal surfaces.
    - .2 13 mm (1/2 inch) plywood for finishes over wood surfaces.
    - .3 50 mm (2 inch) concrete block for finishes over concrete surfaces.
  - .3 Step coats on Samples to show each coat required for system.
  - .4 Label each coat of each Sample.
  - .5 Label each Sample for location and application area.
  - .6 Retain reviewed samples on-site to demonstrate acceptable standard of quality for appropriate on-site surface.
- 1.5.3 Product List: Submit product list in accordance with Division 01 for each product indicated on Drawings and Schedules, include the following:
- .1 Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
  - .2 Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
  - .3 Colour Numbers
  - .4 MPI Environmentally Friendly Classification System Rating
  - .5 Manufacturer's Safety Data Sheets (SDS)
  - .6 VOC content.

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**1.6 Informational Submittals**

- 1.6.1 Test reports: Provide certified test reports for paint from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
- .1 Lead, cadmium and chromium: presence of and amounts.
  - .2 Mercury: presence of and amounts.
  - .3 Organochlorines and PCBs: presence of and amounts.

**1.7 Closeout Submittals**

- 1.7.1 Operation and Maintenance Data: Provide operation and maintenance data for painting materials for incorporation into manual. Include the following cross-referenced to paint system and locations of application areas:
- .1 Product name, type and use.
  - .2 Manufacturer's product number.
  - .3 Colour names and numbers
  - .4 MPI Environmentally Friendly classification system rating.

**1.8 Maintenance Material Submittals**

- 1.8.1 Supply extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- .1 Paint: 5 percent, but not less than 3.8 L (1 gal.) of each material and colour applied.
- 1.8.2 Paint must be boxed and in sealed, unopened cans in undamaged condition, with name of manufacturer, contents, type and colour clearly indicated on a label securely adhered to can.

**1.9 Quality Assurance**

- 1.9.1 Qualifications: Provide work of this Section executed by competent installers with membership in good standing in MPI, OPCA and/or PDCA having a minimum of 5 years' experience in application of Products, systems and assemblies specified and with approval and training of Product manufacturers.
- .1 Qualified journeypersons as defined by local jurisdiction to be engaged in painting work.
  - .2 Apprentices may be employed provided they work under direct supervision of qualified journeyperson in accordance with trade regulations.
- 1.9.2 Mockups: Apply mockups of each paint system directed on Site and each colour and finish selected to verify preliminary selections

made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

- .1 Consultant will select one surface to represent surfaces and conditions for application of each paint system specified.
    - .1 Vertical and Horizontal Surfaces: Provide mock-ups of at least 9 sq. m (100 sq. ft.).
    - .2 Other Items: Consultant will designate items or areas required.
  - .2 Final approval of colour selections will be based on mockups.
    - .1 If preliminary colour selections are not approved, apply additional mockups of additional colours selected by Consultant at no added cost to Owner.
  - .3 Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Consultant specifically approves such deviations in writing.
  - .4 Reviewed mockups may become part of the completed Work if undisturbed at time of Substantial Performance of the Work.
- 1.9.3 Single Source Responsibility: Ensure primary materials provided in this Section are obtained from one source by a single manufacturer and secondary materials are obtained from sources recommended by primary materials manufacturers.
- .1 Use single brand of paint chosen throughout work of this Section, except where specified otherwise.

## **1.10 Delivery, Storage, And Handling**

- 1.10.1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .1 Imprint containers with labels indicating the following:
    - .1 Type of paint or coating.
    - .2 Compliance with applicable standard.
    - .3 Colour number in accordance with established colour schedule.
- 1.10.2 Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 7 deg C (45 deg F).
- .1 Maintain containers in clean condition, free of foreign materials and residue.
  - .2 Remove rags and waste from storage areas daily.

- .3 Keep materials away from excessive heat or direct rays of the sun.
- .4 Remove used cloths from building at the end of every working shift and when not in use.

1.10.3 Fire Prevention:

- .1 Prevent fire or explosion caused by improper storage of paints, solvents, rags, and similar items. Store hazardous materials in location and in manner approved by local fire authority.
- .2 Post "No Smoking" signs in areas of storage and mixing. Provide and maintain CO<sub>2</sub> fire extinguishers of minimum 9 kg (20 lb) capacity.

**1.11 Field Conditions**

- 1.11.1 Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 18 and 35 deg C (65 and 95 deg F).
- 1.11.2 Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 3 deg C (5 deg F) above the dew point and rising; or to damp or wet surfaces.

**1.12 Warranty**

- 1.12.1 Warrant Work of this Section for period of 2 years against defects and deficiencies in accordance with General Conditions of the Contract.
- 1.12.2 Promptly correct defects or deficiencies which become apparent within warranty period, to satisfaction of Consultant and at no expense to Owner.
- 1.12.3 Defects include but are not limited to: material shrinkage, cracking, splitting, bubbling, blistering and delamination resulting from defective materials or poor workmanship.

**2 . PRODUCTS**

**2.1 Manufacturers**

- 2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.
  - .1 Benjamin Moore & Co. (Canada).
  - .2 Cloverdale Paint.
  - .3 Coronado Paint/Corotech/Insl-x .
  - .4 Dulux Paints (Canada).

- .5 PPG Architectural Finishes, Inc.
- .6 Sherwin-Williams Company (The).

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

## **2.2 Performance Requirements**

2.2.1 MPI Standards: Unless indicated otherwise, Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List." Functionally and aesthetically equivalent Products that do not meet requirements of MPI standards may be considered, provided they meet requirements of this Specification and are reviewed by the Consultant.

2.2.2 Unless otherwise specified herein, all painting work shall be in accordance with MPI Premium Grade finish requirements

2.2.3 Material Compatibility:

- .1 Provide materials for use within each paint system that are compatible with one another and substrates indicated on Drawings and Schedules, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
- .2 For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated on Drawings and Schedules.

2.2.4 Standard of Acceptance:

- .1 Walls: no defects visible from a distance of 900 mm (3 ft) at 90 deg to surface when viewed using final lighting source.
- .2 Soffits: no defects visible from floor at 45 deg to surface when viewed using final lighting source.
- .3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

## **2.3 Finishes**

2.3.1 Material Tag: This item is noted as "PT-#" on Drawings and Schedules.

2.3.2 Colours: refer to Finish Schedule on Drawings.

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### **3 . EXECUTION**

#### **3.1 Examination**

- 3.1.1 Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- 3.1.2 Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - .1 Concrete: 12 percent.
  - .2 Masonry (Clay and CMU): 12 percent.
  - .3 Wood: 15 percent.
- 3.1.3 Wood Substrates: Inspect work to ensure surfaces are smooth, free from machine marks and that nailheads have been countersunk.
- 3.1.4 Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- 3.1.5 Proceed with coating application only after unsatisfactory conditions have been corrected.
  - .1 Application of coating indicates acceptance of surfaces and conditions.

#### **3.2 Preparation**

- 3.2.1 Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated on Drawings and Schedules.
- 3.2.2 Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - .1 Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated on Drawings and Schedules.
- 3.2.3 Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- 3.2.4 Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
  - .1 SSPC-SP 3, "Power Tool Cleaning."
- 3.2.5 Decorative Metals: Blast clean removing minimum 0.037 mm to 0.050 mm (1.5 - 2 mil) scale, rust and other foreign matter from



metal surface using grit abrasive to SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

3.2.6 Galvanized Steel:

- .1 Hot Dipped Galvanized Steel (Unweathered): Allow to weather minimum of 26 weeks and clean to SSPC-SP16. Remove silicates or similar surface treatments or any deposits of white rust by sanding or similar abrasive methods (bronze wool).
  - .1 Use of acetic acid to prepare galvanized surfaces is not acceptable.
  - .2 Clean chromate passivated galvanized metal surface contamination by washing with appropriate chemical solution compatible with finish specified such as MPI #25.
- .2 Galvanized Steel (Weathered): Remove dust, dirt, grease, oxides and other foreign material and clean to SSPC-SP16 specified herein prior to coating.
- .3 Galvanized Steel (Pre-Treated - Non-Crystal Appearance): Follow manufacturer's recommendations for preparation, priming and coating of pre-treated galvanized steel.

3.2.7 Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

3.2.8 Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.2.9 Aluminum Substrates: Remove loose surface oxidation.

3.2.10 Wood Substrates:

- .1 Scrape and clean knots, and apply coat of knot sealer before applying primer.
- .2 Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for exterior use in paint system indicated. Sand surfaces that will be exposed to view, and dust off.
- .3 Prime edges, ends, faces, undersides, and backsides of wood.
- .4 After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.2.11 Plastic (PVC or similar): Solvent clean to SSPC-SP1. Sand lightly with No. 120 sandpaper and remove dust.

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**3.3     Mixing**

- 3.3.1 Mix and prepare paint materials in accordance with manufacturer's directions for particular material and coat to be applied. If reducing is required, do so in accordance with recommendations of manufacturer for particular material and coat.
- 3.3.2 Tint undercoats and each finish coat with correct type colours, for identification of each succeeding coat.
- 3.3.3 Clean containers used for storage, mixing and application of materials free of foreign materials and residue.

**3.4     Application**

- 3.4.1 Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
  - .1 Use applicators and techniques suited for paint and substrate indicated on Drawings and Schedules.
  - .2 Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
  - .3 Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
  - .4 Paint entire exposed surface of window frames and sashes.
  - .5 Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  - .6 Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- 3.4.2 Tint undercoats same color as topcoat but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.
- 3.4.3 If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, colour, and appearance.
- 3.4.4 Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and colour breaks.

**3.5     Equipment**

- 3.5.1 Read Divisions 21, 22, 23 and Division 26 for their requirements and further instruction on painting Mechanical and Electrical work

and perform such work under supervision of respective Mechanical and Electrical Divisions.

- 3.5.2 Paint finished area exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as indicated.
- 3.5.3 Do not paint over nameplates.
- 3.5.4 Keep sprinkler heads free of paint.
- 3.5.5 Paint inside of ductwork where visible behind grilles, registers and diffusers with primer and one coat of matt black paint.
- 3.5.6 Paint both sides and edges of backboards for telephone and electrical equipment before installation. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.
- 3.5.7 Do not paint exterior transformers and substation equipment.

### **3.6 Cleaning And Protection**

- 3.6.1 At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- 3.6.2 After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- 3.6.3 Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Consultant, and leave in an undamaged condition.
- 3.6.4 At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.
- 3.6.5 Protect finished areas subject to contact during drying by posting "Wet Paint" signs and barring from traffic where necessary.
- 3.6.6 Leave storage areas clean and free from evidence of occupancy.
- 3.6.7 Collect waste paint by type and provide for delivery to recycling or collection facility. Recycle empty paint cans.
- 3.6.8 Make Good any damage to building surfaces or furnishings resulting from painting operations at no cost to Owner.

### **3.7 Exterior Finish Painting (Pt) Schedule**

- 3.7.1 Substrate: Exterior Asphalt Pavement Marking – Latex Traffic Marking Paint (EXT 2.1A):
  - .1 Primer: As recommended by manufacturer.
  - .2 Finish Coats: Apply water-based traffic paint (MPI #97) coats in strict accordance with manufacturer's instructions:

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- .1 "Setfast® Traffic Marking Paint" by Sherwin Williams
  - .2 "Zoneline Traffic and Zone Marking Paint (11-53)" by PPG - Pittsburgh Paint
  - .3 "Ennis Traffic Standard Dry – Waterborne Marking Paints" by Benjamin Moore
- 3.7.2 Substrate: Concrete Vertical Surfaces (including undersides of balconies, soffits, etc.) - Latex Finish (EXT 3.1A as amended):
- .1 Regular Type:
    - .1 Primer: 1 coat alkali resistant, WB primer (MPI #3):
      - .1 "Loxon Concrete & Masonry Primer, <100 g/L" by Sherwin Williams
      - .2 "Perma-Crete Alkali Resistant Primer (4-603)" by PPG - Pittsburgh Paint
      - .3 "Ultra Spec High Build Masonry Primer K609" by Benjamin Moore
    - .2 Finish Coats: 2 coats exterior latex coating (MPI #10)
      - .1 "A-100 Exterior Latex, <50 g/L" by Sherwin Williams
      - .2 "Speedhide Exterior 100% Acrylic" by PPG - Pittsburgh Paint
      - .3 "K447 Ultra Spec Exterior Flat Finish - Zero VOC" by Benjamin Moore
- 3.7.3 Substrate: Concrete Vertical Surfaces (including undersides of balconies, soffits, etc.) – Textured Latex Aggregate Finish (EXT 3.1N as amended):
- .1 Primer: As recommended by manufacturer.
  - .2 Finish Coats: Apply textured latex aggregate paint (MPI #41 and #42) coats in strict accordance with manufacturer's instructions:
    - .1 "UltraCrete Textured Masonry Topcoat, <50 g/L" by Sherwin Williams.
    - .2 "Perma-Crete Acrylic Texture Coating" by PPG - Pittsburgh Paint
- 3.7.4 Substrate: Concrete Block Masonry - Latex Finish (EXT 4.2A as amended):
- .1 Regular Type:
    - .1 Primer: 1 coat exterior block filler (MPI #4):
      - .1 "Loxon Block Surfacer, <100 g/L" by Sherwin Williams
      - .2 "Speedhide Hi Fill Acrylic Block Filler (6-15)" by PPG - Pittsburgh Paint

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- .3 "Ultra Spec Masonry Block Filler K571" by Benjamin Moore
  - .2 Finish Coats: 2 coats exterior latex coating (MPI #10, #15)
    - .1 "A-100 Exterior Latex, <50 g/L" by Sherwin Williams
    - .2 "Speedhide Exterior 100% Acrylic Flat" by PPG - Pittsburgh Paint
    - .3 "Ultra Spec Exterior Flat Finish K447" by Benjamin Moore
  - 3.7.5 Substrate: Structural Steel and Miscellaneous Ferrous Metals – WB Light Industrial Coating (EXT 5.1M as amended):
    - .1 Primer: 1 coat rust inhibitive primer (MPI #107):
      - .1 "Pro Industrial Pro-Cryl Universal Metal Primer, <100 g/L" by Sherwin Williams
      - .2 "Pitt-Tech Plus DTM Acrylic Primer" by PPG - Pittsburgh Paint
      - .3 "KP04 Super Spec High Performance Acrylic Metal Primer" by Benjamin Moore
    - .2 Finish Coats: 2 coats WB light industrial coating (MPI #163)
      - .1 "Pro Industrial Zero VOC Acrylic, 0 g/L" by Sherwin Williams
      - .2 "Pitt-Tech Plus DTM Acrylic Enamel" by PPG - Pittsburgh Paint
      - .3 "Ultra Spec HP D.T.M. Acrylic Semi-Gloss FP29" by Benjamin Moore
  - 3.7.6 Substrate:
    - .1 Repair of Galvanized Metals: Touch-up damaged surfaces with zinc-rich coating.
      - .1 Primer: 1 coat organic zinc-rich epoxy primer:
        - .1 "Zinc Clad 5" by Sherwin Williams
        - .2 "Aquapon Zinc Rich Epoxy" by PPG - Pittsburgh Paint
        - .3 "Corotech Organic Zinc Rich Primer V170" by Benjamin Moore
    - .2 Galvanized Steel: WB Light Industrial Coating (EXT 5.3J as amended):
      - .1 Primer: 1 coat rust inhibitive primer (MPI #134):
        - .1 "Pro Industrial Pro-Cryl Universal Metal Primer, <100 g/L" by Sherwin Williams
        - .2 "Pitt-Tech Plus DTM Acrylic Primer" by PPG - Pittsburgh Paint

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- .3 "Ultra Spec HP D.T.M. Primer FP04" by Benjamin Moore
  - .2 Finish Coats: 2 coats WB light industrial coating (MPI #163)
    - .1 "Pro Industrial Zero VOC Acrylic, 0 g/L" by Sherwin Williams
    - .2 "Pitt-Tech Plus DTM Acrylic Enamel" by PPG - Pittsburgh Paint
    - .3 "Ultra Spec HP D.T.M. Acrylic Semi-Gloss FP29" by Benjamin Moore
  - 3.7.7 Substrate: Steel (High Heat) including heat exchangers, breeching, pipes, flues, stacks etc. – Heat Resistant Enamel – Maximum 205 deg C (400 deg F) (EXT 5.2A as amended):
    - .1 Primer: As recommended by manufacturer.
    - .2 Finish Coats: Apply heat resistant enamel (MPI #21) coats in strict accordance with manufacturer's instructions:
      - .1 "Heat Flex Hi Temp 500" by Sherwin Williams
      - .2 "Ameron PSX Engineered Siloxane" by PPG
      - .3 Approved equivalent by Benjamin Moore
  - 3.7.8 Substrate: Aluminum – WB Light Industrial Coating (EXT 5.4G as amended):
    - .1 Primer: 1 coat rust inhibitive primer (MPI #134):
      - .1 "Pro Industrial Pro-Cryl Universal Metal Primer, <100 g/L" by Sherwin Williams
      - .2 "Pitt-Tech Plus DTM Acrylic Primer" by PPG - Pittsburgh Paint
      - .3 "Ultra Spec HP D.T.M. Primer FP04" by Benjamin Moore
    - .2 Finish Coats: 2 coats WB light industrial coating (MPI #163)
      - .1 "Pro Industrial Zero VOC Acrylic, 0 g/L" by Sherwin Williams
      - .2 "Pitt-Tech Plus DTM Acrylic Enamel" by PPG - Pittsburgh Paint
      - .3 "Ultra Spec HP D.T.M. Acrylic Semi-Gloss FP29 (MPI 153)" by Benjamin Moore
  - 3.7.9 Substrate: Wood – Opaque Latex Finish:
    - .1 Glue Laminated Lumber (EXT 6.1L as amended),
      - .1 Primer: 1 coat exterior wood latex primer (MPI #6)
        - .1 "Exterior Latex Wood Primer, <100 g/L" by Sherwin Williams
        - .2 "Seal Grip Acrylic Universal Primer" by PPG - Pittsburgh Paint

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- .3 "Fresh Start High-Hiding All-Purpose Primer K046" by Benjamin Moore
  - .2 Finish Coats: 2 coats exterior latex coating (MPI #10, #11, #15)
    - .1 "A-100 Exterior Latex, <50 g/L" by Sherwin Williams
    - .2 "Speedhide Exterior 100% Acrylic" by PPG - Pittsburgh Paint
    - .3 "K447/K448/K449 Ultra Spec Exterior" by Benjamin Moore
  - .2 Dimension Lumber including but not limited to columns, beams, exposed joists, underside of decking, siding, fencing etc. (EXT 6.2M as amended)
    - .1 Primer: 1 coat exterior wood latex primer (MPI #6)
      - .1 "Exterior Latex Wood Primer, <100 g/L" by Sherwin Williams
      - .2 "Seal Grip Acrylic Universal Primer" by PPG - Pittsburgh Paint
      - .3 "K169 Super Spec Latex Exterior Primer" by Benjamin Moore
    - .2 Finish Coats: 2 coats exterior latex coating (MPI #10, #11, #15)
      - .1 "A-100 Exterior Latex, <50 g/L" by Sherwin Williams
      - .2 "Speedhide Exterior 100% Acrylic" by PPG - Pittsburgh Paint
      - .3 "K448 Ultra Spec Exterior" by Benjamin Moore
  - .3 Dressed Lumber including but not limited to doors, door and window frames, casings, battens, smooth fascias etc. (EXT 6.3L as amended)
    - .1 Primer: 1 coat exterior wood latex primer (MPI #6)
      - .1 "Exterior Latex Wood Primer, <100 g/L" by Sherwin Williams
      - .2 "Seal Grip Acrylic Universal Primer" by PPG - Pittsburgh Paint
      - .3 "K169 Super Spec Latex Exterior Primer" by Benjamin Moore
    - .2 Finish Coats: 2 coats exterior latex coating (MPI #10, #11, #15)
      - .1 "A-100 Exterior Latex, <50 g/L" by Sherwin Williams
      - .2 "Speedhide Exterior 100% Acrylic" by PPG - Pittsburgh Paint
      - .3 "K448 Ultra Spec Exterior" by Benjamin Moore

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- .4 Wood Paneling including but not limited to plywood siding, fascias, soffits etc. (EXT 6.4K as amended)
    - .1 Primer: 1 coat exterior wood latex primer (MPI #6)
      - .1 "Exterior Latex Wood Primer, <100 g/L" by Sherwin Williams
      - .2 "Seal Grip Acrylic Universal Primer" by PPG - Pittsburgh Paint
      - .3 "K169 Super Spec Latex Exterior Primer" by Benjamin Moore
    - .2 Finish Coats: 2 coats exterior latex coating (MPI #10, #11, #15)
      - .1 "A-100 Exterior Latex, <50 g/L" by Sherwin Williams
      - .2 "Speedhide Exterior 100% Acrylic" by PPG - Pittsburgh Paint
      - .3 "K448 Ultra Spec Exterior" by Benjamin Moore
  - 3.7.10 Substrate: Wood – Fire-retardant Coating:
    - .1 Primer: As recommended by manufacturer.
    - .2 Finish Coats: Apply ULC approved fire-retardant (MPI #126) coats in strict accordance with manufacturer's instructions:
      - .1 "Flame Control" by Sherwin Williams (Not MPI #126) or approved equivalent.
  - 3.7.11 Substrate: Plaster/Stucco/EIFS (Walls and Soffits) – Latex (EXT 9.1J as amended)
    - .1 Regular Type:
      - .1 Primer: 1 coat exterior primer (MPI #4):
        - .1 "Loxon Concrete & Masonry Primer, <100 g/L" by Sherwin Williams
        - .2 "Speedhide Hi Fill Acrylic Block Filler" by PPG - Pittsburgh Paint
        - .3 "K206 Super Spec High Build Interior/Exterior Block Filler" by Benjamin Moore
      - .2 Finish Coats: 2 coats exterior latex coating (MPI #10, #11, #15)
        - .1 "A-100 Exterior Latex, <50 g/L" by Sherwin Williams
        - .2 "Speedhide Exterior 100% Acrylic" by PPG - Pittsburgh Paint
        - .3 "K448 Ultra Spec Exterior" by Benjamin Moore

END OF SECTION



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**1. GENERAL**

**1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

**1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Interior Painting work specified herein. This includes, but is not necessarily limited, to:

- .1 Painting of all interior exposed elements noted on Room Finish Schedule and noted on Drawings including following substrates:
  - .1 Concrete masonry units (CMU).
  - .2 Steel.
  - .3 Galvanized metal.
  - .4 Aluminum (not anodized or otherwise coated).
  - .5 Wood.
  - .6 Gypsum board.
  - .7 Plaster.
- .2 Where an item or surface is not specifically mentioned on Room Finish Schedules or on Drawings, and is not excluded, Provide same finish as similar adjacent materials or surfaces.
- .3 Do not paint excluded components indicated herein.

1.2.2 Work Excluded:

- .1 Do not paint pre-finished metal.
- .2 Do not paint chrome, stainless steel, vinyl, plastic laminate and aluminum surfaces throughout unless specified otherwise.
- .3 Do not paint interior surfaces of steel tanks and stacks.
- .4 Do not paint sprayed fire-resistant materials.
- .5 Do not paint equipment furnished completely prime- and finish painted by manufacturer unless required to have field painting over factory finish in order to produce common corporate colour as identified in room finish schedule.
- .6 Do not paint over ULC, FM or other code required labels or equipment identification plates.

1.2.3 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only.

- .1 Section 05 12 00, Structural Steel Framing for shop priming of metal substrates with primers specified in this Section.
- .2 Section 09 91 13, Exterior Painting for surface preparation and the application of paint systems on exterior substrates.

### **1.3     References**

1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4     Definitions**

- 1.4.1 Gloss Level 1 (Flat or Matte): Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
- 1.4.2 Gloss Level 2 (Velvet): Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- 1.4.3 Gloss Level 3 (Eggshell): 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- 1.4.4 Gloss Level 4 (Satin): 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
- 1.4.5 Gloss Level 5 (Semi-gloss): 35 to 70 units at 60 degrees, according to ASTM D523.
- 1.4.6 Gloss Level 6 (Gloss): 70 to 85 units at 60 degrees, according to ASTM D523.
- 1.4.7 Exposed: This refers to items visible in completed Work. In case of closets, cabinets and drawers, it includes their interiors.
- 1.4.8 Surface Preparation: This refers to means of cleaning or treating of surface to be painted to ensure best possible bond between surface and painting applied. Surface preparation methods include, but are not limited to:
  - .1 Ensure preparation and workmanship conforms to MPI Painting Manual requirements
  - .2 Removal of surface contaminants that will affect performance of painting including but not limited to: oil, grease, salts, dust, dirt, rust, rust scale, mill scale, and old coatings where applicable.

- .3 Removal of surface imperfections including without limitations: weld spatter, sharp edges, burrs, silvers, laminations, pits, porosities and crevices.
- .4 Preparation of surfaces to Provide anchor profile or surface profile to improve mechanical bonding of coating to prepared surface by increasing surface area.
- 1.4.9 Dry location or area: A location not normally subject to dampness.
- 1.4.10 Damp/wet location or area: Location that is normally or periodically subject to condensation of moisture in, on, or adjacent to, Work of this Section. This includes location in which water or other liquid can drip, splash, or flow on or against Work of this Section. This includes, but is not limited to, showers, drying areas, change rooms, kitchen areas, washrooms, and associated vestibules and corridors.

## **1.5      Action Submittals**

- 1.5.1 Product Data: Submit product data in accordance with Division 01 for each type of product. Include preparation requirements and application instructions.
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for the Interior Painting work and include product characteristics, performance criteria, physical size, finish and limitations
- 1.5.2 Samples: Submit samples in accordance with Division 01 for each type of paint system and in each colour and gloss of topcoat.
  - .1 Submit full range colour sample chips to indicate where colour availability is restricted.
  - .2 Submit Samples (brushouts) on rigid backing, 200 mm (8 inches) square.
    - .1 3 mm (1/8 inch) plate steel for finishes over metal surfaces.
    - .2 13 mm (1/2 inch) plywood for finishes over wood surfaces.
    - .3 50 mm (2 inch) concrete block for finishes over concrete or concrete masonry surfaces.
    - .4 13 mm (1/2 inch) gypsum board for finishes over gypsum board and other smooth surfaces.
  - .3 Step coats on Samples to show each coat required for system.
  - .4 Label each coat of each Sample.
  - .5 Label each Sample for location and application area.

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- .6 Retain reviewed samples on-site to demonstrate acceptable standard of quality for appropriate on-site surface.
  - 1.5.3 Product List: Submit product list in accordance with Division 01 for each product indicated on Drawings and Schedules, include the following:
    - .1 Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
    - .2 Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
    - .3 Colour Numbers
    - .4 MPI Environmentally Friendly Classification System Rating
    - .5 Manufacturer's Safety Data Sheets (SDS)
    - .6 VOC content.
  - 1.6 Informational Submittals**
    - 1.6.1 Test reports: Provide certified test reports for paint from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
      - .1 Lead, cadmium and chromium: presence of and amounts.
      - .2 Mercury: presence of and amounts.
      - .3 Organochlorines and PCBs: presence of and amounts.
  - 1.7 Closeout Submittals**
    - 1.7.1 Operation and Maintenance Data: Provide operation and maintenance data for painting materials for incorporation into manual. Include the following cross-referenced to paint system and locations of application areas:
      - .1 Product name, type and use.
      - .2 Manufacturer's product number.
      - .3 Colour names and numbers
      - .4 MPI Environmentally Friendly classification system rating.
  - 1.8 Maintenance Material Submittals**
    - 1.8.1 Supply extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
      - .1 Paint: 5 percent, but not less than 3.8 L (1 gal.) of each material and colour applied.

- 1.8.2 Paint must be boxed and in sealed, unopened cans in undamaged condition, with name of manufacturer, contents, type and colour clearly indicated on a label securely adhered to can.

**1.9 Quality Assurance**

- 1.9.1 Qualifications: Provide work of this Section executed by competent installers with membership in good standing in MPI, OPCA and/or PDCA having a minimum of 5 years' experience in application of Products, systems and assemblies specified and with approval and training of Product manufacturers.
- .1 Qualified journeypersons as defined by local jurisdiction to be engaged in painting work.
  - .2 Apprentices may be employed provided they work under direct supervision of qualified journeyperson in accordance with trade regulations.
- 1.9.2 Mockups: Apply mockups of each paint system directed on Site and each colour and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
- .1 Consultant will select one surface to represent surfaces and conditions for application of each paint system specified.
    - .1 Vertical and Horizontal Surfaces: Provide mock-ups of at least 9 sq. m (100 sq. ft.).
    - .2 Other Items: Consultant will designate items or areas required.
  - .2 Final approval of colour selections will be based on mockups.
    - .1 If preliminary colour selections are not approved, apply additional mockups of additional colours selected by Consultant at no added cost to Owner.
  - .3 Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Consultant specifically approves such deviations in writing.
  - .4 Reviewed mockups may become part of the completed Work if undisturbed at time of Substantial Performance of the Work.
- 1.9.3 Single Source Responsibility: Ensure primary materials provided in this Section are obtained from one source by a single manufacturer and secondary materials are obtained from sources recommended by primary materials manufacturers.
- .1 Use single brand of paint chosen throughout work of this Section, except where specified otherwise.

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**1.10     Delivery, Storage, And Handling**

1.10.1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .1 Imprint containers with labels indicating the following:
  - .1 Type of paint or coating.
  - .2 Compliance with applicable standard.
  - .3 Colour number in accordance with established colour schedule.

1.10.2 Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 7 deg C (45 deg F).

- .1 Maintain containers in clean condition, free of foreign materials and residue.
- .2 Remove rags and waste from storage areas daily.
- .3 Keep materials away from excessive heat or direct rays of the sun.
- .4 Remove used cloths from building at the end of every working shift and when not in use.

1.10.3 Fire Prevention:

- .1 Prevent fire or explosion caused by improper storage of paints, solvents, rags, and similar items. Store hazardous materials in location and in manner approved by local fire authority.
- .2 Post "No Smoking" signs in areas of storage and mixing. Provide and maintain CO<sub>2</sub> fire extinguishers of minimum 9 kg (20 lb) capacity.

**1.11     Field Conditions**

1.11.1 Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 18 and 35 deg C (65 and 95 deg F). When required, Provide heating facilities to maintain ambient air and substrate temperatures above 10 deg C for 24 hours before, during and after paint application until paint has cured sufficiently.

1.11.2 Provide ventilation to remove odours, evaporating solvents and moisture. Maintain adequate ventilation at all times to control excessive humidity. Provide continuous ventilation for 7 days after completion of application of paint.

1.11.3 Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 3 deg C (5 deg F) above the dew point and rising; or to damp or wet surfaces.

- 1.11.4 Paint and finish work items in clean, dust-free, properly ventilated and adequately lit areas (minimum 100 lx (9.3 ft candles)).

**1.12 Warranty**

- 1.12.1 Warrant Work of this Section for period of 2 years against defects and deficiencies in accordance with General Conditions of the Contract.
- 1.12.2 Promptly correct defects or deficiencies which become apparent within warranty period, to satisfaction of Consultant and at no expense to Owner.
- 1.12.3 Defects include but are not limited to: material shrinkage, cracking, splitting, bubbling, blistering and delamination resulting from defective materials or poor workmanship.

**2 . PRODUCTS**

**2.1 Manufacturers**

- 2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.
- .1 Benjamin Moore & Co. (Canada).
  - .2 Cloverdale Paint.
  - .3 Coronado Paint/Corotech/Insl-x .
  - .4 Dulux Paints (Canada).
  - .5 PPG Architectural Finishes, Inc.
  - .6 Sherwin-Williams Company (The).
- 2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

**2.2 Performance Requirements**

- 2.2.1 MPI Standards: Unless indicated otherwise, Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List." Functionally and aesthetically equivalent Products that do not meet requirements of MPI standards may be considered, provided they meet requirements of this Specification and are reviewed by the Consultant.
- 2.2.2 Unless otherwise specified herein, all painting work shall be in accordance with MPI Premium Grade finish requirements
- 2.2.3 Material Compatibility:
- .1 Provide materials for use within each paint system that are compatible with one another and substrates indicated on

Drawings and Schedules, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

- .2 For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated on Drawings and Schedules.

2.2.4 Minimum Coat Thickness: Unless indicated otherwise, Minimum coat thicknesses for the work of this Section are as follows:

- .1 Latex and Acrylics (Interior): 0.03 mm (1.2 mils) DFT/coat.
- .2 Epoxies (Interior): 0.076 mm (3 mils) DFT/coat.
- .3 Urethanes (Interior): 0.076 mm (3 mils) DFT/coat.

2.2.5 Standard of Acceptance:

- .1 Walls: no defects visible from a distance of 900 mm (3 ft) at 90 deg to surface when viewed using final lighting source.
- .2 Soffits: no defects visible from floor at 45 deg to surface when viewed using final lighting source.
- .3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

2.2.6 Except as noted herein or indicated on Room Finish Schedule, paint interior walls and ceiling surfaces accordance with the following criteria over appropriate prime / sealer coat:

- .1 All areas (except as noted): standard performance low odour/low VOC interior, institutional latex.
- .2 High-traffic areas including bathrooms and stairwells: "scuff-resistant" low odour/low VOC interior, institutional latex
- .3 Commercial wet areas including, locker rooms, kitchenettes, change rooms, janitor rooms, shower rooms: High performance epoxy modified latex or water-based epoxy.

## **2.3 Finishes (PT-#)**

2.3.1 Material Tag: This item is noted as "PT-#" on Drawings and Schedules.

2.3.2 Unless indicated otherwise, gloss values for the work of this Section are as follows:

- .1 Walls: Eggshell or Satin.
- .2 Trim and Doors: Semi-gloss.
- .3 Ceilings: Flat.

2.3.3 Colours: Refer to Finish Schedule on Drawings.



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### **3 .    EXECUTION**

#### **3.1    Examination**

- 3.1.1 Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- 3.1.2 Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - .1 Concrete: 12 percent.
  - .2 Masonry (Clay and CMU): 12 percent.
  - .3 Wood: 15 percent.
  - .4 Gypsum Board: 12 percent.
- 3.1.3 Gypsum Board Substrates: Verify that finishing compound is sanded smooth. Inspect surfaces to ensure there is no "nail popping", screw recessed are recessed, and surface is free of breaks and imperfections.
- 3.1.4 Wood Substrates: Inspect work to ensure surfaces are smooth, free from machine marks and that nailheads have been countersunk.
- 3.1.5 Spray-Textured Ceiling Substrates: Verify that surfaces are dry.
- 3.1.6 Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- 3.1.7 Proceed with coating application only after unsatisfactory conditions have been corrected.
  - .1 Application of coating indicates acceptance of surfaces and conditions.

#### **3.2    Preparation**

- 3.2.1 Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated on Drawings and Schedules.
- 3.2.2 Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - .1 After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- 3.2.3 Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

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- .1 Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated on Drawings and Schedules.
  - 3.2.4 Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
  - 3.2.5 Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.
  - 3.2.6 Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
    - .1 SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
  - 3.2.7 Metal Stacks, Breeching, Piping: Blast clean to 0.037 mm to 0.050 mm (1.5 - 2 mil) profile using grit abrasive to SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 3.2.8 Decorative Metals: Blast clean removing minimum 0.037 mm to 0.050 mm (1.5 - 2 mil) scale, rust and other foreign matter from metal surface using grit abrasive to SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 3.2.9 Galvanized Steel:
    - .1 Hot Dipped Galvanized Steel (Unweathered): Allow to weather minimum of 26 weeks and clean to SSPC-SP16. Remove silicates or similar surface treatments or any deposits of white rust by sanding or similar abrasive methods (bronze wool).
      - .1 Use of acetic acid to prepare galvanized surfaces is not acceptable.
      - .2 Clean chromate passivated galvanized metal surface contamination by washing with appropriate chemical solution compatible with finish specified such as MPI #25.
    - .2 Galvanized Steel (Weathered): Remove dust, dirt, grease, oxides and other foreign material and clean to SSPC-SP16 specified herein prior to coating.
    - .3 Galvanized Steel (Pre-Treated - Non-Crystal Appearance): Follow manufacturer's recommendations for preparation, priming and coating of pre-treated galvanized steel.
  - 3.2.10 Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

- 3.2.11 Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- 3.2.12 Aluminum Substrates: Remove loose surface oxidation.
- 3.2.13 Wood Substrates:
  - .1 Scrape and clean knots, and apply coat of knot sealer before applying primer.
  - .2 Sand surfaces that will be exposed to view, and dust off.
  - .3 Prime edges, ends, faces, undersides, and backsides of wood.
  - .4 After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- 3.2.14 Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.
- 3.2.15 Plastic (PVC or similar): Solvent clean to SSPC-SP1. Sand lightly with No. 120 sandpaper and remove dust.

### **3.3     Mixing**

- 3.3.1 Mix and prepare paint materials in accordance with manufacturer's directions for particular material and coat to be applied. If reducing is required, do so in accordance with recommendations of manufacturer for particular material and coat.
- 3.3.2 Tint undercoats and each finish coat with correct type colours, for identification of each succeeding coat.
- 3.3.3 Clean containers used for storage, mixing and application of materials free of foreign materials and residue.

### **3.4     Application**

- 3.4.1 Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
  - .1 Use applicators and techniques suited for paint and substrate indicated on Drawings and Schedules.
  - .2 Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  - .3 Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

- .4 Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- .5 Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- 3.4.2 Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match colour of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- 3.4.3 If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, colour, and appearance.
- 3.4.4 Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and colour breaks.

### **3.5 Equipment**

- 3.5.1 Read Divisions 21, 22, 23 and Division 26 for their requirements and further instruction on painting Mechanical and Electrical work and perform such work under supervision of respective Mechanical and Electrical Divisions.
- 3.5.2 Paint finished area exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as indicated.
- 3.5.3 Do not paint over nameplates.
- 3.5.4 Keep sprinkler heads free of paint.
- 3.5.5 Paint inside of ductwork where visible behind grilles, registers and diffusers with primer and one coat of matt black paint.
- 3.5.6 Paint both sides and edges of backboards for telephone and electrical equipment before installation. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.
- 3.5.7 Do not paint interior transformers and substation equipment.
- 3.5.8 Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
  - .1 Paint the following work where exposed in Boiler room, mechanical and electrical rooms and similar equipment rooms:

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- .1 Exposed conduits, hangers, ductwork and other mechanical and electrical equipment.
  - .2 Equipment, including panelboards and switch gear.
  - .3 Uninsulated metal piping.
  - .4 Uninsulated plastic piping.
  - .5 Pipe hangers and supports.
  - .6 Metal conduit.
  - .7 Plastic conduit.
  - .8 Tanks that do not have factory-applied final finishes.
  - .9 Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
  - .2 Paint the following work where exposed in occupied spaces:
    - .1 Equipment, including panelboards.
    - .2 Uninsulated metal piping.
    - .3 Uninsulated plastic piping.
    - .4 Pipe hangers and supports.
    - .5 Metal conduit.
    - .6 Plastic conduit.
    - .7 Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
    - .8 Other items as directed by Consultant.
  - .3 Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.
  - .4 Other unfinished areas: leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.

### **3.6     Core And Shell Spaces**

- 3.6.1 Provide paint systems as specified in this Section to interior exposed elements in “finished” areas as noted on Room Finish Schedule. In unfinished areas, Provide minimum one coat of primer whether or not this is indicated on Room Finish Schedule.

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**3.7 Field Quality Control**

3.7.1 Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

.1 Contractor shall touch up and restore painted surfaces damaged by testing.

.2 If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

**3.8 Cleaning And Protection**

3.8.1 At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

3.8.2 After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

3.8.3 Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Consultant, and leave in an undamaged condition.

3.8.4 At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.8.5 Protect finished areas subject to contact during drying by posting "Wet Paint" signs and barring from traffic where necessary.

3.8.6 Leave storage areas clean and free from evidence of occupancy.

3.8.7 Collect waste paint by type and provide for delivery to recycling or collection facility. Recycle empty paint cans.

3.8.8 Make Good any damage to building surfaces or furnishings resulting from painting operations at no cost to Owner.

**3.9 Interior Standard Performance Finish Painting (Pt) Schedule**

3.9.1 Concrete Substrates, Nontraffic Surfaces (INT 3.1A as amended):

.1 Institutional Low-Odor/VOC Latex System:

.1 Prime Coat: one coat alkali-resistant primer (MPI #3)

.1 "Loxon Concrete & Masonry Primer, <100 g/L" by Sherwin Williams

.2 "Seal Grip Acrylic Universal Primer Sealer " by PPG Architectural

.3 "Ultra Spec Masonry Acrylic Sealer K608" by Benjamin Moore

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- .4 "Gripper Acrylic Universal Primer/ Sealer by Dulux Paints
  - .2 Topcoats: two coats, latex, interior, institutional low odor/VOC, (MPI #143, MPI #144, #145)
    - .1 "ProMar 200 Zero VOC, 0 g/L" by Sherwin Williams
    - .2 "Pure Performance Interior Latex Zero VOC 9-line" by PPG Architectural
    - .3 "Ultra Spec 500 Interior Finish, 0g/L" by Benjamin Moore
    - .4 "Ultra Zero VOC" by Dulux Paints
- 3.9.2 Concrete Substrates, Traffic Surfaces:
- .1 Latex Floor Enamel System:
    - .1 Prime Coat: one coat floor paint, latex (MPI #60)
      - .1 "Armorseal Tread-Plex - 100% Acrylic Water Based Floor Coating" by Sherwin Williams.
      - .2 "Water-Based Polyurethane Floor Enamel" by Dulux Paints
    - .2 Topcoats: two coats, Floor paint, latex, (MPI #60)
      - .1 "Armorseal Tread-Plex - 100% Acrylic Water Based Floor Coating" by Sherwin Williams.
      - .2 "Water-Based Polyurethane Floor Enamel" by Dulux Paints
  - .2 Epoxy Floor System: two-component polyamine epoxy
    - .1 Prime Coat: one coat water-based epoxy coating
      - .1 "Armorseal 8100 Water-Based Epoxy Floor Coating" by Sherwin Williams.
      - .2 "Aquapon WB EP Water-Based Epoxy" by PPG Architectural
    - .2 Topcoats: two coats, water-based epoxy coating
      - .1 "Armorseal 8100 Water-Based Epoxy Floor Coating" by Sherwin Williams.
      - .2 "Aquapon WB EP Water-Based Epoxy" or "Perma-Crete Please Seal WB Inter/ Ext Clear Sealer 4-6200XIC by PPG Architectural
  - .3 Provide manufacturer's standard slip resistant additive (SRA) consisting of rubber aggregate, clean/washed silica sand or ground walnut chips (interior dry areas only) for use with or as a component part of paint on horizontal surfaces as required to provide slip resistance. Provide at rate recommended by manufacturer to achieve minimum 0.6 rating per ASTM D2047.
- 3.9.3 CMU Substrates:

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- .1 Institutional Low-Odor/VOC Latex System (INT 4.2E as amended):
    - .1 Block Filler: one coat Block filler, latex, interior/exterior, (MPI #4)
      - .1 "PrepRite Block Filler, 45 g/L" by Sherwin Williams
      - .2 "Speedhide Hi Fill Acrylic Block Filler" by PPG Architectural
      - .3 "Ultra Spec Masonry Block Filler K571" by Benjamin Moore
      - .4 "PRO Latex Blockfiller" by Dulux Paints
    - .2 Topcoats: two coats, latex, interior, institutional low odor/VOC, (MPI #143, MPI #144, #145)
      - .1 "ProMar 200 Zero VOC, 0 g/L" by Sherwin Williams
      - .2 "Pure Performance Interior Latex Zero VOC 9-line" by PPG Architectural
      - .3 "Ultra Spec 500 Interior Finish, 0g/L" by Benjamin Moore
      - .4 "Ultra Zero VOC" by Dulux Paints
  - 3.9.4 Steel Substrates (Non-galvanized):
    - .1 Doors, Frames and Miscellaneous Metals - Water-Based Light Industrial Coating System (INT 5.1B as amended)
      - .1 Prime Coat: One coat Primer, rust-inhibitive, water based (MPI #107).
        - .1 "Pro Industrial Pro-Cryl Universal Primer, <50 g/L" by Sherwin Williams
        - .2 "Pitt-Tech Plus DTM Acrylic Primer" by PPG Architectural
        - .3 "Ultra Spec HP D.T.M. Primer FP04" by Benjamin Moore
      - .2 Topcoats: two coats, Light industrial coating, interior, water based (MPI #151):
        - .1 "Pre-catalyzed Waterbased epoxy, <50 g/L" by Sherwin Williams
        - .2 "Corotech Pre-Catalyzed Waterborne Epoxy" by Benjamin Moore
        - .3 "Pitt-Glaze WB Pre-Catalyzed WB Acrylic Epoxy" by PPG Architectural
  - 3.9.5 Galvanized-Metal Substrates:
    - .1 Doors, Frames and Miscellaneous Metals - Water-Based Light Industrial Coating System (INT 5.1B as amended)
      - .1 Prime Coat: One coat Primer, rust-inhibitive, water based (MPI #107).
        - .1 "Pro Industrial Pro-Cryl Universal Primer, <50 g/L" by Sherwin Williams



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- .2 "Pitt-Tech Plus DTM Acrylic Primer" by PPG Architectural
  - .3 "Ultra Spec HP D.T.M. Primer FP04" by Benjamin Moore
  - .2 Topcoats: two coats, Light industrial coating, interior, water based (MPI #151):
    - .1 "Pre-catalyzed Waterbased epoxy, <50 g/L" by Sherwin Williams
    - .2 "Corotech Pre-Catalyzed Waterborne Epoxy" by Benjamin Moore
    - .3 "Pitt-Glaze WB Pre-Catalyzed WB Acrylic Epoxy" by PPG Architectural
  - 3.9.6 Aluminum (Not Anodized or Otherwise Coated) Substrates:
    - .1 Prime Coat: One coat Primer, rust-inhibitive, water based (MPI #76, MPI #95, MPI #107).
      - .1 "Pro Industrial Pro-Cryl Universal Primer, <50 g/L" by Sherwin Williams
      - .2 "Pitt-Tech Plus DTM Acrylic Primer" by PPG Architectural
      - .3 "Ultra Spec HP D.T.M. Primer FP04" by Benjamin Moore
    - .2 Topcoats: two coats, Light industrial coating, interior, water based (MPI #147, MPI #153):
      - .1 "Pro Industrial Zero VOC Acrylic, 0 g/L" by Sherwin Williams
      - .2 "Pure Performance Interior Latex Zero VOC" by PPG Architectural
      - .3 " Ultra Spec 500 Waterborne Interior Finish, 0g/L " by Benjamin Moore
      - .4 "Lifemaster Interior Acrylic" by Dulux Paints
  - 3.9.7 Painted wood substrates: Including wood trim, architectural woodwork, doors, frames and wood-based panel products indicated to be painted (INT 6.3V as amended).
    - .1 Prime Coat: One coat, multi-purpose latex interior primer sealer (MPI #39)
      - .1 "Prep Rite Pro Block Primer-Sealer, 0 g/L" by Sherwin Williams
      - .2 "Seal Grip Acrylic Universal Primer" by PPG Architectural
      - .3 "Insl-x Aqua Lock AQ-0400" " by Benjamin Moore
      - .4 "Gripper Acrylic Universal Primer/ Sealer by Dulux Paints

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- .2 Topcoats: two coats acrylic Interior, Institutional Low Odor/VOC (MPI #147)
    - .1 "Pro Industrial Zero VOC Acrylic, 0 g/L" by Sherwin Williams
    - .2 "Pure Performance Interior Latex Zero VOC" by PPG Architectural
    - .3 "Ultra Spec 500 Waterborne Interior Finish, 0g/L" by Benjamin Moore
    - .4 "Lifemaster Interior Acrylic" by Dulux Paints
  - 3.9.8 Stained wood substrates: Including wood trim, architectural woodwork, doors, frames and wood-based panel products indicated to be stained (INT 6.3E as amended).
    - .1 Prime Coat: One coat, interior wood stain (semi-transparent) (MPI #90)
      - .1 "Minwax Wood Finish Stain, <250 g/L" by Sherwin Williams
      - .2 "Olympic Low VOC Oil Wood Stain" by PPG Architectural
      - .3 "Professional Wood Finishes Interior Fast Dry Oil Stain" by Dulux Paints
    - .2 Topcoats: two coats acrylic Interior, Institutional Low Odor/VOC (MPI #56, MPI #57)
      - .1 "Minwax Waterbased UrethaneClear, <275 g/L" by Sherwin Williams
      - .2 "Olympic Oil Based Polyurethane" by PPG Architectural
      - .3 "Professional Wood Finishes Polyurethane Oil Based Varnish" by Dulux Paints
  - 3.9.9 Wood Substrates, Traffic Surfaces:
    - .1 Latex Floor Paint System:
      - .1 Prime Coat: Primer sealer, waterbased, interior (MPI #60)
        - .1 "Armorseal Tread-Plex - 100% Acrylic Water Based Floor Coating" by Sherwin Williams
      - .2 Topcoats: two coats, Floor paint, acrylic latex, (MPI #60)
        - .1 "Armorseal Tread-Plex - 100% Acrylic Water Based Floor Coating" by Sherwin Williams.
        - .2 "Water-Based Polyurethane Floor Enamel" by Dulux Paints
    - .2 Provide manufacturer's standard slip resistant additive (SRA) consisting of rubber aggregate, clean/washed silica sand or ground walnut chips (interior dry areas only) for use with or as

a component part of paint on horizontal surfaces as required to provide slip resistance. Provide at rate recommended by manufacturer to achieve minimum 0.6 rating per ASTM D2047.

3.9.10 Fiberglass and Plastic Substrates:

- .1 Institutional Low-Odor/VOC Latex System:
  - .1 Prime Coat: Primer, bonding, water based (MPI #17).
    - .1 "Extreme Bond Waterborne Bonding Primer" by Sherwin Williams
    - .2 "Seal-Grip Acrylic Universal Primer/ Sealer" by PPG Architectural – Pittsburgh Paints
    - .3 "Gripper Acrylic Universal Primer/ Sealer by Dulux Paints
    - .4 "Insl-x Stix Bonding Primer SXA-110" by Benjamin Moore
  - .2 Topcoats: two coats, latex, interior, institutional low odor/VOC, (MPI #143, MPI #144, #145)
    - .1 "ProMar 200 Zero VOC, 0 g/L" by Sherwin Williams
    - .2 "Pure Performance Interior Latex Zero VOC" by PPG Architectural
    - .3 "Ultra Zero VOC" by Dulux Paints
    - .4 "Ultra Spec 500 Waterborne Interior Finish, 0g/L" by Benjamin Moore

3.9.11 Gypsum Board Substrates:

- .1 Regular Gypsum Board: Institutional Low-Odor/VOC Latex System (INT 9.2M as amended):
  - .1 Prime Coat: One coat Primer sealer, interior, institutional low odor/VOC (MPI #149).
    - .1 "ProMar 200 Zero VOC Interior Latex Primer, 0 g/L" by Sherwin Williams
    - .2 "Pure Performance Interior Latex Primer 9-900" by PPG Architectural
    - .3 "K534 Ultra Spec 500 Waterborne Interior Primer Sealer" by Benjamin Moore
    - .4 "Ultra Zero VOC Interior Primer/ Sealer" by PPG Architectural- Dulux Paints
  - .2 Topcoats: two coats, latex, interior, institutional low odor/VOC, (MPI #143, MPI #144, #145)
    - .1 "ProMar 200 Zero VOC, 0 g/L" by Sherwin Williams
    - .2 "Pure Performance Interior Latex Zero VOC 9-line" by PPG Architectural
    - .3 "Ultra Spec 500 Interior Finish, 0g/L" by Benjamin Moore
    - .4 "Ultra Zero VOC" by Dulux Paints

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- .2 Fiberglass-Mat Faced Gypsum Board Walls (Moisture resistant gypsum board, abuse resistant gypsum board, impact resistant gypsum board)
    - .1 Primer: One coat high build surfacer (Minimum DFT: as recommended by manufacturer but not less than 10 mils)
      - .1 "Builders Solution, <50 g/L" by Sherwin Williams
      - .2 "Speedhide Maxbuild High Build Drywall Surfacers" by PPG Architectural
      - .3 "X-pert High Build Primer/Sealer 11020A" by Dulux Paints
    - .2 Sealing Coat: One coat multi-purpose latex interior primer sealer (MPI #39) as recommended by manufacturer:
      - .1 "Prep Rite Pro Block Primer-Sealer, 0 g/L" by Sherwin Williams
      - .2 "Insl-X Prime All Multi-Surface Latex Primer Sealer" by Benjamin Moore
      - .3 "Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer" by PPG Architectural.
    - .3 Topcoats: two coats, latex, interior, institutional low odor/VOC, (MPI #143, MPI #144, #145)
      - .1 "ProMar 200 Zero VOC, 0 g/L" by Sherwin Williams
      - .2 "Pure Performance Interior Latex Zero VOC 9-line" by PPG Architectural
      - .3 "Ultra Spec 500 Interior Finish, 0g/L" by Benjamin Moore
      - .4 "Ultra Zero VOC" by Dulux Paints
- 3.9.12 Spray-Textured Ceiling Substrates:
- .1 Latex (Flat) System:
    - .1 Prime Coat: Latex, interior, flat, (Gloss Level 1) (MPI #53).
      - .1 "ProMar 200 Zero VOC Interior Latex Primer, 0 g/L" by Sherwin Williams
      - .2 "Pure Performance Interior Latex Primer 9-900" by PPG Architectural
      - .3 "K534 Ultra Spec 500 Waterborne Interior Primer Sealer" by Benjamin Moore
      - .4 "Ultra Zero VOC Interior Primer/ Sealer" by PPG Architectural- Dulux Paints
    - .2 Topcoats: two coats, Latex, interior, flat, (Gloss Level 1) (MPI #53).
      - .1 "ProMar 200 Zero VOC, 0 g/L" by Sherwin Williams

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- .2 "Pure Performance Interior Latex Zero VOC 9-line"  
by PPG Architectural
  - .3 "Ultra Spec 500 Interior Finish, 0g/L" by Benjamin  
Moore
  - .4 "Ultra Zero VOC" by Dulux Paints
- 3.9.13 Cotton or Canvas Insulation-Covering Substrates: Including pipe  
and duct coverings.
- .1 Institutional Low-Odor/VOC Latex System:
    - .1 Prime Coat: One coat Primer sealer, interior, institutional  
low odor/VOC (MPI #50).
      - .1 "ProMar 200 Zero VOC Interior Latex Primer, 0 g/L"  
by Sherwin Williams
      - .2 "Pure Performance Interior Latex Primer 9-900" by  
PPG Architectural
      - .3 "K534 Ultra Spec 500 Waterborne Interior Primer  
Sealer" by Benjamin Moore
      - .4 "Ultra Zero VOC Interior Primer/ Sealer" by PPG  
Architectural- Dulux Paints
    - .2 Topcoats: two coats, latex, interior, institutional low  
odor/VOC, (MPI #143, MPI #144, #145)
      - .1 "ProMar 200 Zero VOC, 0 g/L" by Sherwin Williams
      - .2 "Pure Performance Interior Latex Zero VOC 9-line"  
by PPG Architectural
      - .3 "Ultra Spec 500 Interior Finish, 0g/L" by Benjamin  
Moore
      - .4 "Ultra Zero VOC" by Dulux Paints

**3.10 Interior High-Performance Painting (Pt-E) Schedule**

- 3.10.1 Concrete Substrates, Nontraffic Surfaces (INT 3.1G as amended):
- .1 Epoxy Modified Latex System:
    - .1 Prime Coat: As recommended by topcoat manufacturer.
    - .2 Topcoats: two coats coats water-based epoxy (MPI  
#115)
      - .1 "Pro Industrial Zero VOC Waterborne Epoxy, 0 g/L"  
by Sherwin Williams
      - .2 "Corotech Acrylic Epoxy V450" by Benjamin Moore
      - .3 "Aquapon WB EP Water-Based Epoxy" by PPG Ar-  
chitectural
- 3.10.2 CMU Substrates:
- .1 Epoxy Modified Latex System (INT 4.2J as amended):
    - .1 Block Filler: one coat Block filler, latex,  
interior/exterior, (MPI #4)
      - .1 "PrepRite Block Filler, 45 g/L" by Sherwin Williams

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- .2 "Speedhide Hi Fill Acrylic Block Filler" by PPG Architectural
  - .3 "Ultra Spec Masonry Block Filler K571" by Benjamin Moore
  - .4 "PRO Latex Blockfiller" by Dulux Paints
  - .2 Topcoats: two coats, latex, interior, institutional low odor/VOC, (MPI #115, MPI #215)
    - .1 "Pro Industrial Zero VOC Waterborne Epoxy, 0 g/L" by Sherwin Williams
    - .2 "Pitt Glaze Acrylic Epoxy" (NOT MPI APPROVED) by PPG Architectural
    - .3 "Cornado 1138 Line" by Benjamin Moore
- 3.10.3 Steel Substrates (Non-galvanized):
- .1 Epoxy-Modified Latex (over w.b. rust-inhibitive primer) (INT 5.1K as amended)
    - .1 Prime Coat: One coat Primer, rust-inhibitive, water based (MPI #107).
      - .1 "Pro Industrial Pro-Cryl Universal Primer, <50 g/L" by Sherwin Williams
      - .2 "Pitt-Tech Plus DTM Acrylic Primer" by PPG Architectural
      - .3 "Ultra Spec HP D.T.M. Primer FP04" by Benjamin Moore
    - .2 Topcoats: two coats, water-based epoxy (MPI #115)
      - .1 "Pro Industrial Zero VOC B73 Series, Waterbased Epoxy, 0 g/L" by Sherwin Williams
      - .2 "Cornado 1138 Line" by Benjamin Moore
      - .3 "Aquapon WB EP Water-Based Epoxy" by PPG Architectural
- 3.10.4 Galvanized-Metal Substrates:
- .1 Epoxy-Modified Latex (over w.b. rust-inhibitive primer) (INT 5.1K as amended)
    - .1 Prime Coat: One coat Primer, rust-inhibitive, water based (MPI #107).
      - .1 "Pro Industrial Pro-Cryl Universal Primer, <50 g/L" by Sherwin Williams
      - .2 "Pitt-Tech Plus DTM Acrylic Primer" by PPG Architectural
      - .3 "Ultra Spec HP D.T.M. Primer FP04" by Benjamin Moore
    - .2 Topcoats: two coats, water-based epoxy (MPI #115)
      - .1 "Pro Industrial Zero VOC B73 Series, Waterbased Epoxy, 0 g/L" by Sherwin Williams
      - .2 "Cornado 1138 Line" by Benjamin Moore

- .3 "Aquapon WB EP Water-Based Epoxy" by PPG Architectural

3.10.5 Gypsum Board Substrates:

- .1 Regular Gypsum Board: Epoxy Modified Latex System (INT 9.2F as amended):

- .1 Prime Coat: One coat Prep Rite Pro Block Primer-Sealer, 0 g/L sealer (MPI #50).

- .1 "ProMar 200 Zero VOC Interior Latex Primer, 0 g/L" by Sherwin Williams

- .2 "Pure Performance Interior Latex Primer 9-900" by PPG Architectural

- .3 "K534 Ultra Spec 500 Waterborne Interior Primer Sealer" by Benjamin Moore

- .4 "Ultra Zero VOC Interior Primer/ Sealer" by PPG Architectural- Dulux Paints

- .2 Topcoats: two coats, latex, interior, institutional low odor/VOC, (MPI #115, MPI#151, MPI#153)

- .1 "Pro Industrial Zero VOC Waterborne Epoxy, 0 g/L" by Sherwin Williams

- .2 "Pitt Glaze Acrylic Epoxy" by PPG Architectural (MPI 151/153) PPG Architectural

- .3 "Corotech Acrylic Epoxy V450" by Benjamin Moore

- .2 Fiberglass-Mat Faced Gypsum Board Walls (Moisture resistant gypsum board, abuse resistant gypsum board, impact resistant gypsum board)

- .1 Primer: One coat high build surfacer (Minimum DFT: as recommended by manufacturer but not less than 10 mils)

- .1 "Builders Solution, <50 g/L" by Sherwin Williams

- .2 "Speedhide Maxbuild High Build Drywall Surfer" by PPG Architectural

- .3 "X-pert High Build Primer/ Sealer 11020A" by Dulux Paints

- .2 Sealing Coat: One coat multi-purpose latex interior primer sealer (MPI #39) as recommended by manufacturer:

- .1 "Prep Rite Pro Block Primer-Sealer, 0 g/L" by Sherwin Williams

- .3 Topcoats: two coats, latex, interior, institutional low odor/VOC, (MPI #115, MPI#151, MPI#153)

- .1 "Pro Industrial Zero VOC Waterborne Epoxy, 0 g/L" by Sherwin Williams

- .2 "Pitt Glaze Acrylic Epoxy" by PPG Architectural (MPI 151/153) PPG Architectural

- .3 "Corotech Acrylic Epoxy V450" by Benjamin Moore

### **3.11 Miscellaneous Substrates And Specialty Systems**

#### **3.11.1 "Scuff-Resistant" Low Odour/Low VOC Interior, Institutional Latex**

- .1 Concrete Substrates, Nontraffic Surfaces
  - .1 Prime Coat: one coat alkali-resistant primer (MPI #3)
    - .1 "Loxon Concrete & Masonry Primer, <100 g/L" by Sherwin Williams
    - .2 "Ultra Spec® Masonry Interior / Exterior 100% Acrylic Masonry Sealer" by Benjamin Moore
    - .3 "Primemaster Primer/Sealer," by Master Coating Technologies
  - .2 Topcoats: two coats, latex, interior, institutional low odor/VOC "scuff-resistant" acrylic.
    - .1 "ProMar 200 HP Zero VOC, 0 g/L" by Sherwin Williams
    - .2 "Ultra Spec® SCUFF-X™ Finish" by Benjamin Moore
    - .3 "Scuffmaster ScrubTough," by Master Coating Technologies.
- .2 CMU Substrates:
  - .1 Block Filler: one coat Block filler, latex, interior/exterior, (MPI #4)
    - .1 "PrepRite Block Filler, 45 g/L" by Sherwin Williams
    - .2 "Ultra Spec Masonry Block Filler K571" by Benjamin Moore
  - .2 Topcoats: two coats, latex, interior, institutional low odor/VOC "scuff-resistant" acrylic.
    - .1 "ProMar 200 HP Zero VOC, 0 g/L" by Sherwin Williams
    - .2 "Ultra Spec® SCUFF-X™ Finish" by Benjamin Moore
    - .3 "Scuffmaster ScrubTough," by Master Coating Technologies.
- .3 Gypsum Board Substrates (ensure Level 5 finish is provided):
  - .1 Prime Coat: One coat Primer sealer, interior, institutional low odor/VOC (MPI #149).
    - .1 "ProMar 200 Zero VOC Interior Latex Primer, 0 g/L" by Sherwin Williams
    - .2 "K534 Ultra Spec 500 Waterborne Interior Primer Sealer" by Benjamin Moore
    - .3 "Primemaster Primer/Sealer," by Master Coating Technologies



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- .2 Topcoats: two coats, latex, interior, institutional low odor/VOC "scuff-resistant" acrylic.
    - .1 "ProMar 200 HP Zero VOC, 0 g/L" by Sherwin Williams
    - .2 "Ultra Spec® SCUFF-X™ Finish" by Benjamin Moore
    - .3 "Scuffmaster ScrubTough," by Master Coating Technologies.
  - 3.11.2 "Odour Eliminating" Low Odour/Low VOC Interior, Institutional Latex
    - .1 Concrete Substrates, Nontraffic Surfaces
      - .1 Prime Coat: one coat alkali-resistant primer (MPI #3)
        - .1 "Loxon Concrete & Masonry Primer, <100 g/L" by Sherwin Williams
      - .2 Topcoats: two coats, latex, interior, institutional low odor/VOC "odour-eliminating" latex.
        - .1 "Harmony Interior Latex — Odor Eliminating Technology, 0 g/L" by Sherwin Williams
    - .2 CMU Substrates:
      - .1 Block Filler: one coat Block filler, latex, interior/exterior, (MPI #4)
        - .1 "PrepRite Block Filler, 45 g/L" by Sherwin Williams
      - .2 Topcoats: two coats, latex, interior, institutional low odor/VOC "scuff-resistant" acrylic.
        - .1 "Harmony Interior Latex — Odor Eliminating Technology, 0 g/L" by Sherwin Williams
    - .3 Gypsum Board Substrates:
      - .1 Prime Coat: One coat Primer sealer, interior, institutional low odor/VOC (MPI #149).
        - .1 "Harmony Interior Latex Primer — Odor Eliminating Technology, 0 g/L" by Sherwin Williams
      - .2 Topcoats: two coats, latex, interior, institutional low odor/VOC "odour-eliminating" latex.
        - .1 "Harmony Interior Latex — Odor Eliminating Technology, 0 g/L" by Sherwin Williams
  - 3.11.3 Ferrous Exposed Ceilings and Decking (including bar joists) above 6096 mm (20' – 0") – Water-based Dry Fall (INT 5.1CC as amended)
    - .1 Prime coat: Shop-applied Q.D primer (MPI #275): Refer to Section 05 12 00.
    - .2 Topcoats: One coat water based dry fall coating (MPI #118, MPI#226)

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- .1 "Low VOC Waterborne Acrylic Dryfall, <50 g/L" by Sherwin Williams
  - .2 "Speedhide Interior Latex Dryfall" by PPG Architectural
  - .3 "Latex Dryfall Eggshell " by Benjamin Moore
  - .4 "Spraymaster DTM Waterborne Dryfall # 10112" by Dulux Paints
- 3.11.4 Galvanized Exposed Ceilings and Decking (including bar joists) above 6096 mm (20' – 0") – Water-based Dry Fall (INT 5.1CC as amended)
- .1 Top Coats: 2 coats water based dry fall coating (MPI #118, MPI#226)
    - .1 "Low VOC Waterborne Acrylic Dryfall, <50 g/L" by Sherwin Williams
    - .2 "Speedhide Interior Latex Dryfall" by PPG Architectural
    - .3 " Latex Dryfall Eggshell" by Benjamin Moore
    - .4 "Spraymaster DTM Waterborne Dryfall # 10112" by Dulux Paints
- 3.11.5 Steel (High Heat) including heat exchangers, breeching, pipes, flues, stacks etc. – Heat Resistant Enamel – Maximum 205 deg C (400 deg F) (INT 5.2A as amended):
- .1 Primer: As recommended by manufacturer.
  - .2 Topcoats: Apply heat resistant enamel (MPI #21) coats in strict accordance with manufacturer's instructions:
    - .1 "Heat Flex Hi Temp 500" by Sherwin Williams
    - .2 "Ameron Engineered Siloxane PSX 892HS" by PPG Architectural
    - .3 Pitt-Therm Air Dry Silicone" by Dulux Paints

END OF SECTION

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## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Visual Display Surfaces work specified herein. This includes, but is not necessarily limited, to:
- .1 Markerboards.
  - .2 Tackboards.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Definitions**

- 1.4.1 Tackboard: Framed or unframed, tackable, visual display board assembly.
- 1.4.2 Visual Display Board Assembly: Visual display surface that is factory fabricated into composite panel form, either with or without a perimeter frame; includes chalkboards, markerboards, and tackboards.
- 1.4.3 Visual Display Surface: Surfaces that are used to convey information visually, including surfaces of chalkboards, markerboards, tackboards, and surfacing materials that are not fabricated into composite panel form but are applied directly to walls.

### **1.5 Submittals**

- 1.5.1 Product Data: Submit product data in accordance with Division 01 for the following:

**CONSTRUCTION OF THE  
DOCKSTEADER PRPS  
REPORTING STATION**

**10 11 00  
Visual Display Surfaces**

- 
- .1 Submit manufacturer's instructions, printed product literature and data sheets for the Visual Display Surfaces work and include product characteristics, performance criteria, physical size, finish and limitations.
    - .2 Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for visual display surfaces.
  - 1.5.2 Shop Drawings: Submit Shop Drawings in accordance with Division 01 for visual display surfaces. Include plans, elevations, sections, details, and attachments to other work.
    - .1 Show locations of panel joints.
    - .2 Show locations of special-purpose graphics for visual display surfaces.
    - .3 Include sections of typical trim members.
    - .4 Wiring Diagrams: Submit wiring diagrams in accordance with Division 01 for power, signal, and control wiring.
  - 1.5.3 Samples for Initial Selection: Submit samples for initial selection in accordance with Division 01 for each type of visual display surface indicated, for units with factory-applied colour finishes, and as follows:
    - .1 Actual sections of porcelain-enamel face sheet and tackboard assemblies.
    - .2 Include accessory Samples to verify colour selected.
  - 1.5.4 Samples for Verification: Submit samples for verification in accordance with Division 01 for each type of visual display surface indicated.
    - .1 Visual Display Surface: Not less than 215 by 280 mm (8-1/2 by 11 inches), mounted on substrate indicated on Drawings and Schedules for final Work. Include one panel for each type, colour, and texture required.
    - .2 Trim: 152-mm- (6-inch-) long sections of each trim profile.
    - .3 Accessories: Full-size Sample of each type of accessory.
  - 1.5.5 Product Schedule: Submit product schedule in accordance with Division 01 for visual display surfaces.
  - 1.5.6 Product Test Reports: Based product test reports on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of fabrics.
  - 1.5.7 Maintenance Data: Submit maintenance data in accordance with Division 01 for visual display surfaces to include in maintenance manuals.
  - 1.5.8 Warranties: Sample of special warranties.

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**1.6 Quality Assurance**

- 1.6.1 Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of motor-operated, sliding visual display units required for this Project.
- 1.6.2 Source Limitations: Obtain visual display surfaces from single source from single manufacturer.
- 1.6.3 Surface-Burning Characteristics: As determined by testing identical products according to CAN/ULC-S102/S102.2 or equivalent to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - .1 Flame-Spread Index: 25 or less.
  - .2 Smoke-Developed Index: 450 or less.
- 1.6.4 Electrical Components, Devices, and Accessories: Listed and labeled as defined in CSA C22 SERIES AND NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 1.6.5 Mockups: Build mockups to verify selections made under sample submittals and to demonstrate appearance and aesthetic effects and set quality standards for installation.
  - .1 Approved mockups may become part of the completed Work if undisturbed at time of Substantial Performance of the Work.
- 1.6.6 Pre-installation Meetings: Schedule, and conduct pre-installation meeting at Project Site, in order to coordinate work of this Section, with work of related Subcontractors.
  - .1 Ensure attendance of Subcontractor performing work of this Section and representatives of manufacturers and fabricators involved in, or affected by, installation and coordination with other materials and installations that have preceded or will follow. Advise Consultant and Owner in advance of scheduled meeting dates.
  - .2 Agenda: Review progress of other construction activities and preparations for the particular activity under consideration.
  - .3 Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
  - .4 Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.

**1.7 Delivery, Storage, And Handling**

- 1.7.1 Deliver factory-built visual display surfaces, including factory-applied trim where indicated, completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more pieces of equal

length as acceptable to Consultant. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site.

- 1.7.2 Store visual display surfaces vertically with packing materials between each unit.

**1.8 Project Conditions**

- 1.8.1 Environmental Limitations: Do not deliver or install visual display surfaces until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- 1.8.2 Field Measurements: Verify actual dimensions of construction contiguous with visual display surfaces by field measurements before fabrication.
- .1 Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

**1.9 Warranty**

- 1.9.1 Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer's standard form in which manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
- .1 Failures include, but are not limited to, the following:
- .1 Surfaces lose original writing and erasing qualities.
- .2 Surfaces exhibit crazing, cracking, or flaking.
- .2 Warranty Period: Life of the building.

**2 . PRODUCTS**

**2.1 Manufacturers**

- 2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.
- .1 MARKERBOARD ASSEMBLIES
- .1 Porcelain-Enamel Markerboards:
- .1 AARCO Products, Inc.
- .2 ADP Lemco, Inc.
- .3 Bangor Cork Company, Inc.
- .4 Claridge Products and Equipment, Inc.
- .5 Marsh Industries, Inc.; Visual Products Group.

.6 Platinum Visual Systems; a division of ABC School Equipment, Inc.

.7 PolyVision Corporation; a Steelcase company.

.2 TACKBOARD ASSEMBLIES

.1 A-1 Visual Systems.

.2 AARCO Products, Inc.

.3 ADP Lemco, Inc.

.4 Bangor Cork Company, Inc.

.5 Claridge Products and Equipment, Inc.

.6 EverProducts by Glenroy Inc.

.7 Forbo;

.8 Marsh Industries, Inc.; Visual Products Group.

.9 Platinum Visual Systems; a division of ABC School Equipment, Inc.

.10 PolyVision Corporation; a Steelcase company.

.11 Tri-Best Visual Display Products.

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

**2.2 Materials, General**

2.2.1 Porcelain-Enamel Face Sheet: Manufacturer's standard steel sheet with porcelain-enamel coating fused to steel; uncoated thickness indicated.

.1 Matte Finish: Low reflective; chalk wipes clean with dry cloth or standard eraser.

2.2.2 Natural Cork Sheet: Seamless, single-layer, compressed fine-grain cork sheet; bulletin board quality; face sanded for natural finish with surface-burning characteristics indicated.

2.2.3 Hardboard: ANSI A135.4, tempered.

2.2.4 Particleboard: ANSI A208.1, Grade M-1

2.2.5 Fiberboard: ASTM C 208.

2.2.6 Extruded Aluminum: ASTM B 221M (ASTM B 221), Alloy 6063.

**2.3 Markerboard Assemblies**

2.3.1 Porcelain-Enamel Markerboards: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction consisting of backing sheet, core material, and 0.53-mm- (0.021-inch-) thick, porcelain-enamel face sheet with low-gloss finish.

.1 Particleboard Core: 9.5 mm (3/8 inch) thick; with 0.61-mm- (0.024-inch-) thick, galvanized-steel sheet backing.

- .2 Laminating Adhesive: Manufacturer's standard, moisture-resistant thermoplastic type.
- .3 Acceptable Products:
  - .1 "System 300" manufactured by Panel Products
  - .2 "Series 800" manufactured by Claridge

## **2.4 Tackboard Assemblies**

- 2.4.1 Natural-Cork Tackboard: 6-mm- (1/4-inch-) thick, natural cork sheet factory laminated to 6-mm- (1/4-inch-) thick jute backing.
- 2.4.2 Colour: Refer to Finish Schedule on Drawings.
- 2.4.3 Basis-of-Design: "Bulletin Board" as manufactured by Forbo or approved equivalent.

## **2.5 Markerboard And Tackboard Accessories**

- 2.5.1 Aluminum Frames and Trim: Fabricated from not less than 1.57-mm- (0.062-inch-) thick, extruded aluminum; standard size and shape.
  - .1 Field-Applied Trim: Manufacturer's standard, snap-on trim with no visible screws or exposed joints.
  - .2 Factory-Applied Trim: Manufacturer's standard.

## **2.6 Fabrication**

- 2.6.1 Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.
- 2.6.2 Natural-Slate Chalkboards: Surface slate panels to a natural plane. Grind and hone to smooth, uniform finish equivalent to that obtained by minimum 180 grit and maximum 220 grit.
  - .1 Cut joints straight and true. Space joints symmetrically. Fit and match panels before shipment to provide continuous, uniform writing surface.
  - .2 Length: Supply panels approximately equal in length with permissible variation not more than 75 mm (3 inches) in either direction of equal spacing. Allow 6-mm (1/4-inch) clearance at trim in length and width for fitting. Provide lengths of panels in each space as follows:
    - .1 Up to 1.5 m (5 feet); one panel.
    - .2 More than 1.5 m (5 feet) but less than 2.7 m (9 feet); two panels.
    - .3 More than 2.7 m (9 feet) but less than 4.1 m (13.5 feet); three panels.



- .4 More than 4.1 m (13.5 feet) but less than 5.5 m (18 feet); four panels.
  - .5 More than 5.5 m (18 feet) but less than 6.9 m (22.5 feet); five panels.
  - .6 More than 6.9 m (22.5 feet) but less than 8.2 m (27 feet); six panels.
- 2.6.3 Visual Display Boards: Factory assemble visual display boards unless otherwise indicated.
- .1 Where factory-applied trim is indicated, trim shall be assembled and attached to visual display boards at manufacturer's factory before shipment.
- 2.6.4 Factory-Assembled Visual Display Units: Coordinate factory-assembled units with trim and accessories indicated. Join parts with a neat, precision fit.
- .1 Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, as indicated on approved Shop Drawings.
  - .2 Provide manufacturer's standard vertical-joint spline system between abutting sections of markerboards.
  - .3 Provide manufacturer's standard mullion trim at joints between markerboards and tackboards of combination units.
  - .4 Where size of visual display boards or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated on Drawings and Schedules or as selected by Consultant from manufacturer's standard structural support accessories to suit conditions indicated.
- 2.6.5 Modular Visual Display Boards: Fabricated with integral panel clips attached to core material.
- 2.6.6 Aluminum Frames and Trim: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to a neat, hairline closure.
- .1 Where factory-applied trim is indicated, trim shall be assembled and attached to visual display units at manufacturer's factory before shipment.

## **2.7 General Finish Requirements**

- 2.7.1 Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- 2.7.2 Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- 2.7.3 Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

**2.8     Aluminum Finishes**

- 2.8.1 Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

**2.9     Visual Display Surface Schedule**

- 2.9.1 Visual Display Board (VDS-1): Factory assembled.
- .1 Markerboard: Porcelain-enamel markerboard assembly.
    - .1 Colour: White.
  - .2 Corners: Square.
  - .3 Width: 2440 mm (96 inches)
  - .4 Height: 1220 mm (48 inches)
  - .5 Mounting: Wall.
  - .6 Mounting Height: As indicated on Drawings.
  - .7 Factory -Applied Aluminum Trim: Manufacturer's standard with clear anodic finish.
- 2.9.2 Tackboard (TKB-1): Factory assembled.
- .1 Tack Surface: Natural-cork tackboard assembly.
    - .1 Colour: As selected by Consultant from full range of industry colours.
  - .2 Corners: Square.
  - .3 Width: 2440 mm (96 inches)
  - .4 Height: 1220 mm (48 inches)
  - .5 Mounting: Wall.
  - .6 Mounting Height: As indicated on Drawings.
  - .7 Edges: Concealed by trim.
    - .1 Factory-Applied Aluminum Trim: Manufacturer's standard style, with powder-coat finish.
    - .1 Colour: White

**3 .     EXECUTION**

**3.1     Examination**

- 3.1.1 Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface

conditions of wall, and other conditions affecting performance of the Work.

- 3.1.2 Examine roughing-in for electrical power systems to verify actual locations of connections before installation of motor-operated, sliding visual display units.
- 3.1.3 Examine walls and partitions for proper preparation and backing for visual display surfaces.
- 3.1.4 Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.
- 3.1.5 Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 Preparation**

- 3.2.1 Comply with manufacturer's written instructions for surface preparation.
- 3.2.2 Clean substrates of substances that could impair the performance of and affect the smooth, finished surfaces of visual display boards, including dirt, mold, and mildew.
- 3.2.3 Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display surfaces and wall surfaces.
- 3.2.4 Prepare recesses for sliding visual display units as required by type and size of unit.

### **3.3 Installation, General**

- 3.3.1 General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

### **3.4 Installation Of Field-Fabricated Visual Display Boards And Assemblies**

- 3.4.1 Field-Assembled Visual Display Units: Coordinate field-assembled units with grounds, trim, and accessories indicated. Join parts with a neat, precision fit.
  - .1 Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, as indicated on approved Shop Drawings.
  - .2 Provide manufacturer's standard vertical-joint spline system between abutting sections of markerboards.

**CONSTRUCTION OF THE  
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Visual Display Surfaces**

- .3 Provide manufacturer's standard mullion trim at joints between markerboards and tackboards of combination units.
  - .4 Where size of visual display boards or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated on Drawings and Schedules or as selected by Consultant from manufacturer's standard structural support accessories to suit conditions indicated.
- 3.4.2 Natural-Slate Chalkboards: Align and level joints between adjoining panels and apply manufacturer's recommended joint-filler compound. Hone and finish joints to continuous even plane.

**3.5 Installation Of Factory-Fabricated Visual Display Boards And Assemblies**

- 3.5.1 Visual Display Boards: Attach visual display boards to wall surfaces with egg-size adhesive gobs at 400 mm (16 inches) o.c., horizontally and vertically.
- 3.5.2 Visual Display Boards: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display boards with fasteners at not more than 400 mm (16 inches) o.c. Secure both top and bottom of boards to walls.
- .1 Field-Applied Aluminum Trim: Attach trim over edges of visual display boards and conceal grounds and clips. Attach trim to boards with fasteners at not more than 610 mm (24 inches) o.c.
    - .1 Attach chalktrays to boards with fasteners at not more than 300 mm (12 inches) o.c.
  - .2 Field-Applied Wood Trim: Install trim according to requirements in Section 06 40 00, Architectural Woodwork.

**3.6 Cleaning And Protection**

- 3.6.1 Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.
- 3.6.2 Touch up factory-applied finishes to restore damaged or soiled areas.
- 3.6.3 Cover and protect visual display surfaces after installation and cleaning.

END OF SECTION

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only.
- 1.1.3

### **1.2 Summary**

- 1.2.1 Work Included: Provide labour, materials, products, equipment and services to complete the Wire Mesh Partitions work specified herein. This includes, but is not necessarily limited, to:
  - .1 Wire mesh partitions.
  - .2 Wire mesh storage lockers.
  - .3 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout the entirety of Divisions of this Project are directly applicable to this Section, and this Section is directly applicable to them.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Definitions**

- 1.4.1 As defined in ASTM E2016:
  - .1 Intermediate Crimp: Wires pass over one and under the next adjacent wire in both directions, with wires crimped before weaving and with extra crimps between the intersections.
  - .2 Lock Crimp: Deep crimps at points of the intersection that lock wires securely in place.

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**1.5     Submittals**

- 1.5.1 General Requirements and Procedures for Submittals: In accordance with Section 01 33 00, Submittal Procedures.
- 1.5.2 Product Data: Submit product data for the following:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for the wire mesh partitions work and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for wire mesh items.
- 1.5.3 Product Disclosure and Transparency:
  - .1 Environmental Product Declarations (EPD): When available, submit Product-specific Type III EPD or industry-wide (generic) EPD conforming to ISO 14025 or other recognized environmental product declaration framework.
  - .2 Material Ingredient Reporting: When available, submit documentation demonstrating chemical inventory of materials to at least 0.1% (1000ppm) and conforming to one of the following:
    - .1 Health Product Declaration open Standard,
    - .2 Cradle to Cradle v2 Basic level or Cradle to Cradle v3 Bronze level,
    - .3 International Living Future Institute Declare
    - .4 Other approved framework.
  - .3 When multiple Products are specified, give preference to Products with compliant documentation.
- 1.5.4 Safety Data Sheets (SDS): Submit SDS for inclusion in Operation and Maintenance Manual specified in Section 01 77 00, for adhesives, sealants and any other material designated by Consultant.
- 1.5.5 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:
  - .1 Include plans, elevations, sections and details as applicable.
  - .2 Indicate field-measured dimensions on Shop Drawings.
  - .3 Include clearances required for operation of moving components such as doors.
  - .4 Supply location template drawings for items supported or anchored to permanent construction.
- 1.5.6 Delegated Design Submittals:

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- .1 Engineering design completion of WIRE MESH PARTITIONS work is delegated to Contractor based on structural design criteria indicated in Contract Documents.
  - .2 Submit Shop Drawings for work of this Section that bear the stamp of a Professional Engineer registered in Province of Ontario.
  - .3 Submit copy of structural calculations upon request by Consultant.
- 1.5.7 Initial Selection Samples: Submit initial selection samples for Products requiring colour, texture, or design selection. Submit manufacturer's list of finishes or colour swatches for Consultant's selection.
- 1.5.8 Welding Certificate: Submit certification for welding firms and welders to verify compliance with welding qualifications specified in this section.
- 1.5.9 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide regional (i.e., North American) EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
- .1 EPD Scope: must cover Cradle-to-Gate (A1 to A3) as a minimum.
  - .2 EPD Impact Categories: must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
  - .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.5.10 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:
- .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.
  - .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.5.11 Low-Emitting Materials: For applicable Products specified or used for activities of this Section (i.e., site-applied coatings, adhesives, and sealants), submit certifications from third-party organizations indicating compliance with following:

- .1 VOC Emissions: California Department of Public Health (CDPH) Standard Method v1.2–2017, using applicable exposure scenario.
- .2 VOC Content: SCAQMD Rule 1113 (for paints and coatings) and SCAQMD Rule 1168 (for adhesives and sealants).

**1.6      Closeout Submittals**

- 1.6.1 General Requirements and Procedures for Closeout Submittals: in accordance with Section 01 77 00, Closeout Procedures.
- 1.6.2 Operating and Maintenance Data: Submit care and maintenance instructions for wire mesh partitions to be included in building's operation and maintenance manual.

**1.7      Quality Assurance**

- 1.7.1 Qualification:
  - .1 Manufacturers: Provide Products for Work of this Section by manufacturer with minimum 10 years' experience in the manufacture of such materials.
  - .2 Installers: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.
  - .3 Installer's responsibilities include fabricating and installing wire mesh items and providing professional engineering services needed to assume engineering responsibility.
  - .4 Engineering Responsibility: Preparation of data for wire mesh items, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated on Drawings and Schedules for this Project.
- 1.7.2 Welding Qualifications: Qualify procedures and personnel in accordance with the following:
  - .1 Steel: to CSA W47.1 and CSA W59
  - .2 Aluminum: to CSA W47.2 and CSA W59.2
  - .3 Stainless Steel: to CSA W47.1 (Annex K) and CSA W59
- 1.7.3 Single Source Responsibility: Ensure primary materials provided in this Section are obtained from 1 source by a single manufacturer and secondary materials are obtained from sources recommended by primary materials manufacturers.



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**1.8     Delivery, Storage And Handling**

- 1.8.1 Deliver, store and handle wire mesh partitions in accordance with manufacturer's written instructions.
- 1.8.2 deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.8.3 Store materials in off-ground, in clean, dry, well-ventilated area.
- 1.8.4 Replace defective or damaged materials with new.
- 1.8.5 Inventory wire mesh partition door hardware on receipt and provide secure lockup for wire mesh partition door hardware delivered to Project site.
- 1.8.6 Tag each item or package separately with identification and include basic installation instructions with each item or package.
- 1.8.7 Keys: Submit keys for door locks to Owner at Substantial Performance of the Work.

**1.9     Project Conditions**

- 1.9.1 Field Measurements: Verify actual dimensions of construction contiguous with wire mesh units by field measurements before fabrication.

**1.10    Warranty**

- 1.10.1 Provide warranty covering the Work of this Section in accordance with Supplementary Condition SC49 / GC 12.3 WARRANTY.

**2 .     PRODUCTS**

**2.1     Manufacturers**

- 2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.
  - .1 Apex Iron Works, LLC
  - .2 Eagle Steel Inc.
  - .3 Indiana Wire Products
  - .4 SpaceGuard Products, Inc.
  - .5 Standard Wire & Steel Works
  - .6 WIPCO Div. of Jesco Industries, Inc.
- 2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

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**2.2     Design/Performance Criteria**

- 2.2.1 Design partition system to provide for movement of components without damage, undue stress on fasteners or other detrimental effects, when subject to design loads.
- 2.2.2 Design system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
- 2.2.3 Seismic Performance: Provide products and systems specified in this Section to withstand the effects of earthquake motions in accordance with OBC 4.1.8.18 and CAN/CSA S832.
  - .1 Professional engineer specified in Division 01 and referenced in this Section shall be responsible for designing systems and submitting signed and sealed analysis data and Shop Drawings illustrating seismic-resistant systems.
  - .2 Refer to Structural Drawings for seismic sensitivity values.

**2.3     Materials**

- 2.3.1 Steel Wire: to ASTM A510M (ASTM A510).
- 2.3.2 Steel Plates, Channels, Angles, and Bars: to ASTM A36/A36M or equivalent to CSA G40.20/G40.21.
- 2.3.3 Cold-Rolled Steel Sheet: to ASTM A1008/A 1008M, Commercial Steel (CS), Type B.
- 2.3.4 Square Steel Tubing: to ASTM A500, cold-formed structural-steel tubing or equivalent to CSA G40.20/G40.21.
- 2.3.5 Galvanized Steel Sheet: to ASTM A653/A 653M, Commercial Steel (CS), Type B; with Z275 (G90) zinc (galvanized) coating.
- 2.3.6 Panel-to-Panel Fasteners: Manufacturer's standard steel bolts, nuts, and washers.
- 2.3.7 Postinstalled Expansion Anchors: With capability to sustain, without failure, load imposed within factors of safety indicated, as determined by testing per ASTM E488, conducted by a qualified independent testing agency.

**2.4     Standard-Duty Wire Mesh Partitions**

- 2.4.1 Mesh: No. 10 ga (3.5-mm, 0.135-in.) diameter, intermediate-crimp steel wire woven into 38-mm (1-1/2-in.) diamond mesh.
- 2.4.2 Horizontal Framing: 25 by 13 mm (1 in. by ½ in) or greater, minimum 3 mm thick steel channels or thicker.
- 2.4.3 Vertical Frames: 32 mm by 13 mm (1-1/4 in. by 1/2 in.) or greater; minimum 14 ga. or thicker roll formed "C" type steel channels. Provide series of slotted holes for securing to adjacent panels and post.

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- 2.4.4 Horizontal Reinforcement Members: Provide two 19 mm by 10 mm (3/4 in x 3/8 in) or greater; minimum 12 ga. steel channel toe riveted or bolted together through mesh and welded to vertical frames.
- 2.4.5 Panels: Manufacture single panels up to 1520 mm (160 in.) wide and 3658 mm (144 in.) high consisting of horizontal and vertical members specified in this Section mortised and tenoned at corners with diamond mesh securely attached to frames.
- .1 Locate lower horizontal member at maximum 95 mm (3.75 in.) from bottom of panel to create maintenance sweep space. Attach center reinforcement bars as required.
- 2.4.6 Hinged Doors: Construct of the same materials as panels, with 32 mm x 3 mm (1-1/4 in by 1/8 in) flat steel bar cover on sides. Supply complete with necessary mounting and locking hardware to install and operate.
- .1 Provide minimum of three 3 in. x 3 in. butt hinges per doors. Increase hinges as required based on door height.
- .1 Padlock Arrangement: Lug(s) to be welded, bolted, or riveted securely to system.
- .2 Cylinder Lock: Mortise type with keyed different cylinder operated by key outside and recessed turn knob inside.
- 2.4.7 Corner post (for 90 degree corner): minimum 32 mm (1-1/4 in.) by 32 mm (1-1/4 in.) by 3 mm (1/8 in.) steel angle or square tube.
- 2.4.8 Vertical Stiffeners (For partitions greater than 3.6 m (12 ft.) in height):
- .1 From 3.6 m (12 ft) to 4.87 m (16 ft) in height: Minimum 6 mm (1/4 in.) by 50 mm (2 in.) flat steel.
- .2 From 4.87 m (16 ft) to 7.32 m (24 ft) in height: Minimum 8 mm (5/16 in.) by 76 mm (3 in.) flat steel required.
- .3 When height exceeds 7.32 m (24 ft): 76 mm (3 in.) steel channel welded to base plate required
- 2.4.9 Line Post: Minimum 76 mm (3 in.) steel channel welded to base plate. Provide every 3 to 6 m (10 to 20 feet) on center to adequately stiffen long partition runs.
- 2.4.10 Top Capping Channel/Rail: When ceilings are not present, ensure steel channel is through bolted to or u-bolted around top horizontal frame member per the manufacturer's recommended spacing. Channels must be cut to length to cover above panel-to-panel intersections whenever possible.
- 2.4.11 Floor Sockets: Die Cast base shoes to be used whenever a post is not present on panel-to-panel connections at the floor.
- 2.4.12 Accessories:

- .1 Sheet Metal Base: Not less than 1.5-mm- (0.060-in.-) thick, cold-rolled steel sheet.
- .2 Adjustable Filler Panels: Not less than 1.5-mm- (0.060-in.-) thick, cold-rolled steel sheet; capable of filling openings from 50 to 300 mm (2 to 12 in.).
- .3 Wall Clips: Manufacturer's standard, cold-rolled steel sheet; allowing up to 25 mm (1 in.) of adjustment.

2.4.13 Finish: Baked-enamel finish or Powder-coated finish

- .1 Colour: As selected by Consultant from manufacturer's full range.

**2.5      Wire Mesh Storage Lockers**

- 2.5.1 Unit Sizes: As shown on Drawings.
- 2.5.2 Mesh: No. 10 ga (3.5-mm, 0.135-in.) diameter, intermediate-crimp steel wire woven into 38-mm (1-1/2-in.) diamond mesh.
- 2.5.3 Wall Panels: 32-by-32-by-3-mm (1-1/4-by-1-1/4-by-1/8-in.) steel angle framing on top, bottom, and back sides, and 76-by-3-mm (3-by-1/8-in.) cold-rolled steel flat bar framing on front side; with wire mesh welded to framing.
- 2.5.4 Backs: 0.7-mm- (0.027-in.-) thick, metallic-coated steel sheet.
- 2.5.5 Tops: Fabricated from same mesh and framing as doors.
- 2.5.6 Doors: Fabricated from same mesh as wall panels, with framing fabricated from 32-by-32-by-3-mm (1-1/4-by-1-1/4-by-1/8-in.) steel angles on 4 sides; with wire mesh welded to framing. Include door strike and padlock hasp.
- 2.5.7 Finish: Baked-enamel finish or Powder-coated finish unless otherwise indicated.
  - .1 Colour: As selected by Consultant from manufacturer's full range.

**2.6      Fabrication**

- 2.6.1 Fabricate assemblies of framed sections; to sizes and profiles required; with framing members fitted, reinforced and braced to suit design requirements.
- 2.6.2 Fit and assemble in largest practical sections for delivery to Project Site, ready for installation.
- 2.6.3 Fabricate items with joints tightly fitted and secured.
- 2.6.4 Grind exposed welds smooth and flush with adjacent finish surface. Ease exposed edges to small uniform radius.
- 2.6.5 Make exposed joints flush and hairline.

- 2.6.6 Provide components required for anchorage. Fabricate anchorage and related components of same material and finish as framing members.

## **2.7     General Finish Requirements**

- 2.7.1 Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- 2.7.2 Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- 2.7.3 Clean surfaces of rust, scale, grease, and foreign matter before finishing. Clean material using a two to three stage wash system immediately prior to finishing.

## **3 .     EXECUTION**

### **3.1     Examination**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.
- 3.1.2 Examine floors for suitable conditions where wire mesh items will be installed.
- 3.1.3 Examine walls to which wire mesh items will be attached for properly located blocking, grounds, and other solid backing for attachment of support fasteners.
- 3.1.4 Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2     Installation**

- 3.2.1 General Requirements: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.
- 3.2.2 Install components in plumb, level and square. Maintain dimensional tolerances and alignment with surrounding construction.
- 3.2.3 Install partitions and gates plumb and level, accurately fitted, properly aligned, securely fastened, and free from distortion or defects.

- 3.2.4 Install field bracing as necessary to provide rigid, secure installation.

**3.3 Adjusting And Cleaning**

- 3.3.1 Adjust moving components for smooth operation without binding.
- 3.3.2 Adjust locks to provide smooth and secure operation.
- 3.3.3 Remove and replace defective work including doors and framing that are warped, bowed, or otherwise unacceptable.
- 3.3.4 Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 painting.
- 3.3.5 Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

**3.4 Tolerances**

- 3.4.1 Maximum Variation from Plumb or Level: 6 mm (1/4 in.) in total partition height.
- 3.4.2 Maximum Misalignment from True Position: 6 mm (1/4 in.).

**3.5 Protection**

- 3.5.1 Protect wire mesh partitions from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades.
- 3.5.2 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in writing by affected material's manufacturer. Do not use materials or process that can damage finishes, surfaces, or construction.
- 3.5.3 Promptly replace wire mesh partitions work damaged during construction that cannot be satisfactorily repaired.

**3.6 Cleaning And Waste Management**

- 3.6.1 General Requirements for Cleaning and Waste Management: in accordance with Section 01 74 00, Cleaning.
- 3.6.2 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
- 3.6.3 Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**Regional Municipality of  
Peel  
Procurement Division**

**Document 2024-346P  
CONSTRUCTION OF THE  
DOCKSTEADER PRPS  
REPORTING STATION**

**Division 10  
10 22 13  
Wire Mesh Partitions**

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**END OF SECTION**

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Operable Panel Partitions work specified herein. This includes, but is not necessarily limited, to:
- .1 Operable acoustical panels.
  - .2 Seals.
  - .3 Panel finish facings.
  - .4 Suspension systems.
  - .5 Manually operated, acoustical panel partitions.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only.
- .1 Section 05 50 00, Metal Fabrications for supports that attach supporting tracks to overhead structural system.
  - .2 Section 09 21 16, Gypsum Board Assemblies for fire-rated assemblies and sound barrier construction above the ceiling at track.
  - .3 Electrical and communications Sections for electrical service and connections for motor operators, controls, and limit switches and for system disconnect switches.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Definitions**

- 1.4.1 NIC: Noise Isolation Class.
- 1.4.2 NRC: Noise Reduction Coefficient.
- 1.4.3 STC: Sound Transmission Class.



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**1.5 Preinstallation Meetings**

- 1.5.1 Pre-installation Meetings: Schedule, and conduct pre-installation meeting at Project Site, in order to coordinate work of this Section, with work of related Subcontractors.
- .1 Ensure attendance of Subcontractor performing work of this Section and representatives of manufacturers and fabricators involved in, or affected by, installation and coordination with other materials and installations that have preceded or will follow. Advise Consultant and Owner in advance of scheduled meeting dates.
  - .2 Agenda: Review progress of other construction activities and preparations for the particular activity under consideration.
  - .3 Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
  - .4 Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.

**1.6 Action Submittals**

- 1.6.1 Product Data: Submit product data in accordance with Division 01 for the following:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for the Operable Panel Partitions work and include product characteristics, performance criteria, physical size, finish and limitations.
- 1.6.2 Shop Drawings: Submit Shop Drawings in accordance with Division 01 for operable panel partitions.
- .1 Include plans, elevations, sections, details, and attachments to other work.
  - .2 Indicate stacking and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
  - .3 Include diagrams for power, signal, and control wiring.
- 1.6.3 Samples for Initial Selection: Submit samples for initial selection in accordance with Division 01 for each type of exposed material, finish, covering, or facing.
- .1 Include Samples of accessories involving colour selection.
- 1.6.4 Samples for Verification: Submit samples for verification in accordance with Division 01 for each type of exposed material, finish, covering, or facing, prepared on Samples of size indicated below:
- .1 Panel Facing Material: Manufacturer's standard-size unit, not less than 75 mm (3 inches) square.

- .2 Panel Edge Material: Not less than 75 mm (3 inches) long.
- .3 Hardware: One of each exposed door-operating device.
- 1.6.5 Professional Engineer's Stamped Shop Drawings and Submittals: Submit Professional Engineer's Stamped Shop Drawings and Submittals in accordance with Division 01 for operable panel partitions.
  - .1 Include design calculations for seismic restraints.

**1.7 Informational Submittals**

- 1.7.1 Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - .1 Partition track, track supports and bracing, switches, turning space, and storage layout.
  - .2 Suspended ceiling components.
  - .3 Structural members to which suspension systems are attached.
  - .4 Size and location of initial access modules for acoustical tile.
  - .5 Items penetrating finished ceiling, including the following:
    - .1 Lighting fixtures.
    - .2 HVAC ductwork, outlets, and inlets.
    - .3 Speakers.
    - .4 Sprinklers.
    - .5 Smoke detectors.
    - .6 Access panels.
  - .6 Plenum acoustical barriers.
- 1.7.2 Setting Drawings: Submit setting Drawings in accordance with Division 01 for embedded items and cutouts required in other work, including support-beam, mounting-hole template.
- 1.7.3 Seismic Qualification Certificates: Submit seismic qualification certificates in accordance with Division 01 for operable panel partitions, tracks, accessories, and components, from manufacturer. Include seismic capacity of partition assemblies to remain in vertical position during a seismic event and the following:
  - .1 Basis for Certification: Indicate whether certification is based on analysis, testing, or experience data, according to ASCE/SEI 7.
  - .2 Detailed description of partition anchorage devices on which the certification is based and their installation requirements.
- 1.7.4 Product Certificates: Submit product certificates in accordance with Division 01 for each type of operable panel partition.

- .1 Include approval letter signed by manufacturer acknowledging Owner-furnished panel facing material complies with requirements.

1.7.5 Product Test Reports: Submit product test reports in accordance with Division 01 for each operable panel partition, for tests performed by a qualified testing agency.

1.7.6 Sample Warranty: Submit sample warranty in accordance with Division 01 for manufacturer's special warranty.

## **1.8 Closeout Submittals**

1.8.1 Operation and Maintenance Data: Submit operation and maintenance data in accordance with Division 01 for operable panel partitions to include in maintenance manuals.

- .1 In addition to items specified in Section 01 78 00, Closeout Submittals, include the following:

- .1 Panel finish facings and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
- .2 Seals, hardware, track, track switches, carriers, and other operating components.
- .3 Electric operator and controls.

## **1.9 Maintenance Material Submittals**

1.9.1 Supply extra materials, from the same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- .1 Panel Finish-Facing Material: Supply full width in quantity to cover both sides of two panels when installed.

## **1.10 Quality Assurance**

1.10.1 Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

1.10.2 Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

1.10.3 Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

## **1.11 Delivery, Storage, And Handling**

1.11.1 Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

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**1.12 Warranty**

1.12.1 Special Warranty: Manufacturer agrees to repair or replace components of operable panel partitions that fail in materials or workmanship within specified warranty period.

.1 Failures include, but are not limited to, the following:

.1 Faulty operation of operable panel partitions.

.2 Deterioration of metals, metal finishes, and other materials beyond normal use.

.2 Warranty Period: Three years from date of Substantial Performance of the Work.

**2. PRODUCTS**

**2.1 Manufacturers**

2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.

.1 Moderco Inc.

.2 Modernfold, Inc.

.3 Panelfold Inc.

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

**2.2 Performance Requirements**

2.2.1 Professional Engineering Design and Certification: Engage a Professional Engineer licensed to practice in the Province of Ontario, as defined in Section 01 40 00, Quality Requirements, to design seismic bracing of tracks to structure above.

2.2.2 Seismic Performance: Provide products and systems specified in this Section to withstand the effects of earthquake motions in accordance with OBC 4.1.8.18 and CAN/CSA S832.

.1 Professional engineer specified in Division 01 and referenced in this Section shall be responsible for designing systems and submitting signed and sealed analysis data and Shop Drawings illustrating seismic-resistant systems.

.2 Refer to Structural Drawings for seismic sensitivity values.

2.2.3

2.2.4 Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:

- .1 Sound-Transmission Requirements: Operable panel partition assembly tested for laboratory sound-transmission loss performance according to ASTM E 90, determined by ASTM E 413, and rated for not less than the STC indicated.
- 2.2.5 Fire-Test-Response Characteristics: Provide panels with finishes complying with one of the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  - .1 Surface-Burning Characteristics: Comply with CAN/ULC-S102/S102.2 or equivalent to ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - .1 Flame-Spread Index: 25 or less.
    - .2 Smoke-Developed Index: 450 or less.
  - .2 Fire Growth Contribution: Complying with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol or NFPA 286.
- 2.2.6 Electrical Components, Devices, and Accessories: Listed and labeled as defined in CSA C22 SERIES AND NFPA 70, by a qualified testing agency, and marked for intended location and application.

## **2.3 Operable Acoustical Panels (PTN)**

- 2.3.1 Operable Acoustical Panels: Partition system, including panels, seals, finish facing, suspension system, operators, and accessories.
- 2.3.2 Panel Operation: Manually operated, paired panels.
- 2.3.3 Panel Construction: As required to support panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.
- 2.3.4 Dimensions: Fabricate operable acoustical panel partitions to form an assembled system of dimensions indicated on Drawings and Schedules and verified by field measurements.
  - .1 Panel Width: As indicated.
- 2.3.5 STC: 56
- 2.3.6 Panel Weight: 59 kg/sq. m (12 lb/sq. ft.)
- 2.3.7 Panel Thickness: Not less than 102 mm (4 inches).
- 2.3.8 Panel Materials:

- .1 Steel Frame: Steel sheet, manufacturer's standard nominal minimum thickness for uncoated steel.
- .2 Steel Face/Liner Sheets: Tension-leveled steel sheet, manufacturer's standard minimum nominal thickness for uncoated steel.
- 2.3.9 Panel Closure: Manufacturer's standard unless otherwise indicated.
  - .1 Final Closure: Horizontally expanding panel edge with removable crank.
- 2.3.10 Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.
  - .1 Hinges: Concealed (invisible)
- 2.3.11 Basis-of-Design: "Encore Paired Panel" by Modernfold or approved equivalent.

## **2.4     Seals**

- 2.4.1 General: Provide seals that produce operable panel partitions complying with performance requirements and the following:
  - .1 Manufacturer's standard seals unless otherwise indicated.
  - .2 Seals made from materials and in profiles that minimize sound leakage.
  - .3 Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended and closed.
- 2.4.2 Vertical Seals: Deep-nesting, interlocking steel astragals mounted on each edge of panel, with continuous PVC acoustical seal.
- 2.4.3 Horizontal Top Seals: Manufacturers standard automatic operable top seal.
- 2.4.4 Horizontal Bottom Seals: Manufacturer's standard continuous-contact seal exerting uniform constant pressure on floor.

## **2.5     Panel Finish Facings**

- 2.5.1 General: Provide finish facings for panels that comply with indicated fire-test-response characteristics and that are factory applied to operable panel partitions with appropriate backing, using mildew-resistant nonstaining adhesive as recommended by facing manufacturer's written instructions.
  - .1 Apply one-piece, seamless facings free of air bubbles, wrinkles, blisters, and other defects, with invisible seams complying with Shop Drawings for location, and with no gaps

or overlaps. Horizontal butted edges are not permitted. Tightly secure and conceal raw and selvage edges of facing for finished appearance.

- .2 Match facing pattern 1830 mm (72 inches) above finished floor.

2.5.2 Vinyl-Coated Fabric Wall Covering: Manufacturer's standard, mildew-resistant, washable, vinyl-coated fabric wall covering; complying with CFFA-W-101-D for type indicated; Class A.

- .1 Antimicrobial Treatment: Additives capable of inhibiting growth of bacteria, fungi, and yeasts.
- .2 Color/Pattern: Refer to Drawings for Finish Schedule.

2.5.3 Cap-Trimmed Edges: Protective perimeter-edge trim with tight hairline joints concealing edges of panel and finish facing, finished as follows:

- .1 Steel, Painted: Finished with manufacturer's colour as selected by Consultant from manufacturer's full range.

2.5.4 Trimless Edges: Fabricate exposed panel edges so finish facing wraps uninterrupted around panel, covering edge and resulting in an installed partition with facing visible on vertical panel edges, without trim, for minimal sightlines at panel-to-panel joints.

## **2.6 Suspension Systems**

2.6.1 Tracks: Steel or aluminum with adjustable steel hanger rods for overhead support, designed for operation, size, and weight of operable panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 2.54 mm (0.10 inch) between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated on Drawings and Schedules for partition operation and storage.

- .1 Panel Guide: Aluminum guide on both sides of the track to facilitate straightening of the panels; finished with factory-applied, decorative, protective finish.
- .2 Head Closure Trim: As required for acoustical performance; with factory-applied, decorative, protective finish.

2.6.2 Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.

- .1 Multidirectional Carriers: Capable of negotiating intersections without track switches.

2.6.3 Track Intersections, Switches, and Accessories: As required for operation, storage, track configuration, and layout indicated on

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Drawings and Schedules for operable panel partitions, and compatible with partition assembly specified. Fabricate track intersections and switches from steel or aluminum.

- .1 Curve-and-Diverter Switches: Allow radius turns to divert panels to an auxiliary track.
  - .2 L Intersections: Allow panels to change 90 degrees in direction of travel.
  - .3 T Intersections: Allow panels to pass through or change 90 degrees to another direction of travel.
  - .4 X Intersections: Allow panels to pass through or change travel direction full circle in 90-degree increments, and allow one partition to cross track of another.
  - .5 Multidirectional Switches: Adjustable switch configuring track into L, T, or X intersections and allowing panels to be moved in all pass-through, 90-degree change, and cross-over travel direction combinations.
  - .6 Center carrier stop.
- 2.6.4 Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish unless otherwise indicated.
- 2.6.5 Steel Finish: Manufacturer's standard, factory-applied, corrosion-resistant, protective coating unless otherwise indicated.

### **3 . EXECUTION**

#### **3.1 Examination**

- 3.1.1 Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions.
- 3.1.2 Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 Installation**

- 3.2.1 General: Comply with ASTM E 557 except as otherwise required by operable panel partition manufacturer's written installation instructions.
- 3.2.2 Install operable panel partitions and accessories after other finishing operations, including painting, have been completed in area of partition installation.
- 3.2.3 Install panels from marked packages in numbered sequence indicated on Shop Drawings.



- 3.2.4 Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.
- 3.2.5 Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.
- 3.2.6 Light-Leakage Test: Illuminate one side of partition installation and observe vertical joints and top and bottom seals for voids. Adjust partitions for alignment and full closure of vertical joints and full closure along top and bottom seals. Perform test and make adjustments before NIC testing.

### **3.3 Field Quality Control**

- 3.3.1 NIC Testing: Engage a qualified testing agency to perform tests and inspections.
  - .1 Testing Extent: Testing agency shall randomly select one operable panel partition installation(s) for testing.
  - .2 Testing Methodology: Perform testing of installed operable panel partition for noise isolation according to ASTM E 336, determined by ASTM E 413, and rated for not less than NIC indicated. Adjust and fit partitions to comply with NIC test method requirements.
- 3.3.2 An operable panel partition installation will be considered defective if it does not pass tests and inspections.
- 3.3.3 Prepare test and inspection reports.

### **3.4 Adjusting**

- 3.4.1 Adjust operable panel partitions, hardware, and other moving parts to function smoothly, and lubricate as recommended by manufacturer.
- 3.4.2 Adjust pass doors and storage pocket doors to operate smoothly and easily, without binding or warping.
- 3.4.3 Verify that safety devices are properly functioning.

### **3.5 Demonstration**

- 3.5.1 Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable panel partitions.

END OF SECTION

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Corner Guards work specified herein. This includes, but is not necessarily limited, to:
- .1 Corner guards and end-wall guards,
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Administrative Requirements**

- 1.4.1 Pre-installation Meetings: Schedule, and conduct pre-installation meeting at Project Site, in order to coordinate work of this Section, with work of related Subcontractors.
- .1 Ensure attendance of Subcontractor performing work of this Section and representatives of manufacturers and fabricators involved in, or affected by, installation and coordination with other materials and installations that have preceded or will follow. Advise Consultant and Owner in advance of scheduled meeting dates.
  - .2 Agenda: Review progress of other construction activities and preparations for the particular activity under consideration.
  - .3 Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
  - .4 Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.

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**1.5     Action Submittals**

- 1.5.1 Product Data: Submit product data in accordance with Division 01 for the following:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for the Corner Guards work and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Include construction details, material descriptions, impact strength, fire-test-response characteristics, dimensions of individual components and profiles, and finishes for each corner guard.
- 1.5.2 Shop Drawings: Submit Shop Drawings in accordance with Division 01 for each corner guard showing locations and extent. Include sections, details, and attachments to other work.
- 1.5.3 Samples : Submit samples in accordance with Division 01 for each type of corner guard indicated.
- .1 Include similar Samples of accent strips and accessories involving colour selection.

**1.6     Closeout Submittals**

- 1.6.1 Maintenance Data: Submit maintenance data in accordance with Division 01 for each corner guard to include in maintenance manuals.
- .1 Include recommended methods and frequency of maintenance for maintaining optimum condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to plastic finishes and performance.

**1.7     Maintenance Material Submittals**

- 1.7.1 Supply extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- 1.7.2 Include mounting and accessory components. Replacement materials shall be from same production run as installed units.

**1.8     Quality Assurance**

- 1.8.1 Installer Qualifications: An employer of workers trained and approved by manufacturer.
- 1.8.2 Single source responsibility: Provide components of corner guard system manufactured by same company to ensure compatibility of color, texture and physical properties.

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**1.9 Delivery, Storage, And Handling**

1.9.1 Store corner guards in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

- .1 Maintain room temperature within storage area at not less than 21 deg C (70 deg F) during the period plastic materials are stored.
- .2 Keep plastic sheet material out of direct sunlight.
- .3 Store plastic corner guard components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 21 deg C (70 deg F).
  - .1 Store corner-guard covers in a vertical position.

**1.10 Project Conditions**

1.10.1 Environmental Limitations: Do not deliver or install corner guards until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 21 deg C (70 deg F) for not less than 72 hours before beginning installation and for the remainder of the construction period.

**1.11 Warranty**

1.11.1 Extended Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of corner guards that fail in materials or workmanship within specified warranty period.

- .1 Failures include, but are not limited to, the following:
  - .1 Structural failures.
  - .2 Deterioration of plastic and other materials beyond normal use.
- .2 Warranty Period: 3 years from date of Substantial Performance of the Work.

**2 . PRODUCTS**

**2.1 Manufacturers**

2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.

- .1 Construction Specialties, Inc; [www.c-sgroup.com](http://www.c-sgroup.com)
- .2 InPro Corporation.; [www.inprocorp.com](http://www.inprocorp.com)
- .3 Korogard Wall Protection Systems; <http://www.koroguard.com>

.4 Pawling Corporation. <http://www.pawling.com>

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

## **2.2 Regulatory Requirements**

2.2.1 Surface-Burning Characteristics: Provide corner guards with surface-burning characteristics as determined by testing identical products per CAN/ULC-S102/S102.2:

- .1 Flame spread 25 or less;
- .2 Smoke development 150 or less.

2.2.2 Regulatory Requirements: Comply with applicable provisions in CSA B651.

## **2.3 Design And Performance Requirements**

2.3.1 As far as practical and unless otherwise indicated, Provide PVC-free corner guard materials at all locations except egress corridors as required to meet fire-resistance characteristics stipulated by authorities having jurisdiction.

- .1 At egress corridors, a minimal amounts of PVC-based corner guard materials if permitted to comply with requirements of Authorities Having Jurisdiction.

2.3.2 Ensure corner guard systems do not contain materials capable of supporting growth of bacteria, fungi or other disease-causing organism, or encourage the harbourage of insects or mites.

2.3.3 Use components containing which retard mildew and bacterial growth.

2.3.4 Ensure corner guard systems do not, to any appreciable degree, develop or discharge any electrostatic charge.

2.3.5 Final securement method to be selected based upon construction of supporting wall or partition and manufacturer's recommendations. Provide additional reinforcing as required, fastenings, and necessary anchorage for building in of products. Coordinate with Section 05 50 00 and Section 09 21 16.

2.3.6 Ensure manufactured units do not have attached plates, or imprinted or labeled with manufacturer's name or trademark.

2.3.7 Ensure edges of sheet metal which are accessible to users or maintenance personnel are pneumatically sanded to yield smooth safe edges with no sharpness.

2.3.8 Verify that installed products function properly, and adjust them accordingly to ensure satisfactory operation.

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**2.4     Stainless Steel Corner Guards**

2.4.1 Flush-Mounted, Stainless Steel Corner Guards: Fabricated from one-piece, formed Type 304 stainless steel with formed edges.

- .1 Material Tag: This item is noted as "CG-01" on Drawings and Schedules.
- .2 Thickness: Minimum 1.6 mm (0.0625 inch).
- .3 Height: 1500 mm (60 inches)
- .4 Finish: Directional satin, No. 4
- .5 Mounting: Manufacturer's standard adhesive.
- .6 Basis-of-Design: "SSCG-FM" by Inpro Corp or approved equivalent.

2.4.2 Surface-Mounted, Stainless Steel Corner Guards : Fabricated from one-piece, formed Type 304 stainless steel with formed edges.

- .1 Material Tag: This item is noted as "CG-02" on Drawings and Schedules.
- .2 Thickness: Minimum 1.6 mm (0.0625 inch).
- .3 Height: 1500 mm (60 inches)
- .4 Finish: Directional satin, No. 4
- .5 Mounting: Manufacturer's standard adhesive.
- .6 Basis-of-Design Products:
  - .1 90 deg: "CO-8 (89 mm wing)" by Construction Specialties or approved equivalent.
  - .2 135 deg: "CO-8M (89 mm wing)" by Construction Specialties Ltd.
  - .3 End-of-wall Protector: "SCO-8 (89 mm wing)" by Construction Specialties Ltd.

**2.5     Accessories**

2.5.1 Fasteners: Concealed aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Exposed fasteners are not permitted.

2.5.2 Adhesive: As recommended by impact-resistant plastic corner guard manufacturer and that complies with sustainability objectives of the project.

**2.6     Fabrication**

2.6.1 Fabricate corner guards to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.

- 2.6.2 Fit and assemble work of this Section in shop where possible. Execute according to details and reviewed Shop Drawings. Where shop fabrication is not possible, execute trial assembly in shop.
- 2.6.3 Fabricate finished work free from distortion, weld splatter and defects detrimental to appearance and performance.
- 2.6.4 Do not expose trademarks or labels on finished surfaces.
- 2.6.5 Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

## **2.7 Finishes**

- 2.7.1 Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - .1 Remove tool and die marks and stretch lines, or blend into finish.
  - .2 Grind and polish surfaces to produce uniform finish, free of cross scratches.
  - .3 Run grain of directional finishes with long dimension of each piece.
  - .4 When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- 2.7.2 Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

## **3 . EXECUTION**

### **3.1 Examination**

- 3.1.1 Site Verification of Conditions: Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation.
- 3.1.2 Verify gypsum board substrate smooth, plumb and true, free of waves bulges and within tolerances specified in Section 09 21 16.
- 3.1.3 Examine walls to which impact-resistant corner guard will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.

- 3.1.4 For corner guards attached with adhesive or foam tape, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- 3.1.5 Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2      Preparation**

- 3.2.1 Ensure substrate is dry, well-sealed and free of dirt, loose paint, wax and grease. Glossy surfaces may require sanding or priming before installation to help promote adhesion.
- 3.2.2 Complete finishing operations, including painting, before installing impact-resistant corner guard system components.
- 3.2.3 Before installation, clean substrate to remove dust, debris, and loose particles.

### **3.3      Installation**

- 3.3.1 Conform to manufacturer's printed instructions for accurate, secure installation.
- 3.3.2 Provide work of this Section true to dimensions, square, plumb, level and free from distortion or defects detrimental to appearance and performance.
- 3.3.3 Provide work of this Section tightly fitted and level and flush to adjacent surfaces and components.
- 3.3.4 Insulate between dissimilar metals, and metal and masonry materials to prevent electrolysis.
- 3.3.5 Install corner guards in locations and at mounting heights indicated on Drawings and Schedules.
- 3.3.6 Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
- 3.3.7 Provide anchoring devices to withstand imposed loads. Provide all necessary reinforcing, including but not limited to steel stud backup and securely fasten components to suit design requirements.
- 3.3.8 Adjust end and top caps as required to ensure tight seams.
- 3.3.9 Install top and edge moldings, corners, and divider bars as required for a complete installation.
- 3.3.10 Remove material showing evidence of coming loose or showing any blisters, imperfect seams, wrinkles, dried adhesive, or other imperfections, and apply new material.



**3.4     Cleaning**

- 3.4.1 Immediately after completion of installation, clean covers and accessories using a standard, ammonia-based, household cleaning agent.

**3.5     Protection**

- 3.5.1 Cover finished surfaces and protect exposed corners and areas vulnerable to damage by persons or by movement of materials, tools or equipment.

END OF SECTION

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Protective Wall Covering work specified herein. This includes, but is not necessarily limited, to:
  - .1 Sheet wall protection (stainless steel)
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Administrative Requirements**

- 1.4.1 Pre-installation Meetings: Schedule, and conduct pre-installation meeting at Project Site, in order to coordinate work of this Section, with work of related Subcontractors.
  - .1 Ensure attendance of Subcontractor performing work of this Section and representatives of manufacturers and fabricators involved in, or affected by, installation and coordination with other materials and installations that have preceded or will follow. Advise Consultant and Owner in advance of scheduled meeting dates.
  - .2 Agenda: Review progress of other construction activities and preparations for the particular activity under consideration.
  - .3 Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
  - .4 Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.

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**1.5     Action Submittals**

- 1.5.1 Product Data: Submit product data in accordance with Division 01 for the following:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for the Protective Wall Covering work and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Include construction details, material descriptions, impact strength, fire-test-response characteristics, dimensions of individual components and profiles, and finishes for each impact-resistant wall protection unit.
- 1.5.2 Shop Drawings: Submit Shop Drawings in accordance with Division 01 for each impact-resistant wall protection unit showing locations and extent. Include sections, details, and attachments to other work.
- 1.5.3 Samples : Submit samples in accordance with Division 01 for each type of impact-resistant wall protection unit indicated.
- .1 Include similar Samples of accent strips and accessories involving colour selection.

**1.6     Closeout Submittals**

- 1.6.1 Maintenance Data: Submit maintenance data in accordance with Division 01 for each impact-resistant wall protection unit to include in maintenance manuals.
- .1 Include recommended methods and frequency of maintenance for maintaining optimum condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to plastic finishes and performance.

**1.7     Quality Assurance**

- 1.7.1 Installer Qualifications: An employer of workers trained and approved by manufacturer.
- 1.7.2 Single source responsibility: Provide components of wall protection system manufactured by same company to ensure compatibility of color, texture and physical properties.
- 1.7.3 Mock-ups: Provide Mock-ups in locations designated by Consultant and as required to demonstrate quality of workmanship. Maintain Mock-ups during construction in an undisturbed condition as a standard for judging the completed work.

**1.8 Delivery, Storage, And Handling**

1.8.1 Store impact-resistant wall protection units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

- .1 Maintain room temperature within storage area at not less than 21 deg C (70 deg F) during the period plastic materials are stored.
- .2 Keep plastic sheet material out of direct sunlight.
- .3 Store plastic wall protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 21 deg C (70 deg F).

**1.9 Project Conditions**

1.9.1 Environmental Limitations: Do not deliver or install impact-resistant wall protection units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 21 deg C (70 deg F) for not less than 72 hours before beginning installation and for the remainder of the construction period.

**1.10 Warranty**

1.10.1 Extended Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall protection units that fail in materials or workmanship within specified warranty period.

- .1 Failures include, but are not limited to, the following:
  - .1 Structural failures.
  - .2 Deterioration of plastic and other materials beyond normal use.
- .2 Warranty Period: 3 years from date of Substantial Performance of the Work.

**2 . PRODUCTS**

**2.1 Manufacturers**

2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.

- .1 Construction Specialties, Inc; [www.c-sgroup.com](http://www.c-sgroup.com)
- .2 InPro Corporation.; [www.inprocorp.com](http://www.inprocorp.com)
- .3 Korogard Wall Protection Systems; <http://www.koroguard.com>

.4 Pawling Corporation. <http://www.pawling.com>

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

## **2.2 Regulatory Requirements**

2.2.1 Surface-Burning Characteristics: Provide impact-resistant, plastic wall protection units with surface-burning characteristics as determined by testing identical products per CAN/ULC-S102/S102.2

.1 Flame spread 25 or less;

.2 Smoke development 150 or less.

2.2.2 Regulatory Requirements: Comply with applicable provisions in CSA B651.

## **2.3 Design And Performance Requirements**

2.3.1 As far as practical and unless otherwise indicated, Provide PVC-free wall protection materials at all locations except egress corridors as required to meet fire-resistance characteristics stipulated by authorities having jurisdiction.

.1 At egress corridors, use minimal amounts PVC-based wall protection materials as indicated on Drawings and Schedules.

2.3.2 Ensure wall protection systems do not contain materials capable of supporting growth of bacteria, fungi or other disease causing organism, or encourage the harbourage of insects or mites.

2.3.3 Use components containing which retard mildew and bacterial growth.

2.3.4 Ensure wall protection systems do not, to any appreciable degree, develop or discharge any electrostatic charge.

2.3.5 Final securement method to be selected based upon construction of supporting wall or partition and manufacturer's recommendations. Provide additional reinforcing as required, fastenings, and necessary anchorage for building in of products. Coordinate with Section 05 50 00 and Section 09 21 16.

2.3.6 Ensure manufactured units do not have attached plates, or imprinted or labeled with manufacturer's name or trademark.

2.3.7 Ensure edges of sheet metal which are accessible to users or maintenance personnel are pneumatically sanded to yield smooth safe edges with no sharpness.

2.3.8 Verify that installed products function properly, and adjust them accordingly to ensure satisfactory operation.

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**2.4     Stainless Steel Wall Protection**

- 2.4.1 Material Tag: This item is noted as "WP" on Drawings and Schedules.
- 2.4.2 ASTM A240, High impact, rigid sheet stainless steel wall cladding, with matching wall covering accessory trim pieces, outside edge caps, joint covers, inside corner and outside corners.
  - .1 Sheet Size: Maximum practical sizes to minimize seams unless otherwise indicated on Drawings.
  - .2 Sheet Thickness: Minimum 1.2 mm (18 ga.)
  - .3 Height: 1200 mm (48 inches)
  - .4 Installation: mounted to substrates using adhesive methods. Use of exposed fasteners is not acceptable.
  - .5 Trim: Manufacturer's standard, matching moldings and trim complete with division bars between panels, inside and outside corners and cap mouldings as required for complete installation.
  - .6 Finish: AISI No. 4, brushed finish.
  - .7 Acceptable Products: "SS Wall Panels" by InPro Corporation

**2.5     Accessories**

- 2.5.1 Provide Prefabricated, injection-molded or otherwise matching end caps and inside and outside corners with concealed splices, cushions, mounting hardware, division bars between panels, and other accessories as required.
- 2.5.2 Fasteners: Concealed aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Exposed fasteners are not permitted.
- 2.5.3 Adhesive: As recommended by impact-resistant manufacturer and that complies with sustainability objectives of the project.

**2.6     Fabrication**

- 2.6.1 Fabricate impact-resistant wall protection units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.
- 2.6.2 Fit and assemble work of this Section in shop where possible. Execute according to details and reviewed Shop Drawings. Where shop fabrication is not possible, execute trial assembly in shop.
- 2.6.3 Fabricate finished work free from distortion, weld splatter and defects detrimental to appearance and performance.
- 2.6.4 Do not expose trademarks or labels on finished surfaces.

- 2.6.5 Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

## **2.7 Finishes**

- 2.7.1 Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - .1 Remove tool and die marks and stretch lines, or blend into finish.
  - .2 Grind and polish surfaces to produce uniform finish, free of cross scratches.
  - .3 Run grain of directional finishes with long dimension of each piece.
  - .4 When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- 2.7.2 Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

## **3 . EXECUTION**

### **3.1 Examination**

- 3.1.1 Site Verification of Conditions: Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation.
- 3.1.2 Verify gypsum board substrate is smooth, plumb and true, free of waves bulges and within tolerances specified in Section 09 21 16.
- 3.1.3 Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
- 3.1.4 For impact-resistant wall protection units attached with adhesive or foam tape, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- 3.1.5 Proceed with installation only after unsatisfactory conditions have been corrected.

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**3.2      Preparation**

- 3.2.1 Ensure substrate is dry, well-sealed and free of dirt, loose paint, wax and grease. Glossy surfaces may require sanding or priming before installation to help promote adhesion.
- 3.2.2 Complete finishing operations, including painting, before installing impact-resistant wall protection system components.
- 3.2.3 Before installation, clean substrate to remove dust, debris, and loose particles.

**3.3      Installation**

- 3.3.1 Conform to manufacturer's printed instructions for accurate, secure installation.
- 3.3.2 Provide work of this Section true to dimensions, square, plumb, level and free from distortion or defects detrimental to appearance and performance.
- 3.3.3 Provide work of this Section tightly fitted and level and flush to adjacent surfaces and components.
- 3.3.4 Insulate between dissimilar metals, and metal and masonry materials to prevent electrolysis.
- 3.3.5 Install impact-resistant wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- 3.3.6 Install impact-resistant wall protection units in locations and at mounting heights indicated on Drawings and Schedules.
- 3.3.7 Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
- 3.3.8 Provide anchoring devices to withstand imposed loads. Provide all necessary reinforcing including but not limited to steel stud backup and securely fasten components to suit design requirements.
- 3.3.9 Adjust end and top caps as required to ensure tight seams.
- 3.3.10 Install top and edge moldings, corners, and divider bars as required for a complete installation.
- 3.3.11 Apply sheet wall protection covering in maximum widths carefully matched for colour, pattern, texture. Avoid shading. Thoroughly wash off excess adhesive from material and adjoining surfaces as work proceeds.
- 3.3.12 Neatly and closely fit wall protection materials around switches, light outlets, grilles, trim and similar items. Carry wall covering into reveals, jambs, and heads of openings.



- 3.3.13 Take care to ensure wall protection coverings are fully on the wall at inside corners, without coving or subsequently pulling away from the wall.
- 3.3.14 Apply material to outside corners in a manner which will prevent gathering of air beneath the material on each side of the corner. No joints are allowed within 150 mm (6") of any corner.
- 3.3.15 Remove material showing evidence of coming loose or showing any blisters, imperfect seams, wrinkles, dried adhesive, or other imperfections, and apply new material.

**3.4     Cleaning**

- 3.4.1 Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.
- 3.4.2 Remove excess adhesive using methods and materials recommended in writing by manufacturer.

**3.5     Protection**

- 3.5.1 Cover finished surfaces and protect exposed corners and areas vulnerable to damage by persons or by movement of materials, tools or equipment.

END OF SECTION

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the washroom accessories work specified herein. This includes, but is not necessarily limited, to:
  - .1 Commercial Washroom Accessories
  - .2 Hygiene and Custodial Accessories
  - .3 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Submittals**

- 1.4.1 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for washroom accessories work specified in this Section.
- 1.4.2 Schedule: Submit washroom accessory schedule, indicating the type and quantity to be installed in each washroom. Use room numbers as indicated on the Drawings.

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**1.5 Closeout Submittals**

- 1.5.1 Operating and Maintenance Data: Submit care and maintenance instructions for washroom accessories to be included in building operation and maintenance manual.

**1.6 Quality Assurance**

- 1.6.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.
- 1.6.2 Single Source Responsibility: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise acceptable to Consultant. Key units alike unless indicated otherwise.

**1.7 Delivery, Storage, And Handling**

- 1.7.1 Deliver, store and handle materials and products in strict compliance with manufacturer's instructions and recommendations. Protect from damage.
- 1.7.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.7.3 Store materials in off-ground, in clean, dry, well-ventilated area.
- 1.7.4 Replace defective or damaged materials with new.

**1.8 Warranty**

- 1.8.1 Extended warranty: Submit for Owner's review and acceptance, manufacturer's extended warranty in which manufacturer commits to repair or replace components of washroom accessories that fail within specified warranty period. Manufacturer's extended warranty is in addition to, and does not supersede, any other rights that Owner may have under Contract Documents.
- .1 Warranty Period for Mirrors: 10 years from date of Substantial Performance of The work.
  - .2 Warranty Period for Hand Dryers: 5 years from date of Substantial Performance of The work.
  - .3 Other accessories: Manufacturer's standard.

**2 . PRODUCTS**

**2.1 Manufacturers**

- 2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:

- .1 ASI Group Canada;
- .2 Bobrick Washroom Equipment of Canada Ltd.;
- .3 Frost Products Limited;

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

## **2.2 Regulatory Requirements**

2.2.1 Accessibility Requirements: Comply with requirements applicable in the jurisdiction of the project, including but not limited to CSA B651 and OBC requirements as applicable.

## **2.3 Design/Performance Requirements**

2.3.1 Stainless Steel Quality: Use high-quality stainless steel (Type 304 or Type 302) for washroom accessories. Provide ANSI No. 4 mechanical brushed finish unless indicated otherwise. Ensure vertical grain direction for visual consistency and ease of cleaning. Maintain consistency in components. Provide material thicknesses as specified.

2.3.2 Reinforcing Material: Use commercial quality cold rolled galvanized sheet steel (ASTM A653/A653M) with zinc coating designation Z275 (G90). Minimum thickness: 0.912 mm (20 gauge).

2.3.3 Provide specified washroom accessories with indicated options. Verify model numbers before installation.

2.3.4 Accommodation for Semi-recessed Mounting: Provide stainless steel collars for semi-recessed mounting when unit depth exceeds wall cavity depth. Ensure flush appearance in the finished Work.

2.3.5 Anti-Tampering Measures: Provide unobtrusive anti-tampering design features to prevent theft or damage.

2.3.6 Compliance with Accessibility Guidelines: Install accessories at heights and locations that comply with barrier-free codes and guidelines including, but not limited to the OBC and CSA B651.

2.3.7 Durability and Lifespan: Provide accessories designed for high-usage environments. Ensure accessories are resistant to cleaning chemicals.

2.3.8 Ease of Maintenance: Design accessories for easy maintenance. Accessories must simplify supply of replenishment and replacement or repair processes for parts.

## **2.4 Grab Bars**

2.4.1 Manufacturer's standard grab bar with following characteristics:

- .1 Material: Type-304 stainless steel

- .2 Finish: Satin
- .3 Surface: Slip-resistant
- .4 Wall Thickness: 1.2mm (18-gauge)
- .5 Outside Diameter: 38mm (1-1/2") unless indicated otherwise.
- .6 Clearance from wall: 38mm (1-1/2")
- .7 Mounting Flanges: Concealed, stainless steel plate with 0.8mm (22-gauge) flange covers.
- 2.4.2 Straight Grab Bar (WA1.1, WA1.2, WA1.3):
  - .1 Length: 600mm (24 inches)
  - .2 Acceptable Products:
    - .1 Model No. B-5806 by Bobrick
- 2.4.3 L-Shaped Grab Bar, 90 deg Grab Bar (WA1.4):
  - .1 Size: 762 mm x 762 mm (30 in x 30 in)
  - .2 Acceptable Products:
    - .1 Model No. B-6898.99 by Bobrick
    - .2 Model No. 3807-4P by ASI Group Canada.
    - .3 Model No 1003-P by Frost
- 2.4.4 Swing up Grab Bar (WA1.5):
  - .1 Outside diameter: 32 mm (1-1/4 in)
  - .2 Size: 762 mm (30 in)
  - .3 Acceptable Products:
    - .1 Model No. B-4998.99 by Bobrick
    - .2 Model No. 3513P by ASI Group Canada.
    - .3 Model No 1055-S by Frost

## **2.5 Mirrors (WA17.1)**

- 2.5.1 One-piece mirror with satin-finished Type 304 stainless steel frame with polished corners, beveled mirror edge, galvanized steel back, theft-resistant mounting, and concealed wall hanger.
  - .1 Hanging Brackets: Integral horizontal hanging brackets located at top and bottom.
  - .2 Glass: Minimum 6 mm (1/ in) No.1 quality float glass
  - .3 Mounting: Concealed wall hanger to prevent mirror from pulling away from wall.
  - .4 Mirror Size: 460 mm x 910 mm (18 in x 36 in)
  - .5 Acceptable Products:
    - .1 Model No. B-2908 by Bobrick

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**2.6     Sanitary Napkin Vendor (WA 8.1)**

2.6.1 Napkin/tampon vendor with mechanical operation, no batteries or electricity required, allowing for dispensing of sanitary napkins and tampons with following characteristics:

- .1 Dispensing Mechanisms: Combination for sanitary napkins and tampons.
- .2 Operation: Mechanical, no batteries or electricity required.
- .3 Field Convertibility: Convertible for changing coin denomination.
- .4 Construction: All-welded, Type-304 stainless steel, #4 satin finish.
- .5 Flange: Adjustable escutcheon type, semi- or fully recessed installation.
- .6 Door: 1.2mm (18-gauge), three 90° return edges, bottom edge hemmed.
- .7 Hinge: Concealed, full-length stainless steel piano hinge
- .8 Locks: Two tumbler locks, keyed like other washroom accessories
- .9 Coin Box: Equipped with tumbler lock, keyed differently than door locks.

2.6.2 Acceptable Products:

- .1 Model No. B-3500 by Bobrick or approved equivalent as follows:
- .2 Mode No. 6468 by ASI.

**2.7     Sanitary Napkin Disposal (WA5.1):**

2.7.1 Type-304 stainless steel sanitary napkin disposal with all-welded construction, satin finish, tumbler lock, self-closing panel, and removable 0.7-gal capacity polyethylene receptacle.

- .1 Toilet Partition Mounted Type:
  - .1 Model No. B-4354 by Bobrick
  - .2 Model No. 6471 by ASI

**2.8     Waste Paper Receptacle (WA 5.2)**

2.8.1 Recessed waste receptacle with following characteristics:

- .1 Material: Type-304 stainless steel with welded construction
- .2 Finish: Satin finish on exposed surfaces
- .3 Waste Receptacle: Minimum capacity of 45.5-L (12-gal.).
- .4 Acceptable Products:
  - .1 Model No. B-35643 by Bobrick

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**2.9      Combination Paper Towel Dispenser/ Waste Receptacle (WA2.1)**

2.9.1 Recessed paper towel dispenser and waste receptacle capable of dispensing C-fold or multifold paper towels with following characteristics:

- .1 Material: Type-304 stainless steel with welded construction
- .2 Finish: Satin finish on exposed surfaces
- .3 Waste Receptacle: Minimum capacity of 6.1-L (1.6-gal.).
- .4 Acceptable Products:
  - .1 Model No. B-36903 by Bobrick

**2.10     Paper Towel Dispenser**

2.10.1 Roll Paper Towel Dispenser (Automatic) (WA3.2):

- .1 Partition-mounted automatic roll paper towel dispenser, Type 304 stainless steel, all welded construction. Dispenses jumbo non-perforated rolls with adjustable paper length and delay settings.
- .2 Dispensing Mechanism: Towels are automatically dispensed when hands are placed under opening.
- .3 Power: Input 120 volt AC, output 6 volt DC power supply, hardwired to building.
- .4 Basis-of-Design: "109-70S" by Frost or approved equivalent.

2.10.2 Roll Paper Towel Dispenser (Manual) (WA3.3):

- .1 Surface-mounted roll-paper-towel dispenser with touch-free pull mechanism and durable resin construction.
- .2 Material: Type-304 stainless steel with welded construction
- .3 Finish: Satin finish on exposed surfaces
- .4 Acceptable Products:
  - .1 Model No. B-4262 by Bobrick

**2.11     Toilet Tissue Dispensers (WA3.1)**

2.11.1 Toilet Tissue Dispenser, Twin Jumbo Roll:

- .1 Type-304 stainless steel, partition-mounted dual-sided, multi-roll toilet tissue dispenser with high-impact ABS spindles and heavy-duty internal springs.
- .2 Basis-of-Design: "Model B-2892" by Bobrick or approved equivalent.

**2.12     Automatic Soap Dispenser (WA9.1)**

2.12.1 Capacity: 1000 mL or 1200 mL cartridge.

2.12.2 Soap Level Indicator: Equipped with a transparent cover to monitor the amount of soap available in the dispenser.

2.12.3 Basis-of-Design: "TF2CHR" by DEB or approved equivalent.

**2.13 Shower Soap Dispenser (WA9.2)**

2.13.1 Surface-mounted soap dispenser, Type 316 stainless steel body with satin finish.

2.13.2 Valve: Black molded plastic push button.

2.13.3 Operation Force: 22.2N (5 pounds)

2.13.4 Capacity: 1.2 L (40 fl oz)

2.13.5 Acceptable Products:

.1 Model No. B-818615 by Bobrick

**2.14 Hand Sanitizer Dispenser (WA9.3)**

2.14.1 Automatic wall-mounted soap-sanitizer dispenser, Type 304 stainless steel with satin finish.

2.14.2 Capacity: 850 mL (30 fl oz)

2.14.3 Soap Level Indicator: Equipped with clear acrylic refill-indicator window.

2.14.4 Acceptable Products:

.1 Model No. B-2012 by Bobrick

**2.15 Robe / Clothing Hooks (WA13.2)**

2.15.1 Double Robe Hook: Type-304 stainless steel satin finish with minimum 22 gauge (0.8mm), flange, concealed mounting bracket secured to wall plate with stainless steel setscrew and caps.

.1 Acceptable Products:

.1 Model 842.34.010. by Haefele

**2.16 Baby Changing Station (WA11.1)**

2.16.1 ASTM F2285, Surface-mounted baby changing station with controlled opening/closing, and no exposed hinges.

.1 Exterior: 18-gauge satin stainless steel.

.2 Interior: high-density polyethylene.

.3 Operation: Concealed pneumatic cylinder for controlled opening/closing.

.4 Straps: Replaceable, snap-lock, nylon.

.5 Load Capacity: Load capacity: Not less than 1.33 kN (298 lbs-f)

.6 Instructions: Universal graphics, multiple languages.

.7 Braille Label: Required.



2.16.2 Acceptable Products: "Model No. KB110-SSRE" by Koala Kare Products or approved equivalent.

**2.17 Folding Shower Seats (WA10.1)**

2.17.1 Folding shower seat with one-piece solid plastic laminate seat designed to lock in upright position when not in use with following characteristics:

- .1 Capacity: Designed to support 227 kg (500 lbs) in compliant installations.
- .2 Seat Thickness: 8mm (5/16")
- .3 Seat Surface: Plastic laminate matte-finish melamine with ivory-colored face sheets and black phenolic-resin core
- .4 Seat Attachment: Secured to frame with stainless steel carriage bolts and acorn nuts.
- .5 Acceptable Products:
  - .1 "Model B-5191" by Bobrick

**2.18 Mop Rack With Shelf (WA14.2)**

2.18.1 Description: Type 304 satin finish stainless steel, wall-mounted shelf with mop holders.

- .1 Shelf dimensions: 1.2mm (18 gauge) thickness, 205mm (8") deep
- .2 Edges: 19mm (3/4") return edges, front edge hemmed for safety
- .3 Acceptable Products:
  - .1 "Model No. B-239" by Bobrick Washroom Equipment

**2.19 Shower Curtain Rods With Curtains (WA12.1)**

2.19.1 Extra-heavy-duty shower curtain rod manufactured from Type 304, 18-8 stainless steel with 25 mm (1 inch) O.D. tubing with satin finish complete with curtain hooks and and shower curtain.

2.19.2 Acceptable Products:

- .1 "Model No. B-207 (Shower Curtain Rod) complete with B-204-2 (Shower Curtain) and B-204-1 (Shower Curtain Hooks)" by Bobrick Washroom Equipment

**2.20 Shower Shelf (WA12.2)**

2.20.1 Description: wall-mounted stainless-steel shelf with 18-gauge thickness and welded mounting brackets and hemmed front edges.

- .1 Shelf Depth: 205mm (8 inches)
- .2 Shelf size: 406 mm (16 inches)

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2.20.2 Acceptable Products:

- .1 "Model No. B-295" by Bobrick

**2.21 Janitor's Shelf (WA13.4)**

2.21.1 Description: wall-mounted stainless-steel shelf with 18-gauge thickness and welded mounting brackets and hemmed front edges.

- .1 Shelf Depth: 205mm (8 inches)
- .2 Shelf size: 610 mm (24 inches)

2.21.2 Acceptable Products:

- 2.21.3 "Model No. B-298-24" by Bobrick

**2.22 Automatic Hand Dryer (WA7.1)**

2.22.1 Construction: Polycarbonate casing and anti-tamper fasteners; water ingress protection: IP24.

2.22.2 Mounting: Surface mounted on ABS/PBT plastic backplate/mounting bracket, maximum 100 mm (4 in) projection from wall.

2.22.3 Filtration: 99.97% particulate efficiency HEPA filter with anti-microbial coating.

2.22.4 Operation: Touch-free capacitive sensor activation,

2.22.5 Hand dry time: 12 seconds or less.

2.22.6 Rated operating noise power: 79 db(A) or less.

2.22.7 Electrical Requirements: 110-127 V AC, 12 A, 1000 W. Coordinate with Division 26, Electrical; Standby Power Consumption: <0.5 W.

2.22.8 Acceptable Products: "Airblade V Electric hand dryer" (Model HU02); Item No. 307174-01 (sprayed nickel LV) by Dyson.

**2.23 Fabrication**

2.23.1 Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

2.23.2 Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner.

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### **3 . EXECUTION**

#### **3.1 Examination**

- 3.1.1 Prior to commencing work, verify actual site conditions and location of adjacent materials. Notify appropriate parties in writing of conditions that may compromise proper installation of materials.
- 3.1.2 Do not begin activities of this Section until unacceptable conditions have been resolved.

#### **3.2 Installation**

- 3.2.1 Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated on Drawings and Schedules and recommended by unit manufacturer, including the following:
  - .1 Verify blocking has been installed properly.
  - .2 Verify location does not interfere with door swings or use of fixtures.
  - .3 Comply with manufacturer's recommendations for backing and proper support.
  - .4 Use fasteners and anchors suitable for substrate and project conditions.
  - .5 Install units rigid, straight, plumb, and level, in accordance with manufacturer's installation instructions and approved shop drawings.
  - .6 Conceal evidence of drilling, cutting, and fitting to room finish.
  - .7 Test for proper operation.
- 3.2.2 Grab Bars: Install to withstand a downward load of at least 1.3 kN (293 lbf), when tested according to ASTM F 446.

#### **3.3 Cleaning And Protection**

- 3.3.1 Clean exposed surfaces of compartments, hardware, and fittings using methods acceptable to the manufacturer.
- 3.3.2 Touch-up, repair or replace damaged products until Substantial Performance of the Work.

#### **3.4 Adjusting And Cleaning**

- 3.4.1 Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- 3.4.2 Remove temporary labels and protective coatings.
- 3.4.3 Clean and polish exposed surfaces according to manufacturer's written recommendations.

**Regional Municipality of  
Peel  
Procurement Division**

**Document 2024-346P  
CONSTRUCTION OF THE  
DOCKSTEADER PRPS  
REPORTING STATION**

**Division 10  
10 28 13  
Washroom Accessories**

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**END OF SECTION**

**1. GENERAL**

**1.1 Related Documents**

- 1.1.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 Summary**

- 1.2.1 Section Includes:
- .1 Knocked-down corridor lockers.

**1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

**1.4 Preinstallation Meetings**

- 1.4.1 Preinstallation Conference: Conduct conference at Project site.

**1.5 Action Submittals**

- 1.5.1 Product Data: For each type of product.
- .1 Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker.
- 1.5.2 Shop Drawings: For metal lockers.
- .1 Include plans, elevations, sections, and attachment details.
  - .2 Show locker trim and accessories.
  - .3 Include locker identification system and numbering sequence.
- 1.5.3 Samples: For each colour specified, in manufacturer's standard size.
- 1.5.4 Samples for Initial Selection: Manufacturer's colour charts showing the full range of colours available.
- 1.5.5 Samples for Verification: For the following products, in manufacturer's standard size:
- .1 Lockers and equipment.
- 1.5.6 Product Schedule: For lockers.

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**1.6 Informational Submittals**

- 1.6.1 Sample Warranty: Submit sample warranties in accordance with Division 01 for special warranties specified in this section..

**1.7 Closeout Submittals**

- 1.7.1 Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

**1.8 Maintenance Material Submittals**

- 1.8.1 Supply extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- .1 The following metal locker hardware items equal to 10 percent of amount installed for each type and finish installed, but no fewer than five units:

- .1 Locks.
- .2 Blank identification plates.
- .3 Hooks.

**1.9 Quality Assurance**

- 1.9.1 Source Limitations: Obtain metal lockers and accessories from single source from single locker manufacturer.

- .1 Obtain locks from single lock manufacturer.

**1.10 Delivery, Storage, And Handling**

- 1.10.1 Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.

**Field Conditions**

- 1.10.2 Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

**1.11 Coordination**

- 1.11.1 Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

**1.12 Warranty**

- 1.12.1 Extended Warranty: Repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.

- .1 Failures include, but are not limited to, the following:
  - .1 Structural failures.
  - .2 Faulty operation of latches and other door hardware.
- .2 Damage from deliberate destruction and vandalism is excluded.
- .3 Warranty Period for Knocked-Down Metal Lockers: Ten years from date of Substantial Performance of the Work.

## **2 . PRODUCTS**

### **2.1 Manufacturers**

- 2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.
  - .1 ASI Group Canada.
  - .2 Dasco Storage Solutions.
  - .3 Hadrian Inc.
  - .4 General Storage Systems
  - .5 Shanahan's Limited
- 2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

### **2.2 Design And Performance Requirements**

- 2.2.1 Accessibility Standard: For lockers indicated to be accessible, comply with applicable provisions in CSA B651.
- 2.2.2 Build lockers on a unit principle with common intermediate uprights separating units.
- 2.2.3 Fabricate metal lockers by assembling at Project site using manufacturer's nuts, bolts, screws, or rivets.
- 2.2.4 Locker Configurations:
  - .1 As indicated on Drawings.

### **2.3 Materials**

- 2.3.1 Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.

### **2.4 Corridor Lockers (LKR)**

- 2.4.1 Doors: 1.90-mm (0.075-inch - 14 ga) nominal-thickness steel sheet outer door panel and 0.91-mm (20 ga) inner door panel; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.

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- .1 Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 381 mm (15 inches) wide; welded to inner face of doors.
  - .2 Stiffeners: Manufacturer's standard full-height stiffener fabricated from not less than 1.21-mm (0.048-inch - 18 ga) nominal-thickness steel sheet; welded to inner face of doors.
  - .3 Door Style: Vented panel as follows:
    - .1 Concealed Vents: Slotted perforations in top and bottom horizontal door return flanges.
- 2.4.2 Body: Assembled by riveting or bolting body components together. Fabricate from unperforated steel sheet with thicknesses as follows:
- .1 Sloped Tops, Bottoms, and Intermediate Dividers: not less than 0.61-mm (0.024-inch - 24 ga) nominal thickness, with single bend at sides.
  - .2 Backs and Sides: not less than 0.61-mm (0.024-inch - 24 ga) nominal thickness, with full-height, double-flanged connections.
  - .3 Shelves: not less than 0.61-mm (0.024-inch - 24 ga) nominal thickness, with double bend at front and single bend at sides and back.
- 2.4.3 Door Frames: Channel formed; fabricated from not less than 1.52-mm (0.060-inch - 16 ga) nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.
- .1 Cross Frames between Tiers: Channel formed and fabricated from not less than same material as main frames; welded to vertical main frames.
  - .2 Frame Vents: Fabricate face frames with vents.
- 2.4.4 Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees; self-closing.
- .1 Continuous Hinges: Manufacturer's standard, steel, full height.
- 2.4.5 Recessed Door Handle and Latch: Stainless steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.
- .1 Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks, built-in key locks, or padlocks; positive automatic latching and prelocking.
  - .2 Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking



device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.

2.4.6 Locks: As follows:

- .1 Combination Padlock: Key-controlled, three-number dialing combination locks; capable of five combination changes.

2.4.7 Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum plates, with numbers and letters at least 10 mm (3/8 inch) high.

2.4.8 Equipment: Provide each locker with an identification plate and the following equipment:

- .1 Single-Tier Units : Shelf, one ceiling hook, and two wall hooks.

2.4.9 Continuous Zee Base: Fabricated from not less than 1.52-mm (0.060-inch - 16 ga) nominal-thickness steel sheet.

- .1 Height: 102 mm (4 inches) unless otherwise indicated on Drawings. .

2.4.10 Recess Trim: Fabricated from not less than 1.21-mm (0.048-inch - 18 ga) nominal-thickness steel sheet.

2.4.11 Filler Panels: Fabricated from not less than 1.21-mm (0.048-inch - 18 ga) nominal-thickness steel sheet.

2.4.12 Boxed End Panels: Fabricated from not less than 1.52-mm (0.060-inch - 16 ga) nominal-thickness steel sheet.

2.4.13 Finished End Panels: Fabricated from not less than 0.61-mm (0.024-inch - 24 ga) nominal-thickness steel sheet to cover unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

2.4.14 Center Dividers: Fabricated from not less than 0.61-mm (0.024-inch - 24 ga) nominal-thickness steel sheet.

2.4.15 Basis-of-Design: "Excalibur" as manufactured by Dasco Storage Solutions.

**2.5 Finish**

2.5.1 Manufacturer's standard 2 mm hybrid epoxy/polyester baked enamel or powder coat applied to ensure uniform thickness and baked to cure.

- .1 Colour: As selected by Consultant from manufacturer's full range.

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**2.6      Fabrication**

- 2.6.1 Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.
- 2.6.2 Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
- 2.6.3 Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.
- 2.6.4 Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.
- 2.6.5 Accessible Lockers: Fabricate to conform to requirements of the Ontario Building Code and CSA B651.

**2.7      Accessories**

- 2.7.1 Interior equipment:
  - .1 Shelf at single tier lockers 1524 mm (60 inches) or higher.
  - .2 3 wall hooks and one ceiling hook in single tier lockers less than 460 mm (18 inches) deep.
  - .3 Coat rod instead of ceiling hook in single tier lockers 460 mm (18 inches) deep or more.
  - .4 3 wall hooks and one ceiling hook double tier lockers
  - .5 3 wall hooks at 305 mm (12 inch) wide triple tier lockers.
  - .6 4 wall hooks at 380 mm (15 inches) and wider triple tier lockers.
  - .7 Number Plates: Polished aluminum number plate riveted to door face with black numerals 13 mm (1/2 inch) high.
- 2.7.2 Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.
- 2.7.3 Anchors: Material, type, and size required for secure anchorage to each substrate.
  - .1 Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls, and in wet areas, for corrosion resistance.
  - .2 Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

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### **3 .    EXECUTION**

#### **3.1    Examination**

- 3.1.1 Examine walls and floors or support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- 3.1.2 Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- 3.1.3 Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2    Installation**

- 3.2.1 Install lockers level, plumb, and true; shim as required, using concealed shims.
  - .1 Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 910 mm (36 inches) o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
  - .2 Anchor single rows of metal lockers to walls near top of lockers and to floor.
  - .3 Anchor back-to-back metal lockers to floor.
- 3.2.2 Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

#### **3.3    Adjusting**

- 3.3.1 Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. Verify that integral locking devices operate properly.

#### **3.4    Protection**

- 3.4.1 Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.
- 3.4.2 Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION

**1. GENERAL**

**1.1 Section Includes**

- 1.1.1 Provide labour, materials, products, equipment and services to complete the Exterior Sun Control Devices work specified herein. This includes, but is not necessarily limited to:
- .1 Exterior sun shades at building exterior.
  - .2 Framing and associated anchorage.
  - .3 Auxiliary materials required for a complete installation.
- 1.1.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

**1.2 References**

- 1.2.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

**1.3 Administrative Requirements**

- 1.3.1 Pre-Installation Meetings:
- .1 Prior to starting work of this Section, convene a pre-installation meeting at the Project site to review the Project requirements and site conditions with pertinent parties. Conform to requirements of Section 01 31 00.

**1.4 Action Submittals**

- 1.4.1 Product Data: Submit in accordance with Division 01 for the following:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for the Exterior Sun Control Devices work and include product characteristics, performance criteria, physical size, finish and limitations.
- 1.4.2 Product Disclosure and Transparency:
- .1 Environmental Product Declarations (EPD): When available, submit Product-specific Type III EPD or industry-wide (generic) EPD conforming to ISO 14025 or other recognized environmental product declaration framework.
  - .2 Material Ingredient Reporting: When available, submit documentation demonstrating chemical inventory of materials

to at least 0.1% (1000ppm) and conforming to one of the following:

- .3 Health Product Declaration open Standard,
  - .4 Cradle to Cradle v2 Basic level or Cradle to Cradle v3 Bronze level,
  - .5 International Living Future Institute Declare
  - .6 Other approved framework.
  - .7 When multiple Products are specified, give preference to Products with compliant documentation.
- 1.4.3 Shop Drawings: Submit in accordance with Division 01 for sun control devices and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
- 1.4.4 Samples: Submit samples in accordance with Division 01 for each type of metal finish required.

## **1.5 Quality Assurance**

- 1.5.1 Welding Qualifications:
- .1 Provide welding in accordance with CSA W59-M performed by a fabricator and mechanics fully approved by the Canadian Welding Bureau as specified herein.
  - .2 Ensure fabricator is fully certified by Canadian Welding Bureau for fusion welding of steel structures to CSA W47.1 and for fusion welding of aluminum to CSA W47.2.
- 1.5.2 Fabricator qualifications. A firm experienced in producing fencing/infill/gate products similar to those indicated for the Project and with a record of successful in-service performance.
- 1.5.3 Source Limitations: Obtain sun control devices from single source from a single manufacturer where indicated to be of same type, design, or factory-applied colour finish.
- 1.5.4 Licensed Professionals: Employ a full time structural Professional Engineer registered in the Province of Ontario, and carrying liability insurance as noted in the Owner's supplementary conditions, to:
- .1 design the components of the work of this Section requiring structural performance,
  - .2 be responsible for full assemblies and connections,
  - .3 be responsible for determining sizes, yield strengths, gauge thicknesses and joint spacing to allow thermal movement and loading of components in accordance with applicable codes and regulations,
  - .4 be responsible for production and review of Shop Drawings,
  - .5 inspect the Work of this Section during fabrication and erection,

- .6 stamp and sign each Shop Drawing, and
- .7 provide site administration and inspection of this part of the Work.

1.5.5 Mock-ups: Provide mock-ups in locations designated by Consultant and as required to demonstrate quality of workmanship. Maintain mock-ups during construction in an undisturbed condition as a standard for judging the completed work.

**1.6 Field Conditions**

1.6.1 Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

**1.7 Warranty**

1.7.1 Extended Warranty for Finishes: Repair or replace components on which finishes fail in materials or workmanship within specified warranty period.

- .1 Deterioration includes, but is not limited to, the following:
- .2 Colour fading more than 5 Hunter units when tested according to ASTM D2244.
- .3 Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
- .4 Cracking, checking, peeling, or failure of paint to adhere to bare metal.

1.7.2 Warranty Period: 10 years from date of Substantial Performance of the Work.

**2 . PRODUCTS**

**2.1 Manufacturers**

2.1.1 Products from the following manufacturers may be acceptable for inclusion into the Work, provided they meet requirements of Contract Documents.

- .1 Construction Specialties; [www.c-sgroup.com](http://www.c-sgroup.com)
- .2 Levolux; [www.levolux.com](http://www.levolux.com)
- .3 TenPlus Architectural Products; [www.tenplus-online.com](http://www.tenplus-online.com)

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

**2.2 Regulatory Requirements**

- .1 Design shall be based on Limit States Design principles using factored loads and resistance. Resistance and resistance

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factors shall be determined in accordance with the OBC and CSA S136 requirements.

**2.3     Design and Performance Requirements:**

- 2.3.1 Professional Engineering Design and Certification: Design sun control devices, including comprehensive engineering analysis by a Professional Engineer licensed to practice in the Province of Ontario, using structural performance requirements and design criteria indicated.
- 2.3.2 Seismic Performance: Provide products and systems specified in this Section to withstand the effects of earthquake motions in accordance with OBC 4.1.8.18 and CAN/CSA S832.
  - .1 Professional engineer specified in Division 01 and referenced in this Section shall be responsible for designing systems and submitting signed and sealed analysis data and Shop Drawings illustrating seismic-resistant systems.
  - .2 Refer to Structural Drawings for seismic sensitivity values.
- 2.3.3 Structural Performance: Sun control devices shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of sun control device components, noise or metal fatigue caused by sun control device-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
- 2.3.4 Solar Control: Angle and pitch louvers to prevent direct sunlight penetration above 45° or as required to meet specific aesthetic or performance criteria.
- 2.3.5 Wind Loads: Determine loads based on pressures as indicated on Drawings.
- 2.3.6 Limit deflection of members and framing to L/360.
- 2.3.7 Vibration Control: Ensure sun control device members do not vibrate when subjected to above wind loading.
- 2.3.8 Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - .1 Temperature Change (Range): 67 deg C (120 deg F), ambient; 100 deg C (180 deg F), material surfaces.
- 2.3.9 SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

**2.4     Materials**

- 2.4.1 Steel Plates, Shapes, and Bars: ASTM A 36/A 36M or equivalent to CSA G40.20/G40.21, Grade 300W..

- 2.4.2 Aluminum Extrusions: ASTM B 221M (ASTM B 221), Alloy 6063-T5, T-52, or T6.
- 2.4.3 Aluminum Sheet: ASTM B 209M (ASTM B 209), Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- 2.4.4 Fasteners: Use types and sizes to suit unit installation conditions.
  - .1 Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.
  - .2 For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
  - .3 For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.
  - .4 For fastening stainless steel, use 300 series stainless-steel fasteners.
  - .5 For color-finished sun control devices, use fasteners with heads that match colour of sun control devices.
- 2.4.5 Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187.
- 2.4.6 Grout: Non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, and water-reducing and plasticizing additives.

## **2.5 Aluminum Sunshades (SS#)**

- 2.5.1 Sunshades: Assemblies consisting of manufacturer's standard outrigger brackets, louvers, and fascia, designed for attachment to curtain wall with mechanical fasteners.
- 2.5.2 Orientation: Horizontal.
- 2.5.3 Projection from Wall: As indicated on Drawings
- 2.5.4 Carrier Arms: Extruded aluminum with hidden fasteners.
- 2.5.5 Fastening: Stainless steel (316 grade), compatible with system and specific site conditions.
- 2.5.6 Louver Width: Refer to Drawings.
- 2.5.7 Profile: To be selected by Consultant.
- 2.5.8 Finish: Custom powder-coated finish as selected by Consultant. Submit samples for review. Allow Consultant to select final finish from manufacturer's full range.
- 2.5.9 Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
- 2.5.10 Steel Reinforcement: As required by manufacturer.



2.5.11 Basis-of-Design: "INFINITY ALUMINUM AEROFOIL" by Levlux or approved equivalent.

## **2.6 Aluminum Finishes**

2.6.1 Finish sun control devices after assembly.

2.6.2 High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70percent PVDF resin by weight in both colour coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

.1 Manufacturer's standard powder coating of performance equivalent to AAMA 2605 is acceptable in lieu of high-performance organic finish specified in this Section.

## **3 . EXECUTION**

### **3.1 Examination**

3.1.1 Site Verification of Conditions: Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify the Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.

3.1.2 Examine substrates and openings, with installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

### **3.2 Preparation**

3.2.1 Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

### **3.3 Installation**

3.3.1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.3.2 Locate and place sun control devices level, plumb, and at indicated alignment with adjacent work.

3.3.3 Use concealed anchorages where possible.

3.3.4 Form closely fitted joints with exposed connections accurately located and secured.

- 3.3.5 Provide perimeter reveals and openings of uniform width for sealants and joint fillers.
- 3.3.6 Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

### **3.4 Field Quality Control**

- 3.4.1 Manufacturer Services: Arrange for Product manufacturer's technical representative to:
  - .1 meet and discuss installation procedures and unique conditions at the Place of the Work.
  - .2 inspect substrate surfaces and recommend solutions to accommodate adverse conditions.
  - .3 periodically visit and inspect installation and report unsatisfactory conditions to Contractor.
  - .4 attend final inspection and to submit written certification that Products, systems and assemblies have been installed in accordance with manufacturer's requirements.

### **3.5 Adjusting and Cleaning**

- 3.5.1 Clean exposed sun control device surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- 3.5.2 Restore sun control devices damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, remove damaged units and replace with new units.
- 3.5.3 Touch up minor abrasions in finishes with air-dried coating that matches colour and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the Security Mirrors And Domes specified herein. This includes, but is not necessarily limited, to:
- .1 Security mirrors and domes,
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Submittals**

- 1.4.1 General Requirements and Procedures for Submittals: in accordance with Section 01 33 00, Submittal Procedures.
- 1.4.2 Product Data: Submit Product characteristics, performance criteria, physical size, finish, and limitations for Security Mirrors And Domes work specified in this Section.
- 1.4.3 Shop Drawings: Submit Shop Drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.

### **1.5 Quality Assurance**

- 1.5.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.
- 1.5.2 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and

secondary materials from sources recommended by manufacturers of primary materials.

**1.6 Delivery, Storage And Handling**

- 1.6.1 Deliver, store and handle materials in accordance with manufacturer's written instructions .
- 1.6.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.6.3 Storage and Handling Requirements: Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- 1.6.4 Replace defective or damaged materials with new.

**1.7 Warranty**

- 1.7.1 Provide warranty covering the Work of this Section in accordance with Supplementary Condition SC49 / GC 12.3 WARRANTY.

**2 . PRODUCTS**

**2.1 Manufacturers**

- 2.1.1 Products from the following manufacturers may be acceptable for inclusion into The work, provided they meet requirements of Contract Documents.
  - .1 CR Laurence
  - .2 DuraVision Mirror Systems
  - .3 Approved equivalent.
- 2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

**2.2 Indoor Acrylic Vision Dome Mirrors (DM)**

- 2.2.1 Material: 3 mm (1/8") thick vacuum-coated acrylic producing sharp, clear images and capable of being ceiling mounted.
- 2.2.2 Installation method: screw mount
- 2.2.3 90 deg Vision Mirrors:
  - .1 Size: 600 mm x 600 mm (24 inch x 24 inch) - up to 10 m viewing distance
  - .2 Basis-of-Design: "Quarter Dome Convex Mirror" by DuraVision or approved equivalent.

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**2.3     Accessories**

- 2.3.1 Provide manufacturer's standard suspension kit for attachment to ceilings.

**3 .     EXECUTION**

**3.1     Examination**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.

**3.2     Installation**

- 3.2.1 Install security mirrors and domes in accordance with manufacturer's instructions.

**3.3     Cleaning And Protection**

- 3.3.1 Upon completion clean mirrors with soft, damp cloth or chamois, wiping gently.

**END OF SECTION**

**1 . General**

**1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only.

**1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the vehicle washing equipment work specified herein. This includes, but is not necessarily limited, to:
  - .1 Rollover vehicle washing system
  - .2 Vehicle cleaning station
  - .3 Auxiliary materials required for a complete installation
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

**1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

**1.4 Submittals**

- 1.4.1 Product Data: Submit in accordance with Division 01 for the following:
  - .1 Vehicle wash system.
  - .2 Vehicle wash station
- 1.4.2 Shop Drawings: Submit detailed shop drawings showing all components, plumbing and electrical connections.
- 1.4.3 Operation and Maintenance Data: Submit complete set of operating and maintenance manuals, including installation drawings.

**1.5     Warranty**

- 1.5.1 Provide warranty covering the Work of this Section in accordance with Supplementary Condition SC49 / GC 12.3 WARRANTY.

**2 .     Products**

**2.1     Manufacturers**

- 2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.
- .1 CustomKraft
  - .2 Istobal
  - .3 Approved equivalent.
- 2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

**2.2     Rollover Vehicle Washing System**

- 2.2.1 Provide vehicle washing system with easy access to programmable controller and with following features:
- .1 Total vehicle coverage for vehicles up to 2895 mm (114 inches) high.
  - .2 Dimensions: Refer to Drawings.
  - .3 Operation: Manufacturer's standard entry system.
- 2.2.2 Materials
- .1 Structural Components:
    - .1 Hot-dip galvanized steel for durability and corrosion resistance.
  - .2 Brushes: Three (3) brushes, colour to be selected by Consultant at a later date.
  - .3 Finishes: Powder-coated, colour to be selected by Consultant at a later date.
- 2.2.3 Electrical Requirements
- .1 Electrical Service:
    - .1 Provide power as required by the manufacturer's specifications.
  - .2 Control Systems:
    - .1 PLC based control system for operation and diagnostics.
- 2.2.4 Accessories
- .1 On-board lighted signs and pictograms.

- .2 Vinyl wrap for customization.
- .3 High-pressure wheel-wash system.
- 2.2.5 Basis-of-Design: "Flex 5 XL – 3 Brushes" by Istobal or Consultant approved equivalent.
- 2.2.6 Seismic Performance: Provide products and systems specified in this Section to withstand the effects of earthquake motions in accordance with OBC 4.1.8.18 and CAN/CSA S832.
  - .1 Professional engineer specified in Division 01 and referenced in this Section shall be responsible for designing systems and submitting signed and sealed analysis data and Shop Drawings illustrating seismic-resistant systems.
  - .2 Refer to Structural Drawings for seismic sensitivity values.

## **2.3 Vehicle Cleaning Station**

- 2.3.1 Characteristics:
  - .1 Dimensions:
    - .1 Single-sided: 762 mm wide x 762 mm deep x 2032 mm tall (30 in wide x 30 in deep x 80 in tall).
    - .2 Double-sided: 1219 mm wide x 1575 mm deep x 1626 mm high (48 in wide x 62 in deep x 64 in high).
  - .2 Frame and Tanks: Stainless steel with automatic proportioning valves.
  - .3 Electric Motor: Baldor 5 hp, 3 phase (Super E).
  - .4 Pump: CAT pump with lifetime warranty manifold.
  - .5 Drive: Direct drive.
  - .6 Controls: Meter box with digital timer and rotary switch.
  - .7 Pressure Gauge: 907 kg liquid-filled (2000 lbs).
  - .8 Trigger Gun: Safety trigger gun.
- 2.3.2 Standard Features
  - .1 Variable Frequency Drive (VFD) accepts single or three-phase input.
  - .2 High-pressure wash system providing 15 liters per minute (4 gpm) up to 11700 kPa (1700 psi).
  - .3 Foam Brush: Air-operated diaphragm pump with hog's hair bristles.
- 2.3.3 Basis-of-Design: "Wash-Me Express" by CustomKraft or Consultant approved equivalent.



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**3 .     Execution**

**3.1     Examination**

- 3.1.1 Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, including equipment bases; accurate placement, pattern, and orientation of anchor bolts; critical dimensions; and other conditions affecting performance of the Work.
- 3.1.2 Examine roughing-in for electrical, plumbing and communication systems to verify actual locations of connections before parking control equipment installation.
- 3.1.3 Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2     Installation**

- 3.2.1 Install vehicle washing equipment in strict accordance with manufacturer's instructions and as required for complete and integrated installation.

**3.3     Adjusting**

- 3.3.1 Adjust vehicle washing equipment to function smoothly, and lubricate as recommended by manufacturer.
- 3.3.2 After completing installation of exposed, factory-finished equipment, inspect exposed finishes and repair damaged finishes.

**3.4     Demonstration**

- 3.4.1 Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment.

End Of Section

## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Loading Dock Equipment work specified herein. This includes, but is not necessarily limited, to:
- .1 Vertical-storing dock levelers.
  - .2 Frame-type dock shelters.
  - .3 Steel finishes.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only.
- .1 Section 03 30 00, Cast-in-Place Concrete
  - .2 Section 05 50 00, Metal Fabrications
  - .3 Section 08 33 24, Overhead Coiling Doors for coiling and other overhead doors electrically interlocked to dock levelers.
  - .4 Division 26 for electrical wiring for, and connections to, loading dock equipment.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

### **1.4 Definitions**

- 1.4.1 Operating Range: Maximum amount of travel above and below the loading dock level.
- 1.4.2 Working Range: Recommended amount of travel above and below the loading dock level for which loading and unloading operations can take place.

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**1.5     Submittals**

- 1.5.1 Product Data: Submit product data in accordance with Division 01 for each type of product indicated on Drawings and Schedules. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for loading dock equipment. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- .1 Submit manufacturer's instructions, printed product literature and data sheets for the Loading Dock Equipment work and include product characteristics, performance criteria, physical size, finish and limitations
- 1.5.2 Shop Drawings: Submit Shop Drawings in accordance with Division 01 for loading dock equipment. Include plans, elevations, sections, details, and attachments to other work.
- .1 Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- .2 Wiring Diagrams: Submit wiring diagrams in accordance with Division 01 for power, signal, and control wiring.
- 1.5.3 Samples for Initial Selection: Submit samples for initial selection in accordance with Division 01 for each type of dock -shelter fabric indicated on Drawings and Schedules.
- 1.5.4 Samples for Verification: Submit samples for verification in accordance with Division 01 for each type of dock-shelter fabric indicated on Drawings and Schedules.
- 1.5.5 Welding certificates.
- 1.5.6 Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency; indicate compliance of dock levelers with requirements in MH 30.1 for determining rated capacity, which is based on comprehensive testing within last two years of current products.
- .1 Submittal Form: According to MH 30.1, Appendix A.
- 1.5.7 Operation and Maintenance Data: Submit operation and maintenance data in accordance with Division 01 for loading dock equipment to include in operation and maintenance manuals.
- 1.5.8 Warranty: Submit sample warranty in accordance with Division 01 for manufacturer's special warranty. .

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**1.6     Quality Assurance**

- 1.6.1 Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
  - .1 Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
- 1.6.2 Source Limitations: Obtain loading dock equipment from single source from single manufacturer.
- 1.6.3 Welding Qualifications: Qualify procedures and personnel according to the following:
  - .1 AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - .2 AWS D1.3, "Structural Welding Code - Sheet Steel."
- 1.6.4 Electrical Components, Devices, and Accessories: Listed and labeled as defined in CSA C22 SERIES AND NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 1.6.5 Pre-installation Meetings: Schedule, and conduct pre-installation meeting at Project Site, in order to coordinate work of this Section, with work of related Subcontractors.
  - .1 Ensure attendance of Subcontractor performing work of this Section and representatives of manufacturers and fabricators involved in, or affected by, installation and coordination with other materials and installations that have preceded or will follow. Advise Consultant and Owner in advance of scheduled meeting dates.
  - .2 Agenda: Review progress of other construction activities and preparations for the particular activity under consideration.
  - .3 Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
  - .4 Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
  - .5 Inspect and discuss electrical roughing-in, equipment bases, and other preparatory work specified elsewhere.
  - .6 Review sequence of operation for each type of loading dock equipment.
  - .7 Review coordination of interlocked equipment specified in this Section and elsewhere.
  - .8 Review required testing, inspecting, and certifying procedures.

**1.7     Delivery, Storage, And Handling**

1.7.1 Store and handle dock shelters in a manner to avoid significant or permanent damage to fabric or frame.

- .1 Comply with manufacturer's written instructions for minimum and maximum temperature requirements for storage.

**1.8     Project Conditions**

1.8.1 Field Measurements: Verify actual dimensions of construction contiguous with loading dock equipment, including, by field measurements before fabrication.

**1.9     Warranty**

1.9.1 Special Warranty for Dock Levelers: Manufacturer's standard form in which manufacturer agrees to repair or replace dock-leveler components that fail in materials or workmanship within specified warranty period.

- .1 Failures include, but are not limited to, the following:
  - .1 Structural failures including cracked or broken structural support members, load-bearing welds, and front and rear hinges.
  - .2 Faulty operation of operators, control system, or hardware.
  - .3 Deck plate failures including cracked plate or permanent deformation in excess of 6 mm (1/4 inch) between deck supports.
  - .4 Hydraulic system failures including failure of hydraulic seals and cylinders.
- .2 Warranty Period for Structural Assembly: 10 years from date of Substantial Performance of the Work.
- .3 Warranty Period for Hydraulic System: Five years from date of Substantial Performance of the Work.
- .4 Warranty shall be for unlimited usage of leveler for the specified rated capacity over the term of the warranty.

**2 .     PRODUCTS**

**2.1     Materials**

2.1.1 Steel Plates, Shapes, and Bars: ASTM 36/A 36M.

2.1.2 Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from steel plate complying with ASTM A 572/A 572M, Grade 380 (55).

2.1.3 Steel Tubing: ASTM A 500, cold formed.

- 2.1.4 Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

## **2.2 Vertical-Storing Dock Levelers**

- 2.2.1 General: Recessed, hinged-lip-type, vertical-storing dock levelers designed for permanent installation in shallow concrete pits preformed in the edge of loading platform; of type, function, operation, capacity, size, and construction indicated on Drawings and Schedules; and complete with controls, safety devices, and accessories required.
- .1 Basis-of-Design Product: "RHV-5000 with Safe-T-Pit" by Rite-Hite or comparable product by one of the following:
    - .1 SPX Dock Products - Serco.
- 2.2.2 Standard: Comply with MH 30.1, except for structural testing to establish rated capacity.
- 2.2.3 Rated Capacity: Capable of supporting minimum gross load of 15,000 lbs without permanent deflection or distortion.
- 2.2.4 Platform: Not less than 6-mm- (1/4-inch-) thick, nonskid steel plate.
- .1 Platform Size: As indicated on Drawings.
- 2.2.5 Hinged Lip:
- .1 Acceptable Product: "Smooth Transition Dok System" by Rite-Hite.
- 2.2.6 Function: Dock levelers shall compensate for differences in height between truck bed and loading platform.
- .1 Vertical Travel: Operating range above platform level of sufficient height to enable lip to extend and clear truck bed before contact with the following minimum working range:
    - .1 Above Adjoining Platform: As indicated on Drawings.
    - .2 Below Adjoining Platform: As indicated on Drawings
  - .2 Automatic Vertical Compensation: Floating travel of ramp with lip extended and resting on truck bed shall compensate automatically for upward or downward movement of truck bed during loading and unloading.
  - .3 Automatic Lateral Compensation: Tilting of ramp with lip extended and resting on truck bed shall compensate automatically for canted truck beds of up to 102 mm (4 inches) over width of ramp.
  - .4 Lip Operation: Manufacturer's standard mechanism that automatically extends and supports hinged lip on ramp edge with lip resting on truck bed over dock leveler's working range,

allows lip to yield under impact of incoming truck, and automatically retracts lip when truck departs.

.1 Length of Lip Extension: 508 mm (20 inches).

2.2.7 Hydraulic Operating System: Electric control from a remote-control station; fully hydraulic operation. Electric-powered hydraulic raising and hydraulic lowering of ramp. Equip leveler with a packaged unit including a unitized, totally enclosed, nonventilated electric motor, pump, manifold reservoir, and valve assembly of proper size, type, and operation for capacity of leveler indicated on Drawings and Schedules. Provide a hydraulic velocity fuse connected to main hydraulic cylinder to limit loaded ramp's free fall to not more than 76 mm (3 inches). Provide mechanical lock that prevents leveler from lowering without hydraulic pressure.

.1 Remote-Control Station with Emergency Stop: Multibutton control station with an UP button of the constant-pressure type and an emergency STOP button of the momentary-contact type, enclosed in NEMA ICS 6, Type 12 box. Ramp raises by depressing and holding UP button; ramp lowers at a controlled rate by releasing UP button. All ramp movement stops, regardless of position of ramp or lip, by depressing STOP button. Normal operation resumes by engaging a manual reset button or by pulling out STOP button.

.1 Master Panel: Control panel with integral fused disconnecting means for operating dock leveler, dock door, and truck restraints.

.2 Independent Lip Operation: Electric-powered hydraulic raising and lowering of lip, controlled independent of raising and lowering of ramp.

2.2.8 Construction: Fabricate dock-leveler frame, platform supports, and lip supports from structural- or formed-steel shapes. Weld platform and hinged lip to supports. Fabricate entire assembly to withstand deformation during both operating and stored phases of service. Chamfer lip edge to minimize obstructing wheels of material-handling vehicles.

2.2.9 Accessories:

.1 Interlock: Leveler will not operate while overhead door is in open position and truck restraint is not engaged.

.2 Curb Angles: 76-by-76-by-6-mm (3-by-3-by-1/4-inch) galvanized-steel curb angles for edge of recessed leveler pit, with 13-mm- (1/2-inch-) diameter by 152-mm- (6-inch-) long concrete anchors welded to angle at 152 mm (6 inches) o.c.

2.2.10 Finish: Corrosion resistant finish.

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**2.3     Frame-Type Dock Shelters**

2.3.1 General: Dock shelters designed to form a seal with sides and top of truck body while leaving entire width and height of truck's rear opening unobstructed; of type, size, and construction indicated on Drawings and Schedules.

.1 Basis-of-Design Product: "Eclipse Dock Shelter" by Rite-Hite Corporation or approved equivalent.

2.3.2 Door Opening Size: As indicated on Drawings.

2.3.3 Rigid-Frame Type: Fabricated from translucent, fabric-covered side and top panels attached to fixed supporting framework. Provide head and side curtains with built-in flexible stays, wind straps between head curtain and side frame, pleated protectors on head curtain, and a yellow aim patch on side curtains. Slope head frame from center for drainage. Provide replaceable, fabric-covered, tapered, foam-bottom pads and protective steel bumpers of size and type required for application shown.

2.3.4 Flexible-Frame Type: Fabricated from fabric-covered side and top panels attached to retractable supporting framework with independent spring-tension extension arms. Provide head and side curtains with built-in flexible stays, pleated protectors on head curtain, and a yellow aim patch on side curtains. Provide replaceable, fabric-covered, tapered, foam-bottom pads of size and type required for application shown.

2.3.5 Head-Pad Height: As indicated on Drawings.

2.3.6 Construction: Fabricate framework, pads, bumpers, fabric for curtains and panels, and other components to sizes and shapes indicated on Drawings and Schedules or required to fit door opening sizes shown and allow for not less than 457 mm (18 inches) of truck-body penetration when truck is docked.

.1 Steel Framework: Zinc-plated steel tubing of size and thickness standard with manufacturer, with joints welded.

.2 Top and Side Panels: White, translucent vinyl, weighing 4272 g/sq. m (14 oz./sq. ft.).

.3 Cover Fabric: Manufacturers standard friction-resistant fabric.

.1 Colour: As selected by Consultant from manufacturer's full range.

.4 Pleated Protectors: Overlapping layers of same fabric as cover.

2.3.7 Accessories:

.1 Buffer flaps.

.2 Bottom filler curtain.

.3 Bottom seal pads.



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**2.4     General Finish Requirements**

2.4.1    Finish loading dock equipment after assembly and testing.

**2.5     Steel Finishes**

2.5.1    Galvanizing: Hot-dip galvanize components as indicated to comply with the following:

- .1    ASTM A 123/A 123M or equivalent to CAN/CSA-G164 for iron and steel loading dock equipment.
- .2    ASTM A 153/A 153M or ASTM F 2329 for iron and steel hardware for loading dock equipment.

2.5.2    Galvanized-Steel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat in manufacturer's standard colour.

**3 .     EXECUTION**

**3.1     Examination**

- 3.1.1    Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of loading dock equipment.
- 3.1.2    Examine roughing-in for electrical systems for loading dock equipment to verify actual locations of connections before equipment installation.
- 3.1.3    Examine walls and floors of pits for suitable conditions where recessed loading dock equipment is to be installed. Pits shall be plumb and square and properly sloped for drainage from back to front of loading dock.
- 3.1.4    Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2     Preparation**

- 3.2.1    Coordinate size and location of loading dock equipment indicated on Drawings and Schedules to be attached to or recessed into concrete or masonry, and Supply anchoring devices with templates, diagrams, and instructions for their installation.
- 3.2.2    Set curb angles in concrete edges of dock-leveler recessed pits with tops flush with loading platform. Fit exposed connections together to form hairline joints.
- 3.2.3    Set curb angles in concrete edges of truck-leveler recessed pits with tops flush with driveway. Fit exposed connections together to form hairline joints.

3.2.4 Place self-forming pan system for edge-of-dock levelers in proper relation to loading platform before pouring concrete.

3.2.5 Clean recessed pits of debris.

**3.3     Installation**

3.3.1 General: Install loading dock equipment, including control stations and accessories as required for a complete installation.

.1 Rough-in electrical connections according to requirements specified in Division 26 Sections.

3.3.2 Truck Levelers: Attach truck levelers securely to driveway construction with expansion anchors and bolts.

3.3.3 Dock Shelters: Attach dock shelters securely to building structure in proper relation to openings, dock bumpers, and dock levelers to ensure an effective seal of dock-shelter curtains with sides and top of truck body when trucks are positioned against dock bumpers.

**3.4     Adjusting**

3.4.1 Adjust loading dock equipment to function smoothly and safely, and lubricate as recommended by manufacturer.

3.4.2 Test dock levelers for vertical travel within operating range indicated on Drawings and Schedules.

3.4.3 After completing installation of exposed, factory-finished loading dock equipment, inspect exposed finishes and repair damaged finishes.

**3.5     Demonstration**

3.5.1 Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain loading dock equipment.

END OF SECTION

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**1. GENERAL**

**1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only.

**1.2 Summary**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the automotive lifts specified herein. This includes, but is not necessarily limited, to:
  - .1 Heavy-duty four-post truck lift system.
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.
  - .1 Related requirements provided below are for convenience purposes only.
    - .1 Section 03 30 00 - Cast-in-Place Concrete
    - .2 Section 05 50 00 - Metal Fabrications
    - .3 Division 26 Electrical

**1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

**1.4 Preinstallation Meetings**

- 1.4.1 General Requirements and Procedures for Project Meetings: In accordance with Section 01 31 00, Project Management and Coordination.

- 1.4.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
- .1 Ensure attendance of Subcontractor performing work of this Section, as well as representatives from manufacturers and fabricators involved in or affected by installation. Notify Consultant and Owner of scheduled meeting dates in advance.
  - .2 Agenda:
    - .1 Review progress of related construction activities and preparations for particular activity under consideration.
    - .2 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
  - .3 Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
  - .4 Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

## **1.5 Submittals**

- 1.5.1 General Requirements and Procedures for Submittals: In accordance with Section 01 33 00, Submittal Procedures.
- 1.5.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for automotive lifts work specified in this Section
- 1.5.3 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
- .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
  - .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO<sub>2</sub>e/declared unit as a minimum.
  - .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- 1.5.4 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:
- .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.

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- .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
    - 1.5.5 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:
      - .1 Indicate field-measured dimensions on Shop Drawings.
      - .2 Provide templates for anchors and bolts anchored to permanent construction
    - 1.5.6 Product Test Reports: Indicate compliance of dock lifts with requirements in MH 30.1 for determining rated capacity.
    - 1.5.7 Delegated Design Submittals:
      - .1 Engineering design completion of automotive lifts work is delegated to Contractor based on structural design criteria indicated in Contract Documents.
      - .2 Submit Shop Drawings for work of this Section that bear the stamp of a Professional Engineer registered in Province of Ontario.
      - .3 Submit copy of structural calculations upon request by Consultant.
    - 1.5.8 Certificates:
      - .1 Manufacturer Certificate: Submit certificate signed by automotive lifts manufacturer certifying that product meets all requirements in regards to functionality, appearance and safety specifications.
      - .2 Welding Certificate: Submit certification for welding firms and welders to verify compliance with welding qualifications specified in this section.
  - 1.6 **Closeout Submittals**
    - 1.6.1 General Requirements and Procedures for Closeout Submittals: In accordance with Section 01 78 00, Closeout Submittals.
    - 1.6.2 Operating and Maintenance Data: Submit care and maintenance instructions for Automotive lifts to be included in building's operation and maintenance manual.
    - 1.6.3 Warranty Documentation: Submit copy of extended warranties specified in this Section.
  - 1.7 **Quality Assurance**
    - 1.7.1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.

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- 1.7.2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.
- .1 Certification: Installer must be trained and certified by manufacturer.
- 1.7.3 Welding Qualifications: Qualify procedures and personnel in accordance with the following:
- .1 Steel: to CSA W47.1 and CSA W59
- .2 Aluminum: to CSA W47.2 and CSA W59.2
- .3 Stainless Steel: to CSA W47.1 (Annex K) and CSA W59.
- 1.7.4 Professional Engineer's Qualifications: Employ Professional Engineer licensed to practice in Province of Ontario who carries professional liability insurance as noted in the Owner's supplementary conditions and has at least 5 years' experience providing engineering services of similar kind, scope, and complexity.
- .1 Professional Engineer's Responsibility:
- .1 production and review of Shop Drawings,
- .2 design and certification of Automotive Lifts, including attachments for building construction, in accordance with applicable codes and regulations,
- .3 stamping and signing of each Shop Drawing and associated calculations.
- 1.7.5 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.

**1.8 Delivery, Storage and Handling**

- 1.8.1 General Product Requirements: In accordance with Section 01 61 00, Common Product Requirements. Deliver, store and handle automotive lifts materials in accordance with manufacturer's written instructions.
- 1.8.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.8.3 Store materials in off-ground, in clean, dry, well-ventilated area.
- 1.8.4 Replace defective or damaged materials with new.

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**1.9     Field Conditions**

1.9.1 Field Measurements: Verify actual dimensions of construction contiguous with automotive lifts by field measurements before fabrication.

**1.10    Warranty**

1.10.1 Extended Warranty: Extended warranty: Submit for Owner's review and acceptance, manufacturer's extended warranty in which manufacturer commits to repair or replace components of automotive lifts that fail within specified warranty period. Manufacturer's extended warranty is in addition to, and does not supersede, any other rights that Owner may have under Contract Documents.

- .1 Warranty Period: 5 years from date of Substantial Performance of The work.
- .2 Warranty Scope: Materials and workmanship

**2 .     PRODUCTS**

**2.1     Manufacturers**

2.1.1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:

- .1 BendPak Inc.

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

**2.2     Performance / Design Criteria**

2.2.1 Lift Standard: Comply with ANSI/ALI ALCTV and ANSI/UL 201.

2.2.2 Electrical Components, Devices, and Accessories (motorized doors): Listed and labeled as defined in CSA C22 Series, by a qualified testing agency, and marked for intended location and application.

**2.3     Automotive lift**

2.3.1 Product Description: Automotive lift capable of accommodating vehicles up to Class 7 semi-trucks.

- .1 Lifting Capacity: 12,247 kgs (27,000 lbs)
- .2 Max Lifting Height: 1,765 mm (69.5 inches)
- .3 Width and Length: 3, 899 mm (153.5 inches) x 7,944 mm (312.75 inches)
- .4 Drive-Thru Clearance: 2,769 mm (109 inches)
- .5 Locking Positions: 9

- .6 Lock Spacing: every 152 mm (6 inches)
- .7 Lifting Time: 75 seconds
- .8 Motor: 220 VAC/ 60 Hz/ 1 Ph

2.3.2 Metals: exposed metal surfaces and fastening materials must comply with minimum requirements of ASTM A123/A123M, ASTM A143/A143M, and ASTM A153/A153M.

- .1 Basis-of-Design: "HDS-27" by BendPak.

## **2.4     Operation**

- 2.4.1 Operating System: Hydraulic lift with remote push-button control. Provide packaged unit including enclosed motor, pump, manifold reservoir, and valve assembly.
- 2.4.2 Control Station: Multibutton station in NEMA ICS 6, Type 12 box. Provide constant-pressure "up" button for raising; lowering is achieved by releasing button. Provide emergency stop button to halt movement, and manual reset or pull to resume.

## **2.5     Accessories**

- 2.5.1 Rolling Jacks: Manufacturer's standard system for lifting wheels off runways to accommodate wheel and brake service.

## **2.6     Finishes**

- 2.6.1 Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

# **3 .     EXECUTION**

## **3.1     Examination**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.
- 3.1.2 Examine roughing-in for electrical systems for automotive lift to verify actual locations of connections before installation.
- 3.1.3 Examine walls and floors of pits for suitable conditions where automotive lift is to be installed.
- 3.1.4 Electrical Connections: Rough-in electrical connections according to requirements in Division 26.



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**3.2     Installation**

- 3.2.1 General Requirements: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.
- 3.2.2 Install components in plumb, level, square, and warp- and twist-free manner while maintaining dimensional tolerances and alignment with the surrounding construction.

**3.3     Startup Service**

- 3.3.1 Engage a factory-authorized service representative to perform startup service.
- 3.3.2 Perform installation and startup checks according to manufacturer's written instructions.
- 3.3.3 Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

**3.4     Adjusting**

- 3.4.1 Adjust hardware and moving parts to function smoothly so that lifts operate easily, free of warp, twist, or distortion.
- 3.4.2 Lubricate bearings and parts as recommended by manufacturer.

**3.5     Demonstration**

- 3.5.1 Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain automotive lift.

**3.6     Protection**

- 3.6.1 Protect automotive lift from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades.
- 3.6.2 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in writing by affected material's manufacturer. Do not use materials or process that can damage finishes, surfaces, or construction.
- 3.6.3 Promptly replace automotive lift damaged during construction that cannot be satisfactorily repaired.

**3.7     Cleaning and Waste Management**

- 3.7.1 General Requirements for Cleaning and Waste Management: In accordance with Section 01 74 00, Cleaning and Waste Management.

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- 3.7.2 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
- 3.7.3 Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**END OF SECTION**

## **1. GENERAL**

### **1.1 GENERAL INSTRUCTIONS**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only

### **1.2 SUMMARY**

- 1.2.1 Provide labour, materials, Products, equipment and services to complete the appliances and equipment work specified herein. This includes, but is not necessarily limited, to:
  - .1 Appliances and equipment indicated on appliance schedule.
  - .2 Auxiliary materials required for a complete installation.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only:
  - .1 Section 06 40 00, Architectural Woodwork.
  - .2 Division 22, Plumbing.
  - .3 Division 26, Electrical.

### **1.3 REFERENCES**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to 01 42 19 - Reference Standards.

### **1.4 PREINSTALLATION MEETINGS**

- 1.4.1 Project Meetings, generally: in accordance with Section 01 31 00, Project Management and Coordination.
- 1.4.2 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.

- .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.
- .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.
- .3 Agenda:
  - .1 Discuss issues including, but not limited to, power, water and utility requirements.
  - .2 Coordination with built-in dimensions along with shipping and delivery schedules.
  - .3 Review progress of related construction activities and preparations for particular activity under consideration.
  - .4 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
- .4 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
- .5 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

## **1.5 SUBMITTALS**

- 1.5.1 Submittals, generally: in accordance with Section 01 33 00, Submittal Procedures.
- 1.5.2 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for appliances and equipment work specified in this Section.
  - .1 Include manufacturer's installation instructions.
- 1.5.3 Schedule: Submit appliance schedule using same designations indicated on Drawings for all appliances used on project. Include manufacturer's name and product number, and location within Project.

## **1.6 CLOSEOUT SUBMITTALS**

- 1.6.1 Closeout Submittals, generally: in accordance with Section 01 78 00, Closeout Submittals.
- 1.6.2 Operating and Maintenance Data: Submit care and maintenance instructions for appliances and equipment to be included in building operation and maintenance manual.
- 1.6.3 Warranty Documentation: Submit copy of extended warranties specified in this Section.

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**1.7 QUALITY ASSURANCE**

- 1.7.1 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.

**1.8 DELIVERY, STORAGE AND HANDLING**

- 1.8.1 Product Requirements, generally: in accordance with Section 01 61 00, Common Product Requirements.
- 1.8.2 Deliver, store and handle appliances and equipment materials in accordance with manufacturer's written instructions.
- 1.8.3 deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.8.4 Store materials in off-ground, in clean, dry, well-ventilated area.
- 1.8.5 Replace defective or damaged materials with new.

**1.9 FIELD CONDITIONS**

- 1.9.1 Environmental Restrictions: Do not deliver or install appliances and equipment until building is enclosed, wet work is complete, and HVAC system is operational and will maintain temperature and relative humidity levels equal to occupancy levels for remainder of construction period.
- 1.9.2 Field Measurements: Verify actual dimensions of construction contiguous with appliances and equipment by field measurements before fabrication.

**1.10 Warranty**

- 1.10.1 Provide warranty covering the Work of this Section in accordance with Supplementary Condition SC49 / GC 12.3 WARRANTY.

**2 . PRODUCTS**

**2.1 MANUFACTURERS**

- 2.1.1 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

**2.2 PERFORMANCE / DESIGN CRITERIA**

- 2.2.1 Provide appliances with labels complying with CSA, cUL, CGA, and other standards required by authorities having jurisdiction.
- 2.2.2 Electrical Appliances: Must be listed and labelled to CSA C22.1 by a qualified testing agency.

- 2.2.3 Gas-Fueled Appliances: Must have CSA Blue Star mark.
- 2.2.4 Product Options: Where product is at Contractor's option, prefer appliances that qualify for the ENERGY STAR program.

### **2.3 APPLIANCES**

- 2.3.1 Refer to Equipment Schedule for list of appliances. Provide quantities, physical dimensions, colors, and electrical characteristics indicated.
- 2.3.2 For Owner-supplied appliances, refer to Division 01 for Owner's and Contractor's responsibilities.

## **3 . EXECUTION**

### **3.1 EXAMINATION**

- 3.1.1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.

### **3.2 INSTALLATION**

- 3.2.1 Installation, generally: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.
- 3.2.2 Unwrap, level, and support appliances. Install items square, plumb, and free from defects.
- 3.2.3 Securely anchor units to supporting construction with concealed fasteners.
- 3.2.4 Place free-standing units after finishes are complete; provide adequate clearances for operation.
- 3.2.5 Anti-Tip Devices: Install for each appliance according to manufacturer's written instructions.

### **3.3 START-UP SERVICE**

- 3.3.1 Perform operation tests on all equipment to ensure components, controls, safety devices, and attachments function correctly and as specified before final acceptance.

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**3.4     PROTECTION**

- 3.4.1 Protect appliances and equipment from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades.
- 3.4.2 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in writing by affected material's manufacturer. Do not use materials or process that can damage finishes, surfaces, or construction.
- 3.4.3 Promptly replace appliances and equipment work damaged during construction that cannot be satisfactorily repaired.

**3.5     CLEANING AND WASTE MANAGEMENT**

- 3.5.1 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
- 3.5.2 Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

**END OF SECTION**

**1 .        GENERAL**

**1.1        General Instructions**

- 1.1.1    Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2    Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only.

**1.2        Summary**

- 1.2.1    Provide labour, materials, products, equipment and services to complete the Facility Fall Protection work specified herein. This includes, but is not necessarily limited, to:
- .1    Design, supply and installation of fall protection equipment,
  - .2    Design, supply and installation of window washing equipment
  - .3    Auxiliary materials required for a complete installation.
- 1.2.2    Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

**1.3        References**

- 1.3.1    Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

**1.4        Administrative Requirements**

- 1.4.1    Pre-installation Meetings: Conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.
- 1.4.2    Sequence with other Work and Comply with window washing equipment manufacturer's written recommendations for sequencing construction operations.



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**1.5     Action Submittals**

- 1.5.1     Product Data: Submit product data in accordance with Division 01 for each type of product indicated on Drawings and Schedules. Include preparation requirements and application instructions.
- .1     Submit manufacturer's instructions, printed product literature and data sheets for the Facility Fall Protection work and include product characteristics, performance criteria, physical size, finish and limitations
- 1.5.2     Shop Drawings: Submit Shop Drawings in accordance with Division 01
- .1     Submit shop drawings showing complete layout and configuration of window cleaning and suspended maintenance system, including components and accessories. Clearly indicate design and fabrication details, hardware, and installation details.
- .2     Include installation and rigging instructions and:
- .1     Required restrictive working usage and general safety notes.
- .2     Non-restrictive working usage and general safety notes.
- .3     Submit Shop Drawings including analysis data, complying with performance requirements and design criteria, signed and sealed by the Professional Engineer licensed to practice in the Province of Ontario responsible for their preparation.

**1.6     Information Submittals**

- 1.6.1     Quality Assurance Submittals:
- .1     Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
- .2     Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3     Submit manufacturer's installation instructions and manufacturer's field reports specified in this Section.

**1.7     Closeout Submittals**

- 1.7.1     Submit standard manufacturer warranty documents specified.
- 1.7.2     Operation and Maintenance Data: Submit Operation and Maintenance data for installed products in accordance with Division 01.
- .1     Include:
- .1     Manufacturer's instructions covering maintenance requirements and parts catalog giving complete list of

repair and replacement parts with cuts and identifying numbers.

- .2 One copy of system Equipment Manual & Inspection Log Book, with "Initial Inspection - Certification for Use" and "Inspection Sign-Off" forms completed.
- .3 Two copies of reduced, laminated "as-built shop drawing" showing equipment locations and details. Ensure drawing is posted adjacent exits to roof.

## **1.8 Quality Assurance**

### **1.8.1 Qualifications:**

- .1 Installer: experienced (minimum two years experience) in performing work of this section who has specialized in installation of work similar to that required for this project.
- .2 Manufacturer: capable of providing field service representation during construction and approving application method.
  - .1 Ensure manufacturer has minimum five years experience in manufacturing fall protection, window washing and suspended equipment system components similar to or exceeding requirements of project.
  - .2 Manufacturer's Insurance: Ensure manufacturer carries liability insurance as noted in the Owner's supplementary conditions.
- .3 Welding: to be executed by certified welders in accordance with CSA W59 and CSA W47.2 requirements.

1.8.2 Single Source Responsibility: Ensure materials specified herein are provided by a single manufacturer to ensure sole source responsibility.

## **1.9 Delivery, Storage And Handling**

1.9.1 Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.

### **1.9.2 Delivery:**

- .1 Deliver materials in manufacturer's original packaging with identification labels intact and in sizes to suit project.

### **1.9.3 Storage and Protection:**

- .1 Store materials protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.

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**1.10 Project Conditions**

1.10.1 Installation Location: Assemble and erect components only when temperatures are above 5 deg C (40 deg F)

**1.11 Warranty**

1.11.1 Provide warranty covering the Work of this Section in accordance with Supplementary Condition SC49 / GC 12.3 WARRANTY.

**2 . PRODUCTS**

**2.1 Manufacturers**

2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.

- .1 Ankor Engineering Systems Inc.;
- .2 Atlas Anchor Systems Ltd.;
- .3 Pro-Bel Enterprises Limited;
- .4 SSI – Suspended Stages;
- .5 Thaler Metal Industries Ltd

2.1.2 Basis-of-Design: This Specification is based on Products by Pro-Bel Enterprises. Comparable systems from manufacturers listed herein offering functionally equivalent Products will be considered provided they meet the requirements of this Specification.

2.1.3 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

**2.2 Regulatory Requirements**

2.2.1 Comply with Ontario Building Code, specifically clause 4.4.4.1. Anchor Systems on Building Exterior (to be provided where any portion of the roof is more than 8 m (26'-3") above adjacent ground level).

2.2.2 Comply with the requirements of the Occupational Health and Safety Act (O/reg 59/90 as amended by 523/92, and O/reg 213/91 as amended by 631/94).

**2.3 Design Performance Requirements**

2.3.1 Subcontractor awarded work of this Section is responsible for structural and performance design, fabrication and installation of facility fall protection in compliance with requirements of the Contract Documents, applicable codes at time of award and ordinance and requirement of local officials.

- 2.3.2 Facility fall protection design is based on mutually agreed upon design and details as submitted by Subcontractor for final review by Consultant. Drawings covering work of this Section show design intent and are diagrammatic in nature. Drawings also show some general building standards for tying into adjacent building trades, which are to be completed and coordinated by this Section. In addition to Specification requirements, final design and performance of facility fall protection and approval by authorities having jurisdiction is responsibility of this Section.
- 2.3.3 Professional Engineering Design and Certification: Design facility fall protection systems, including comprehensive engineering analysis by a Professional Engineer licensed to practice in the Province of Ontario, in accordance with requirements of Ontario Building Code, and using performance requirements and design criteria indicated on Drawings and Schedules in this Section.
- 2.3.4 Seismic Performance: Provide products and systems specified in this Section to withstand the effects of earthquake motions in accordance with OBC 4.1.8.18 and CAN/CSA S832.
- .1 Professional engineer specified in Division 01 and referenced in this Section shall be responsible for designing systems and submitting signed and sealed analysis data and Shop Drawings illustrating seismic-resistant systems.
  - .2 Refer to Structural Drawings for seismic sensitivity values.
- 2.3.5 Design, install and test system in conformance with CAN/CSA-Z91, CAN/CSA 271 and CAN/CSA Z259 Series and ensure anchor components and equipment supports comply with the following structural requirements:
- .1 Fall Arrest Safety Anchors: designed to a maximum fall arresting force of typically 8.0 kN (1800 lbs) when wearing a body harness with a safety factor of 2 without any permanent deformation and to 22.24 kN (5000 lbs) against fracture or detachment.
- 2.3.6 Steel design to conform to CAN/CSA-S16.1 and CSA S136.
- 2.3.7 Locate anchorages to suit suspension equipment that will be used on building with respect to items such as reach, spacing, roof edge condition and similar items.

## **2.4 Materials**

- 2.4.1 Stainless Steel: ASTM A167, Type 304. Flashings, coverings and casing shall be stainless steel. Stainless steel components, Type 316.
- 2.4.2 Welding Materials: CSA W48.1-M and CSA W59-M.

- 2.4.3 Galvanized Steel Components: Carbon steel to CSA G40.21, Grade 300W, hot dipped after fabrication and with zinc chromate coating to CAN/CGSB-1.132-M applied over zinc.
- 2.4.4 Steel Components: CSA G40.21, Type 300W.
- 2.4.5 Bolts, Nuts and Washers: Stainless steel conforming to ASTM A325M.

## **2.5 Safett And Tie-Back Anchors**

- 2.5.1 Safety U-bars: Type 304 stainless steel with yield strength of 240 MPa (35 Ksi). U-bar to be not less than 19 mm (3/4") diameter material with 38 mm (1-1/2") eye opening.
- 2.5.2 Securement bolts: mild steel, Type 300W with yield strength of 300 MPa (44 Ksi), hot dipped galvanized to CSA G164.
- 2.5.3 Hollow steel section (HSS) piers: mild steel, Type 300W with yield strength of 350 MPa (50 Ksi). Wall thickness to suit application, hot dipped galvanized to CSA G164.
- 2.5.4 Base plate and all other sections: galvanized mild steel with yield strength of 300 MPa (44 Ksi). Thickness and securement to suit application.
- 2.5.5 Seamless spun aluminum flashing (for steel pier anchors): Type 6061-T6 alloy to ASTM B221 with deck flange flashed to CRCA recommendations. Seal top of aluminum flashing with conformable mastic tape and torch applied heat-shrink rubber collar flashing.
- 2.5.6 Miscellaneous bolts, nuts and washers: mild steel, Type 300W with yield strength of 300 MPa (44 Ksi), hot dipped galvanized to CSA G164 or Type 304 stainless steel with yield strength of 240 MPa (35 Ksi).

## **2.6 Horizontal Lifeline System**

- 2.6.1 Cable: 8 mm (5/16") dia, Type 316 stainless steel with minimum breaking strength of 85 kN (19,125 lbs.), complete with permanently swaged cable ends.
- 2.6.2 Data Plate: cable system entry points to be equipped with prominently displayed non-corrosive data plate clearly stating Maximum Service Capacity and Number of Users.
- 2.6.3 Standard Intermediate support brackets: multi-position Type 316 stainless steel with reinforcing end caps and suitable for installation at any height. Secured using 13 mm (1/2") dia. fasteners.
- 2.6.4 Mobile Intermediate support brackets: multi-position, Type 316 stainless steel for working both sides of sloped roof at ridge point.

- 2.6.5 Corner units: manufacturer's standard 90 deg or 135 deg flexible corner units as required.
- 2.6.6 End terminal hardware: stainless steel swaged termination at one end and stainless steel tensioner with shock absorber at other end, as required.
- 2.6.7 Lanyard cable runner: Type 316 stainless steel with automatic runner bypass for continuous "hands-free" operation that can be inserted or removed anywhere on the cable.
- 2.6.8 Harness: manufacturer's standard "hands-free" full body harness and lanyard complete with shock absorber.

## **2.7 Davits**

- 2.7.1 Davit Booms: rigged, aluminum sections of engineered length and size to suit application, equipped with: carrying handles; stainless steel rolling trolley on outboard end, designed to carry 1000 lbs (4.5 kN) vertical service load, minimum.
  - .1 Ensure non-corrosive UV resistant data plate stating Maximum Service Capacity of boom, Manufacturer's Name, Serial No., Manufacturing Date, rated load and other pertinent information is prominently displayed.
- 2.7.2 Davit Masts: Round tubular steel section capable of rotating through 360° with carrying handles and connecting pins.
- 2.7.3 Davit Arms: Davits to be demountable, portable, capable of being easily and quickly broken down into pieces weighing 80 lbs (36.3 kg) maximum.
  - .1 Ensure davit arm booms equipped with rolling trolleys or friction trolleys have stops to prevent detachment from boom. Provide hoisting winches and dolly wheels.
- 2.7.4 Davit Bases: Round, mild steel, hollow section piers, Type 350W with 50 Ksi (350 MPa) minimum yield strength, hot dipped galvanized to ASTM A123/A123M with 0.75 inches (19 mm) diameter U-bar safety anchor, and securement to suit application.
- 2.7.5 Acceptable Material: Pro-Bel Group, Davit System

## **3. EXECUTION**

### **3.1 Manufacturers Instructions**

- 3.1.1 Compliance: Comply with manufacturer's written data, including product technical bulletins, product catalog installation instructions and technical data sheets.

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**3.2     Examination**

3.2.1     Site Verification of Conditions:

- .1     Verify that substrate conditions which have been previously installed under other sections or contracts, are acceptable for product installation in accordance with manufacturer's instructions prior to installation of equipment.
- .2     Inform Consultant of unacceptable conditions immediately upon discovery.
- .3     Proceed with installation only after unacceptable conditions have been remedied.

**3.3     Preparation**

- 3.3.1     Ensure structure or substrate is adequate to support complete equipment system.
- 3.3.2     Ensure structural steel to receive safety anchors has adequate bearing surface as indicated on shop drawings and has 100% welds between anchors and structural steel.

**3.4     Installation**

- 3.4.1     Coordinate equipment work with work of other trades, for proper time and sequence to avoid construction delays.
- 3.4.2     Install equipment plumb and level in accordance with manufacturer's written instructions.
- 3.4.3     Accurately fit and align, securely fasten and install free from distortion or defects.
- 3.4.4     Deform threads of tail end of anchor studs after nuts have been tightened to prevent accidental removal and vandalism.
- 3.4.5     At anchor locations, *Provide* seamless flashings. Fabricate flashings to suit roofing conditions. Seal top of anchor with 1-piece watertight cap. Rubber gaskets, grommets and "pitch pans" are not permitted.
- 3.4.6     Coordinate fall arrest anchor system installation with roofing and flashing Work specified under roofing Section. Ensure integrity of roofing and flashing systems.
- 3.4.7     Seal between assemblies and adjacent materials to ensure watertight installations. Do sealing Work in accordance with Section 07 92 00.
- 3.4.8     Track Works: Install tracks straight, true and level, with 0.125 inches (3 mm) maximum step deviation and in accordance with manufacturer's written instructions

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**3.5     Field Quality Control**

- 3.5.1     Manufacturer's Field Services: Have manufacturer's technical representative schedule site visits to review work as follows:
- .1     After delivery and storage of products.
  - .2     When preparatory work for which work of this Section depends is complete, but before installation begins.
  - .3     during progress of work at 25% and 60% of completion.
  - .4     Upon completion of work, after cleaning is carried out.
- 3.5.2     Testing: Test on site 100% of all anchors using load cell test apparatus in accordance with manufacturer's written recommendations and CSA requirements.
- 3.5.3     Complete "Initial Inspection - Certification for Use" form included in Equipment Manual and Inspection Log Book provided by manufacturer.

**3.6     Final Cleaning**

- 3.6.1     Do cleanup in accordance with Division 01.
- 3.6.2     Upon completion, remove surplus and excess materials, rubbish, tools and equipment.

**3.7     Protection**

- 3.7.1     Protect installed product from damage during construction in accordance with Division 01.
- 3.7.2     Make good damage to adjacent materials caused by equipment installation.

**3.8     Maintenance And Cleaning**

- 3.8.1     Train Owner's personnel in the use of the fall arrest anchor system under Division 1 requirements.

END OF SECTION



## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Waste Compactors And Destructors work specified herein. This includes, but is not necessarily limited, to:
- .1 One-cylinder baling system and associated safety equipment.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only.
- .1 Division 26 Sections for electrical service connections.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Submittals**

- 1.4.1 Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.
- .1 Submit manufacturer's instructions, printed product literature and data sheets for the Waste Compactors And Destructors work and include product characteristics, performance criteria, physical size, finish and limitations
- 1.4.2 Shop Drawings: Drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
- .1 Roughing-in dimensions, service connection details, and locations of field connections.
  - .2 Required clearances for equipment service and operation.
  - .3 Setting drawings, templates, and directions for installing anchor bolts and other anchorages.

1.4.3 Maintenance Data: Submit maintenance data in accordance with Division 01 for baling systems to include in maintenance manuals. In addition to items specified in Section 01 78 00, Closeout Submittals, include the following:

- .1 Operating and maintenance instructions.
- .2 Parts inventory list.
- .3 Purchase source for operating and maintenance materials.
- .4 Emergency information.
- .5 Name, address, and telephone number of manufacturer's service representative whose location is nearest to Project site.

## **1.5 Quality Assurance**

1.5.1 Manufacturer Qualifications: Manufacturer must have a minimum of 5 years of experience producing baling systems of similar scope and complexity.

1.5.2 Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

- .1 Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

1.5.3 Electrical Components, Devices, and Accessories: Listed and labeled as defined in CSA C22 SERIES by a testing agency acceptable to authorities having jurisdiction.

## **1.6 Delivery, Storage, and Handling**

1.6.1 Delivery: Deliver materials in manufacturer's original packaging, with labels intact.

1.6.2 Storage: Store baling system components in a dry, protected area to prevent damage or deterioration.

1.6.3 Handling: Handle materials with care to avoid damage.

## **1.7 Maintenance Service**

1.7.1 Initial Maintenance Service: Beginning at Substantial Performance of the Work, provide 12 months' full maintenance by skilled employees of baling system Installer.

- .1 Schedule regular surveillance and preventive maintenance visits at seven-day intervals for three months and at one-month intervals for nine months.
- .2 Repair or replace worn or defective components; and lubricate, clean, and adjust equipment as required for proper equipment operation. Use replacement parts and

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maintenance supplies that were used in the manufacture and installation of the original equipment.

**1.8     Warranty**

- 1.8.1 Provide warranty covering the Work of this Section in accordance with Supplementary Condition SC49 / GC 12.3 WARRANTY.

**2 .     PRODUCTS**

**2.1     Manufacturers**

- 2.1.1 Basis-of-Design: Materials specified in this Section are based on "Baler 1050" as supplied by MDA Compaction.
- 2.1.2 Substitutions: Refer to Section 01 25 00.

**2.2     Baling System**

- 2.2.1 Certifications: Baling system must be certified under CSA C22.2 NO. 14-05 and UL 508A standards.
- 2.2.2 Description: Manufacturer's standard vertical packaged units with components, options, and accessories needed to comply with requirements and provide complete functional systems.
- 2.2.3 Dimensions:
- .1 Baler Dimensions: 1395 mm x 1395 mm x 2591 mm (52-5/8" W x 93" H x 139-5/8" D).
  - .2 Bale Size: 1524 mm W x 1219 mm H x 762 mm D (60" W x 48" H x 30" D).
  - .3 Bale Weight: Up to 1000 lbs.
- 2.2.4 Key Features:
- .1 Mobility: System can be moved with a pallet truck.
  - .2 Bale Ready Light: Integrated indicator light for bale readiness.
  - .3 Control Panel: Includes QR code linking to video tutorials, electrical, and hydraulic diagrams.
  - .4 Loading Door: Equipped with bearings for smooth operation and automatic opening at the end of the cycle.
  - .5 Submerged Pump: Operates at a noise level of 85 dB.
  - .6 PowerPak: Mounted on hinges for easy access.
  - .7 Interchangeable Parts: All moving parts are removable and compatible with balers from the same series, regardless of size.
- 2.2.5 Bullpen:
- .1 Function: Mobile belt that secures the bale ejection area.

- .2 Operation: Magnetic contact prevents ejection unless the Bullpen is lowered.

2.2.6 Bullguard:

- .1 Function: Automatic barrier protecting the operator during bale ejection.
- .2 Operation: Repositions automatically when the ejection door opens.

2.2.7 Bullhorn:

- .1 Function: Prevents ram from subsiding during door opening.
- .2 Safety Mechanism: Interlocks with the ram, with three devices to ensure stability.

2.2.8 Safety Management System:

- .1 Certification: CSA approved, compliant with CAT.III safety standards.
- .2 Features: Includes a safety relay that monitors electrical operations to prevent system bypassing.

2.2.9 Automatic Bale Ejection: System activates upon door opening.

2.2.10 Wire Guides: Provides alignment for wire placement.

2.2.11 Heating Element: Heats oil and control box for outdoor operations during winter.

**2.3 Fabrication**

2.3.1 Fabricate baling systems with smooth, eased exposed edges.

2.3.2 Fabricate bins, hoppers, chutes, compaction chambers, unit bodies, and similar components of steel plate with welded joints. Reinforce with structural-steel members sized and spaced to withstand impacts and pressures of normal operations and to prevent excessive long-term development of waves and valleys.

2.3.3 Fabricate equipment with replaceable parts at points of normal wear.

2.3.4 Provide electrical devices, controls, and materials of type and quality recommended by NEMA for applications indicated on Drawings and Schedules. See Division 26 Sections for power characteristics and service to equipment, including disconnect switches.

**3. EXECUTION**

**3.1 Examination**

3.1.1 Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, clearance

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requirements, service rough-ins, and other conditions affecting performance of work.

- .1 Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2     Installation**

- 3.2.1 Set baling systems level, plumb, properly aligned, and securely in place. Anchor as required for secure operation.
- 3.2.2 Complete field assembly with joining methods recommended in writing by manufacturer.
- 3.2.3 Connect electrical components as specified in Division 26. Ensure compliance with CSA and UL standards.

**3.3     Start-up**

- 3.3.1 Test baling system, including safety features, to confirm proper operation.

**3.4     Adjustments And Cleaning**

- 3.4.1 Adjustments: Make necessary adjustments to ensure the system operates smoothly.
- 3.4.2 Cleaning: Clean baler and surrounding area after installation.

**3.5     Demonstration**

- 3.5.1 Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain baling systems. Refer to Section 01, Demonstration and Training.

END OF SECTION

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**1. GENERAL**

**1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

**1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Roller Window Shades work specified herein. This includes, but is not necessarily limited, to:
- .1 Manually operated roller shades
  - .2 Motor-operated roller shades.
  - .3 Shadeband materials.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.
- .1 Related requirements provided below are for convenience purposes only.
    - .1 Section 06 10 00, Rough Carpentry for wood blocking and grounds for mounting roller shades and accessories.
    - .2 Section 07 92 00, Joint Sealants for sealing the perimeters of installation accessories for light-blocking shades with a sealant.

**1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

**1.4 Action Submittals**

- 1.4.1 Product Data: Submit product data in accordance with Division 01 for the following:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for the Roller Window Shades work and include product characteristics, performance criteria, physical size, finish and limitations.

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- .2 Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.
    - 1.4.2 Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.
      - .1 Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.
    - 1.4.3 Samples: Submit samples in accordance with Division 01 for each exposed product and for each colour and texture specified, 250 mm (10 inches) long.
    - 1.4.4 Samples for Verification: Submit samples of verification in accordance with Division 01 for each type of roller shade.
      - .1 Shadeband Material: Not less than 76 mm (3 inches) square. Mark inside face of material if applicable.
      - .2 Installation Accessories: Full-size unit, not less than 250 mm (10 inches) long.
    - 1.4.5 Roller-Shade Schedule: Use same designations indicated on Drawings.
  - 1.5 **Closeout Submittals**
    - 1.5.1 Maintenance Data: Submit maintenance data in accordance with Division 01 for roller shades to include in maintenance manuals.
  - 1.6 **Maintenance Material Submittals**
    - 1.6.1 Supply extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
      - .1 Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, colour, and shadeband material indicated on Drawings and Schedules, but no fewer than two units.
  - 1.7 **Quality Assurance**
    - 1.7.1 Installer Qualifications: Fabricator of products.
    - 1.7.2 Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
      - .1 Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Consultant specifically approves such deviations in writing.

- .2 Reviewed mockups may become part of the completed Work if undisturbed at time of Substantial Performance of the Work.

**1.8 Delivery, Storage, And Handling**

- 1.8.1 Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

**1.9 Field Conditions**

- 1.9.1 Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- 1.9.2 Field Measurements: Where roller shades are indicated on Drawings and Schedules to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Consultant of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

**1.10 Warranty**

- 1.10.1 Provide warranty covering the Work of this Section in accordance with Supplementary Condition SC49 / GC 12.3 WARRANTY.

**2 . PRODUCTS**

**2.1 Manufacturers**

- 2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.
  - .1 Altex/SunProject;
  - .2 Draper Inc.
  - .3 Elite Window Fashions
  - .4 Hunter Douglas Contract.
  - .5 Lutron Electronics Co., Inc.
  - .6 Silent Gliss USA, Inc.
  - .7 Solarfactive® Legrand.
- 2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.



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**2.2 Regulatory Requirements**

- 2.2.1 Roller shades specified in this Section must conform to the Corded Window Coverings Regulations (SOR /2019-97) under the Canada Consumer Product Safety Act and ANSI/WCMA A100.1-2018, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

**2.3 Performance/Design Criteria**

- 2.3.1 Provide manually-operated roller window shade systems that provide easy lifting, finger-tip control, with infinite positioning so shade can stop and hold at any position within window opening. Provide limit stops to prevent shade from being raised or lowered too far.
- 2.3.2 System must be designed to operate without reachable chains. Where chains are provided, they must not exceed 40% of total shade length, and must be provided with a chain-retainer secured to window jambs or sills. In residential buildings (houses and condominiums), chains must not exceed 220 mm.
- 2.3.3 Design systems such that removal does not require disassembly of entire shade unit.
- 2.3.4 Provide units consisting of factory assembled roller window shade units with end brackets, shade roller tubes, extruded fasciae, hembars, fabrics, fastenings, anchorages and accessories specified and required. Treat steel elements for corrosion resistance.
- 2.3.5 Provide roller tube that operates smoothly and of sufficient diameter and thickness to prevent excessive deflection.
- 2.3.6 Motorization:
- .1 Electrical Components must be listed and labeled in accordance with CSA C22.1, validated by a Nationally Recognized Testing Laboratory (NRTL), and tested to the Canadian Electrical Code and National Electrical code standards. Approved certifications are CSA, UL and ULC.
  - .2 Motors: Manufacturer's standard tubular type, enclosed in roller assembly capable of accommodating total shade width, drop and weight capacity.
    - .1 Unless indicated otherwise, provide motors that are line voltage 120V AC 60Hz, or low voltage 24V DC hardwired, wired into power enclosures for low voltage or into building electrical system for line voltage. In renovation projects, provide systems that plug into standard AC electrical outlets that are concealed from view. Battery-operated systems are not acceptable.

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- .2 When required supply low voltage data cable wiring from motor controls to network intelligent motors. Coordinate operator wiring requirements, wiring scope of work and electrical characteristics with building electrical system to be managed by general contractor.
  - .3 Motors must be capable of operating at or below 45 dBA when measured at 915 mm (3 ft) from center of shade. There must be no audible clicks when motors start and stop.
  - .4 Provide mechanical or encoder based adjustable limit switches, interlocked to motor controls and set to automatically stop motion of shades when shades are fully raised or lowered.
  - .3 Shade Controls: Final shade operation will be confirmed during Shop Drawing review.
    - .1 Motorized roller window shades must be able to be controlled by wall-mounted individual/group switches or remote controls.
    - .2 For shade controls, coordinate operator wiring requirements, wiring scope of work and electrical characteristics with building electrical system to be managed by general contractor.
    - .3 System must be capable of being connected to Building Automation Systems, low voltage lighting control system, timer controls, sun sensor controls, or AV control system. To be determine during shop drawing review.
    - .4 System must provide interface to communicate with both wired and wireless inputs.
  - .4 Acceptable Motorization Manufacturer: Somfy Systems, Inc. or approved equivalent.
  - 2.3.7 Where motorized shades are provided in the Project, ensure manual roller window shades match motorized roller window shades in appearance and quality.
  - 2.3.8 Fabrics:
    - .1 Provide shade fabric that hangs flat without buckling or distortion. When trimmed, edges must be straight without ravelling. Unguided roller shade cloth must roll true and straight without shifting sideways more than 3 mm (1/8") in either direction due to wrap distortion or weave design.
    - .2 Flame Retardance of fabric: certified by an independent laboratory to pass the Small Scale Vertical Burn

Requirements of CAN/ULC S109 or NFPA 701, small scale test.

- .3 Provide fabrics complying with CDPH Standard Method for VOC Emissions (California Specification 01350) for indoor air quality requirements in accordance with UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or other third-party certification agency.

## **2.4     Single-Roller Manually Operated Shades**

- 2.4.1 Material Tag: This item is noted as "RS-1" on Drawings and Schedules.
- 2.4.2 Spring Operating Mechanisms: Roller contains spring sized to accommodate shade size indicated on Drawings and Schedules. Provide with positive locking mechanism that can stop shade movement at each half-turn of roller and with manufacturer's standard pull.
  - .1 Pole: Manufacturer's standard type in length required to make operation convenient from floor level and with hook for engaging pull.
- 2.4.3 Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated on Drawings and Schedules without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
  - .1 Roller Drive-End Location: As indicated on reviewed Shop Drawings.
  - .2 Direction of Shadeband Roll: Reverse, from front of roller.
  - .3 Shadeband-to-Roller Attachment: Manufacturer's standard method.
- 2.4.4 Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated on Drawings and Schedules.
- 2.4.5 Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.
- 2.4.6 Shadebands:
  - .1 Shadeband Material: Light-filtering fabric.
  - .2 Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
    - .1 Type: Exposed with endcaps.

- .2 Colour and Finish: As selected by Consultant from manufacturer's full range.

2.4.7 Installation Accessories:

- .1 Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
  - .1 Height: Manufacturer's standard height required to conceal roller and shadeband when shade is fully open, but not less than 102 mm (4 inches).
- .2 Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.
  - .1 Height: Manufacturer's standard height required to enclose roller and shadeband when shade is fully open, but not less than 76 mm (3 inches).
- .3 Endcap Covers: To cover exposed endcaps.
- .4 Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.
  - .1 Height: Manufacturer's standard height required to enclose roller and shadeband when shade is fully open, but not less than height indicated on Drawings.
  - .2 Provide pocket with lip at lower edge to support acoustical ceiling panel.
- .5 Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.
- .6 Side Channels: With light seals and designed to eliminate light gaps at sides of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning shadebands with channels at tops.
- .7 Bottom (Sill) Channel or Angle: With light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.
- .8 Installation Accessories Colour and Finish: As selected from manufacturer's full range.

**2.5 Double-Roller Manually Operated Shades**

- 2.5.1 Material Tag: This item is noted as "RS-2" on Drawings and Schedules.

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- 2.5.2 Crank-and-Gear Operating Mechanisms: Sealed gearbox drive system controlled by crank handle.
    - .1 Crank-Handle Type: Detachable.
    - .2 Crank-Handle Length: Manufacturer's standard.
  - 2.5.3 Spring Operating Mechanisms: Roller contains spring sized to accommodate shade size indicated on Drawings and Schedules. Provide with positive locking mechanism that can stop shade movement at each half-turn of roller and with manufacturer's standard pull.
    - .1 Pole: Manufacturer's standard type in length required to make operation convenient from floor level and with hook for engaging pull.
  - 2.5.4 Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated on Drawings and Schedules without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
    - .1 Double-Roller Mounting Configuration: Side by side or Offset, outside roller over and inside roller under as noted on Drawings.
    - .2 Shadeband-to-Roller Attachment: Manufacturer's standard method.
  - 2.5.5 Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller mounting configuration, roller assemblies, operating mechanisms, installation accessories, and installation locations and conditions indicated on Drawings and Schedules.
  - 2.5.6 Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.
  - 2.5.7 Inside Shadebands:
    - .1 Shadeband Material: Light-filtering fabric.
    - .2 Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
      - .1 Type: Exposed with endcaps.
      - .2 Colour and Finish: As selected by Consultant from manufacturer's full range.
  - 2.5.8 Outside Shadebands:
    - .1 Shadeband Material: Light-blocking fabric.
    - .2 Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
      - .1 Type: Exposed with endcaps.

- .2 Colour and Finish: As selected by Consultant from manufacturer's full range.

2.5.9 Installation Accessories:

- .1 Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
  - .1 Shape: L-shaped.
  - .2 Height: Manufacturer's standard height required to conceal roller and shadeband when shade is fully open, but not less than 76 mm (3 inches).
- .2 Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.
  - .1 Height: Manufacturer's standard height required to enclose roller and shadeband when shade is fully open, but not less than 102 mm (4 inches).
- .3 Endcap Covers: To cover exposed endcaps.
- .4 Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.
  - .1 Height: Manufacturer's standard height required to enclose roller and shadeband when shade is fully open, but not less than height indicated on Drawings.
  - .2 Provide pocket with lip at lower edge to support acoustical ceiling panel.
- .5 Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.
- .6 Side Channels: With light seals and designed to eliminate light gaps at sides of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning shadebands with channels at tops.
- .7 Bottom (Sill) Channel or Angle: With light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.
- .8 Installation Accessories Colour and Finish: As selected from manufacturer's full range.

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**2.6     Motor-Operated, Single-Roller Shades**

2.6.1 Material Tag: This item is noted as "RS-3" on Drawings and Schedules.

2.6.2 Motorized Operating System: Provide factory-assembled, shade-operator system of size and capacity and with features, characteristics, and accessories suitable for conditions indicated on Drawings and Schedules, complete with electric motor and factory-prewired motor controls, power disconnect switch, enclosures protecting controls and operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.

.1 Electrical Components: Listed and labeled as defined in CSA C22 Series, by a qualified testing agency, and marked for intended location and application.

.2 Electric Motor: Manufacturer's standard tubular, enclosed in roller.

.1 Electrical Characteristics: Provide motors that are line voltage 120V AC 60Hz, or low voltage 24V DC hardwired, wired into power enclosures for low voltage or into building electrical system for line voltage.

.3 Remote Control: Electric controls with NEMA ICS 6, Type 1 enclosure. Provide the following for remote-control activation of shades:

.1 Individual/Group Control Station: Maintained-contact, three-position, rocker-style, wall-switch-operated control station with open, close, and center off functions for individual and group control.

.2 Colour: As selected by Consultant from manufacturer's full range.

.4 Crank-Operator Override: Crank and gearbox operate shades in event of power outage or motor failure.

.5 Limit Switches: Adjustable switches interlocked with motor controls and set to stop shades automatically at fully raised and fully lowered positions.

.6 Operating Features:

.1 Group switching with integrated switch control; single faceplate for multiple switch cutouts.

.2 Capable of interface with multiroom control system.

.3 Capable of accepting input from building automation control system.

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- .4 Override switch.
  - 2.6.3 Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated on Drawings and Schedules without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
    - .1 Roller Drive-End Location: As indicated on reviewed Shop Drawings.
    - .2 Direction of Shadeband Roll: Regular, from back of roller.
    - .3 Shadeband-to-Roller Attachment: Manufacturer's standard method.
  - 2.6.4 Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated on Drawings and Schedules.
  - 2.6.5 Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.
  - 2.6.6 Shadebands:
    - .1 Shadeband Material: Light-filtering fabric.
    - .2 Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
      - .1 Type: Exposed with endcaps.
      - .2 Colour and Finish: As selected by Consultant from manufacturer's full range.
  - 2.6.7 Installation Accessories:
    - .1 Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
      - .1 Height: Manufacturer's standard height required to conceal roller and shadeband when shade is fully open, but not less than 102 mm (4 inches).
    - .2 Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.
      - .1 Height: Manufacturer's standard height required to enclose roller and shadeband when shade is fully open, but not less than 76 mm (3 inches).
    - .3 Endcap Covers: To cover exposed endcaps.



- .4 Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.
    - .1 Height: Manufacturer's standard height required to enclose roller and shadeband when shade is fully open, but not less than height indicated on Drawings.
    - .2 Provide pocket with lip at lower edge to support acoustical ceiling panel.
  - .5 Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.
  - .6 Side Channels: With light seals and designed to eliminate light gaps at sides of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning shadebands with channels at tops.
  - .7 Bottom (Sill) Channel or Angle: With light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.
  - .8 Installation Accessories Colour and Finish: As selected from manufacturer's full range.
- 2.6.8 Acceptable Motorization Manufacturer: Somfy Systems, Inc. or approved equivalent.

## **2.7 Shadeband Materials**

- 2.7.1 Shadeband Material Flame-Resistance Rating: Comply with NFPA 701 and CAN/ULC S109. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- 2.7.2 Shadeband materials shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- 2.7.3 Solar Control (Light-Filtering) Fabric (3% openness): Woven fabric, stain and fade resistant.
  - .1 Type: PVC-coated fiberglass (approximately 65% PVC-coated fiberglass; 35% fiberglass).
  - .2 Microbial Resistance, ASTM E2180 and ASTM G21: Pass.
  - .3 Thickness: Not less than 0.45 mm (0.0178 inches)
  - .4 Mesh Weight: Not less than 350 g/sq.m (10.3 oz/sq. yd)
  - .5 Openness Factor: 3 percent.

- .6 Colour: to be selected by Consultant.
  - .7 Use with: RS-1, RS-2, and RS-3
  - .8 Acceptable Products: "TexScreen 9103" by ALTEX or approved equivalent.
- 2.7.4 Blackout (Light-Blocking) Fabric (0% openness): Opaque fabric, stain and fade resistant.
- .1 Type: Polyester with foamed-acrylic backing (PVC-free).
  - .2 Microbial Resistance, ASTM E2180 and ASTM G21: Pass.
  - .3 Thickness: Not less than 0.75 mm (0.030 inches)
  - .4 Weight: Not less than 470 g/sq.m (13.83 oz/sq. yd)
  - .5 Colour: to be selected by Consultant.
  - .6 Use with: RS-2
  - .7 Acceptable Products: "Shearweave 7000" by Phifer or "Avila Twilight" by Mermet Corp. or approved equivalent.

## **2.8 Roller-Shade Fabrication**

- 2.8.1 Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
- 2.8.2 Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 23 deg C (74 deg F):
- .1 Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 6 mm (1/4 inch) per side or 13-mm (1/2-inch) total, plus or minus 3.1 mm (1/8 inch). Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 6 mm (1/4 inch), plus or minus 3.1 mm (1/8 inch).
  - .2 Outside of Jamb Installation: Width and length as indicated on Drawings and Schedules, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
- 2.8.3 Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible except as follows:
- .1 Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.

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### **3 . EXECUTION**

#### **3.1 Examination**

- 3.1.1 Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the Work.
- 3.1.2 Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 Roller-Shade Installation**

- 3.2.1 Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
  - .1 Opaque Shadebands: Located so shadeband is not closer than 51 mm (2 inches) to interior face of glass. Allow clearances for window operation hardware.
- 3.2.2 Electrical Connections: Connect motor-operated roller shades to building electrical system.

#### **3.3 Adjusting**

- 3.3.1 Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

#### **3.4 Cleaning And Protection**

- 3.4.1 Clean roller-shade surfaces after installation, according to manufacturer's written instructions.
- 3.4.2 Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Performance of the Work.
- 3.4.3 Replace damaged roller shades that cannot be repaired, in a manner approved by Consultant, before time of Substantial Performance of the Work.

#### **3.5 Demonstration**

- 3.5.1 Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION

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## **1. GENERAL**

### **1.1 General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Design-Build Contract and Subcontracts, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.

### **1.2 Summary**

- 1.2.1 Provide labour, materials, products, equipment and services to complete the Entrance Floor Grilles work specified herein. This includes, but is not necessarily limited, to:
- .1 Floor grilles
  - .2 Frames.
  - .3 Support system.
  - .4 Drain pans.
- 1.2.2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section.

### **1.3 References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

### **1.4 Coordination**

- 1.4.1 Coordinate size and location of recesses in concrete to receive floor grilles and frames.

### **1.5 Action Submittals**

- 1.5.1 Product Data: Submit product data in accordance with Division 01 for the following:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for the Entrance Floor Grilles work and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for entrance floor grilles and foot grilles.
- 1.5.2 Product Disclosure and Transparency:

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- .1 Environmental Product Declarations (EPD): When available, submit Product-specific Type III EPD or industry-wide (generic) EPD conforming to ISO 14025 or other recognized environmental product declaration framework.
  - .2 Material Ingredient Reporting: When available, submit documentation demonstrating chemical inventory of materials to at least 0.1% (1000ppm) and conforming to one of the following:
    - .1 Health Product Declaration open Standard,
    - .2 Cradle to Cradle v2 Basic level or Cradle to Cradle v3 Bronze level,
    - .3 International Living Future Institute Declare
    - .4 Other approved framework.
  - .3 When multiple Products are specified, give preference to Products with compliant documentation.
- 1.5.3 Shop Drawings:
- .1 Items penetrating floor grilles and frames, including door control devices.
  - .2 Divisions between grille sections.
  - .3 Perimeter floor moldings.
- 1.5.4 Samples: Submit samples in accordance with Division 01 for the following products, in manufacturer's standard sizes:
- .1 Floor Grille: Assembled section of floor grille.
  - .2 Frame Members: Sample of each type and colour.
- 1.6 Closeout Submittals**
- 1.6.1 Maintenance Data: Submit maintenance data in accordance with Division 01 for floor grilles and frames to include in maintenance manuals.
- 1.7 Field Conditions**
- 1.7.1 Field Measurements: Indicate measurements on Shop Drawings.
- 1.8 Warranty**
- 1.8.1 Provide warranty covering the Work of this Section in accordance with Supplementary Condition SC49 / GC 12.3 WARRANTY.

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## **2 . PRODUCTS**

### **2.1 Manufacturers**

2.1.1 Products from the following manufacturers may be acceptable for inclusion into The Work, provided they meet requirements of Contract Documents.

- .1 Balco, Inc.
- .2 Crowder, K. N. Manufacturing, Inc.
- .3 C/S Group.
- .4 Pawling Corporation; Architectural Products Division.

2.1.2 Substitution Limitations: In accordance with requirements of Section 01 25 00, Substitution Procedures.

### **2.2 Entrance Flooring, Generally**

2.2.1 Regulatory Requirements: Comply with applicable provisions in OBC and CSA B651

2.2.2 Slip Resistance: Provide materials having a minimum 0.6 coefficient of friction in accordance with ASTM D2047.

### **2.3 Stainless Steel Floor Grilles**

2.3.1 Provide manufacturer's standard floor-grille assemblies consisting of treads of type and profile indicated on Drawings and Schedules, interlocked or joined together by cross members, and with support legs (if any) and other components needed to produce a complete installation.

2.3.2 Structural Performance: Provide floor grilles and frames capable of withstanding the following loads and stresses:

- .1 Wheel load of 4.45 kN (1000 lb) per wheel.

2.3.3 Grille: Type 304 stainless steel, minimum 15.97 mm (5/8") deep, with electronically welded wires measuring 2.28mm (0.090") x 3.81mm (0.150") and spaced 3.68mm (0.145") apart.

2.3.4 Stainless Steel Finish: ASTM A480/A480M No. 4.

2.3.5 Frames: Provide manufacturer's standard frames of size and style for grille type.

2.3.6 Support System: Level Bed Applications: Provide manufacturer's standard, vinyl cushion support system.

2.3.7 Drain Pans: Provide manufacturer's standard, 1.52-mm (16 ga) thick, galvanized steel sheet drain pan. Coat bottom of pan with protective coating recommended by manufacturer.

2.3.8 Size: As noted on Drawings.

- 2.3.9 Basis-of-Design: "GridLine® G6" by Construction Specialties, Inc. or approved equivalent.

**2.4 Fabrication**

- 2.4.1 Shop fabricate floor grilles to greatest extent possible in sizes as indicated on Drawings and Schedules. Unless otherwise indicated on Drawings and Schedules, provide each grille as a single unit; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in grilles are necessary, space symmetrically and away from normal traffic lanes.
- 2.4.2 Fabricate frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.

**3 . EXECUTION**

**3.1 Examination**

- 3.1.1 Examine substrates and floor conditions for compliance with requirements for location, size, minimum recess depth, and other conditions affecting installation of floor grilles and frames.
- 3.1.2 Examine roughing-in for drainage piping systems to verify actual locations of piping connections before floor grille and frame and drain pan installation.
- 3.1.3 Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 Installation**

- 3.2.1 Install recessed floor grilles and frames and drain pans to comply with manufacturer's written instructions at locations indicated on Drawings and Schedules and with top of floor grilles and frames in relationship to one another and to adjoining finished flooring as recommended by manufacturer. Set floor-grille tops at height for most effective cleaning action. Coordinate top of floor-grille surfaces with doors that swing across grilles to provide clearance under door.

**3.3 Protection**

- 3.3.1 After completing frame installations, provide temporary filler of plywood or fiberboard in floor-grille recesses and cover frames with plywood protective flooring. Maintain protection until

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construction traffic has ended and Project is near Substantial  
Performance of the Work.

END OF SECTION



**1 .     General**

**1.1     General Instructions**

- 1.1.1 Read and conform to: The general provisions of the Contract, including General and Supplementary Conditions; and the requirements of Division 01 Specifications and any additional documents referred to in this Section.
- 1.1.2 Contractor is solely responsible for dividing the Work among Subcontractors and Suppliers. Consultant and Owner assume no responsibility to act as arbiters or to establish subcontract limits between Sections or Divisions of the Work. Any references to related work items contained in this Section are provided for convenience only.

**1.2     Summary**

- 1.2.1 Provide seismic control assemblies for operational and functional components including but not limited to following:
  - .1 Work in this Section includes supplying and installing complete seismic restraint systems for architectural components. Work in this Section may also include the seismic restraint design and/or equipment/product certifications to be submitted for review by the registered design professional.
  - .2 Architectural assemblies or components requiring seismic restraint include, but are not limited to, the following:
    - .1 nonstructural exterior wall components,
    - .2 interior partitions and infill walls,
    - .3 suspended ceiling assemblies and bulkheads,
    - .4 exit doors, and overhead doors,
    - .5 roof accessories, and similar components,
    - .6 wall-mounted components weighing more than 9 kg (20 lbs)
    - .7 Owner-supplied, Contractor-installed equipment,
    - .8 other components needing seismic restraints and listed in Contract Documents.
- 1.2.2 Related Requirements: Specifications throughout entirety of Divisions of this Project are directly applicable to this Section, and this Section is directly applicable to them.

**1.3     References**

- 1.3.1 Reference Standards: Unless otherwise indicated in this Section or the Building Code, the latest published editions of reference standards as of the Project's Bid Closing deadline apply. Refer to Section 01 42 19 for list of standards used in Specifications.

**1.4     Administrative Requirements**

- 1.4.1 Sequencing: Coordinate installation with the work of related Sections referenced herein.

.1 Prior to start of work, arrange for Project site meeting of parties associated with work of this Section.

- 1.4.2 Scheduling:

- .1 Prior to commencing work of this Section, arrange for manufacturer's technical representative to review with Contractor and Consultant procedures to be adopted and conditions under which work shall be performed. Inspect surfaces to determine adequacy of existing and proposed conditions.
- .2 Co-operate fully with other Subcontractors on the Work and promptly proceed with work of this Section as rapidly as job conditions permit.
- .3 Co-operate with those performing the work of other Sections for application of all miscellaneous specialties.
- .4 Supply items to be built-in in ample time to be incorporated into work of other Subcontractors, together with measurements and other information required for location of it.

**1.5     Submittals**

- 1.5.1 Product Data: Submit manufacturer's literature and data sheets for each type of material provided under this Section for Project in accordance with requirements of Division 01. Ensure data sheets provide required information including detailed instructions for installing as well as maintaining, preserving and keeping materials in clean and safe conditions. Provide adequate warning of maintenance practices or cleaning agents detrimental to specified materials.

- 1.5.2 Material Safety Data Sheets: Submit MSDS for inclusion in operation and maintenance manual without limitations for adhesives, sealants and any other material later designated by Consultant.

- 1.5.3 Shop Drawings: Submit in accordance with Division 01 and indicating following:
- 1.5.4 Submit complete seismic restraint design, consisting of calculations, restraint selection, installation details, and other documentation signed and sealed by Professional Engineer stipulated herein. Seismic restraint Shop Drawings shall be prepared and overseen by a Professional Engineer as specified herein experienced in designing seismic restraints for operational and functional components as required by the Authority Having Jurisdiction
- 1.5.5 Where walls, floors, slabs, or supplementary steel work is used for seismic restraint, submit details of acceptable attachment methods for equipment and components; including spacing, static loads, and seismic loads at all attachment and support points. Obtain approval of Consultant prior to installation.
- 1.5.6 Provide specific details of seismic restraints and anchors; include number, size, and locations for each piece of equipment; provide details of suspension supports and restraints for equipment hung from ceiling.

## **1.6 Quality Assurance**

- 1.6.1 Qualifications:
  - .1 Manufacturers:
    - .1 Provide work of this Section by a specialty consultant or equipment manufacturer designated to develop seismic restraint system and perform seismic calculations in accordance with requirements of OBC, standards stipulated herein and additional requirements particular to this Section.
    - .2 Ensure equipment manufacturer or specialty consultant specified herein designs, recommends, reviews, and supervises installation of proposed seismic restraint design and connection methods for entire Project, excluding work associated with Divisions 20, 21, 22, 23 & 26.
  - .2 Installers: Provide work of this Section executed by competent installers with minimum 5 years experience in the application of Products, systems and assemblies specified and with approval and training of the Product manufacturers.
- 1.6.2 Licensed Professionals: Employ a full time structural Professional Engineer registered in the Province of Ontario, carrying minimum

professional liability insurance as noted in the Owner's supplementary conditions to:

- .1 design the components of the work of this Section requiring structural performance,
- .2 be responsible for full assemblies and connections,
- .3 be responsible for determining sizes, yield strengths, gauge thicknesses and joint spacing to allow thermal movement and loading of components in accordance with applicable codes and regulations,
- .4 be responsible for production and review of Shop Drawings,
- .5 inspect the work of this Section during fabrication and erection,
- .6 stamp and sign each Shop Drawing,
- .7 provide site administration and inspection of this part of the Work, and
- .8 submit certificate validating seismic assessment and field review of this part of the Work

1.6.3 Single Source Responsibility: Ensure materials specified herein are designed and provided by a single seismic restraint manufacturer to ensure sole source responsibility for performance of seismic restraints used.

## **1.7 Delivery, Storage And Handling**

1.7.1 Delivery and Acceptance Requirements:

- .1 Comply with material manufacturer's ordering instructions and lead time requirements to avoid delays.

## **1.8 Warranty**

1.8.1 Provide warranty covering the Work of this Section in accordance with Supplementary Condition SC49 / GC 12.3 WARRANTY.

## **2 . Products**

### **2.1 Description**

2.1.1 Design and Performance Requirements:

- .1 Seismic Performance: Provide products and systems specified in this Section to withstand the effects of earthquake motions in accordance with OBC 4.1.8.18 and CAN/CSA S832.

**CONSTRUCTION OF THE  
DOCKSTEADER PRPS  
REPORTING STATION**

**13 48 50  
Seismic Control  
Assemblies For  
Operational And  
Functional Components**

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- .1 Professional engineer specified in Division 01 and referenced in this Section shall be responsible for designing systems and submitting signed and sealed analysis data and Shop Drawings illustrating seismic-resistant systems.
  - .2 Refer to Structural Drawings for seismic sensitivity values.
  - .2 Drawings covering work of this Section may show design intent and profiles that are diagrammatic in nature. Drawings may also show general building standards for seismic restraint of operational and functional components, which are to be completed and coordinated by this Section. Drawings are not intended to identify or solve completely problems of structural or seismic movements, assembly framing, engineering design, fixings and anchorages
  - .3 Requirements of this seismic restraint Section are in addition to other requirements specified elsewhere for the support and attachment of operational and functional components. Nothing on Contract Documents shall be interpreted as justification to waive requirements of this Section.
  - .4 In addition to Contract Documents requirements, final design and performance of seismic control and restraint assemblies of operational and functional components and their approval by Authorities Having Jurisdiction is the responsibility of the contractor performing the work of this Section.
  - .5 Design seismic restraint system and clearly indicate attachment points to building structure and design forces (in X, Y, and Z direction) at the attachment points in accordance with OBC for designated seismic hazard values for location of Project as listed in Supplementary Standard SB-1. Design anchorage in accordance with ACI 318, Appendix D.
  - .6 Provide attachment loading values to Professional Engineer specified herein for verification of attachment methods and building's structure ability to accept imposed loading. Base seismic restraint design on actual OFC data (dimensions, weight, center of gravity, and similar criteria) obtained from submittals or item manufacturers. Ensure that equipment manufacturer verifies that attachment points on equipment and components can accept combination of seismic loading and other loads imposed.
  - .7 Design seismic restraint system in accordance with OBC requirements and requirements of CAN/CSA S832 based non-exhaustively on the following:

- .1 Anticipated ground motion (including spectral response acceleration as defined by local codes and Authorities Having Jurisdiction);
- .2 Soil type in specific geographic area
- .3 Importance Factor of Building (i.e 1.5 for post-disaster buildings)
- .4 Specific element of component factor
- .5 Height factor
- .6 Element's or component's response modification factor
- .7 Element's or component's weight.
- .8 For each element or component identified herein determine seismic risk rating score (low, moderate or high) and provide mitigation and reduction procedures in accordance with CAN/CSA S832.
- .9 Include in seismic analysis calculated dead loads, static seismic loads, and capacity of materials utilized for connection of the equipment or system to building structure. Detail anchoring methods, bolt diameter, embedment and welded length. Ensure seismic restraint devices are designed to accept, without failure, forces through components or system's center of gravity.

## **2.2 Materials**

- 2.2.1 Provide manufacturer's standard recommended materials or proprietary systems for seismic bracing and restraint to meet requirements of local codes and Authorities Having Jurisdiction based on design and performance criteria stipulated herein. Provide materials with full published ratings, verified through third party testing and bearing OSHPD pre-approval for use in the State of California.

## **3 . Execution**

### **3.1 Examination**

- 3.1.1 Site Verification of Conditions: Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.

- 3.1.2 Evaluation and Assessment: Notify seismic restraint system manufacturer's representative prior to installing seismic restraint devices. Seek manufacturer's guidance regarding unusual installation procedures.

### **3.2     Installation**

- 3.2.1 Install seismic restraint systems in strict accordance with the manufacturer's written instructions and submittal data specified herein.
- 3.2.2 Ensure installation of seismic restraints do not cause change of position of OFCs resulting in detrimental stresses or misalignment.
- 3.2.3 Coordinate work with other trades to avoid rigid contact with building elements. Bring to attention of Consultant and structural consultant prior to installation, conflicts with other trades that may result in rigid contact with equipment due to inadequate space or other unforeseen conditions.
- 3.2.4 Install ceiling suspension and connections components ensuring hanger rods are not subject to bending in accordance with requirements of ASTM E580.
- 3.2.5 Do not brace seismic restraint system to 2 different structures, such as a wall and a ceiling.
- 3.2.6 Unless otherwise indicated by seismic consultant specified herein, Provide following seismic mitigation measures to following building elements:
- .1 Partitions:
- .1 In buildings with flexible structural frames, anchor partitions to only structural element, such as a floor slab, and separate such partition by physical gap from other structural elements.
- .2 Properly anchor masonry walls to the structure for restraint, so as to carry lateral loads imposed due to earthquake along with their own weight and other lateral forces.
- .2 Ceilings And Lighting Fixtures:
- .1 At regular intervals, laterally brace suspended ceilings against lateral and vertical movements, and provide with a physical separation at the walls.
- .2 Independently support and laterally brace lighting fixtures. Refer to applicable portion of lighting Specifications.

.3 Facades And Glazing:

- .1 Do not install concrete masonry unit filler walls in a manner that can restrain the lateral deflection of the building frame. Provide a gap with adequately sized resilient filler to separate the structural frame from the non-structural filler wall.
- .2 Tie brick veneers to a separate wall that is independent of the steel frame as shown on construction drawings to ensure strength against applicable seismic forces at the project location.
- .3 Install attachments to structure for all façade materials as shown on construction drawings to ensure strength against applicable seismic forces at the project location.

.4 Storage Racks, Cabinets, And Bookcases:

- .1 Install storage racks to withstand earthquake forces and anchored to the floor or laterally braced from the top to the structural elements.
- .2 Anchor filing cabinets that are more than 2 drawers high to the floor or walls, and equip all drawers with properly engaged, lockable latches.
- .3 Anchor bookcases that are more than 30 inches high to the floor or walls, and equip any doors with properly engaged, lockable latches.

**3.3 Field Quality Control**

3.3.1 Manufacturers' Field Services:

- .1 Upon completion of installation of seismic restraint system, have manufacturer's local representative inspect completed system and report in writing any installation errors, improperly selected seismic devices, or other faults which could affect system performance. Perform corrective measures until final approval is granted at no additional cost to Owner.
- .2 Submit, upon request by Consultant, letter of certification signed by Professional Engineer specified herein, substantiating that seismic restraint materials have been properly installed.

**3.4 Cleaning**

- 3.4.1 Upon completion of installation of seismic restraint materials and before Substantial Performance of the Work, clean debris beneath



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OFCs and leave the Place of the Work in a clean and acceptable condition.

End of Section

**1. GENERAL****1.1 General instructions****1.1.1 Read and conform to:**

- .1 Division 1 requirements and documents referred to therein.

**1.2 Scope****1.2.1 Provide labour, materials, products, equipment and services necessary for the:**

- .1 Supply and installation of a single machine-room-less traction passenger elevator and as specified in Section 14 21 23.
- .2 Maintenance of the elevators in accordance with Section 14 01 20 until one year following Substantial Performance of the installation.

**1.3 Maintenance: warranty period****1.3.1 Provide labour, materials, products, equipment and services necessary for the maintenance of the elevating devices in accordance with Section 14900.****1.3.2 This maintenance to begin at Substantial Performance and end 12 months after Substantial Performance.****1.3.3 Costs for this maintenance are to be included in the project costs.****1.4 Definitions of terms****1.4.1 The term "Owner" as used herein, refers to Region of Peel.****1.4.2 The term "architect", as used herein, refers to Diamond Schmitt Architects.****1.4.3 The term "consultant", "elevator consulting engineer", "consulting engineer" or "engineer", as used herein, refers to KJA Consultants Inc.****1.4.4 The term "elevator contractor" or "contractor", as used herein, refers to any person, partners, firm or corporation having a contract with the Owner to furnish labour and materials for the execution of the work herein described.****1.4.5 The term "sub-contractor", as used herein, refers to any person, partners, firm or corporation having a contract with the contractor to furnish labour and materials for the execution of the work herein described.****1.4.6 The term "inspecting authorities", as used herein, refers to authorized agents of governments and of insurance groups which are charged with the responsibility of carrying out periodic inspections and tests on vertical transportation equipment.****1.4.7 The term "provide", as used herein, means to supply and install new equipment.****1.4.8 The term "Code", as used herein, refers to the latest edition of the CAN/CSA-B44 Safety Code for Elevators and Escalators, with updates and including Nonmandatory Appendices (which are deemed mandatory herein), as adopted by the Authority Having Jurisdiction.**

- 1.4.9 All terms in the specifications that are not otherwise defined shall have the definitions as given in the Code.

**1.5 Operation and maintenance manual**

- 1.5.1 Supply to the Consultant and Owner prior to the Substantial Performance inspection, operation and maintenance manuals.
- 1.5.2 The project shall not be deemed to have reached Substantial Performance until the complete operation and maintenance manuals have been approved by the Consultant or Owner.
- 1.5.3 Upon acceptance by the Consultant or Owner, provide three copies of the operation and maintenance manuals per group in one of the following formats, as selected by the Owner.
- .1 Print and bind hard copies of which two will be given to the Owner and one will be placed in the respective machine room; OR
  - .2 Provide an electronic copy in PDF format on an unprotected digital storage device (such as a USB).
- 1.5.4 The operation and maintenance manual shall incorporate, at a minimum:
- .1 A cover page including project title, address;
  - .2 An index;
  - .3 Contact details for the respective parties;
  - .4 A warranty letter signed by a representative of the contractor having authority to bind the company;
  - .5 Controller and drive manuals, including:
    - .1 A description of the controller user interface;
    - .2 The installation and user's manuals;
    - .3 A list of fault and error codes, including an explanation of meanings and corrective actions;
    - .4 Troubleshooting and diagnostic procedures, methods of use and the adjustment of programmable parameters together with their settings at the time of final adjustment.
  - .6 As-built wiring diagrams;
  - .7 The operation of the equipment including special features, dispatching sequences, and such items as intercom systems and security systems;
  - .8 Step-by-step instructions for the operation for special features such as Firefighters' Emergency Operation, Independent service and Emergency Power service;
  - .9 As-built diagrams and drawings of operating panels (e.g. car panels, central control consoles) with descriptions of the function of switches and indicators;
  - .10 A copy of the final submission to the Authority Having Jurisdiction;

- .11 A copy of the final inspection report from the Authority Having Jurisdiction;
- .12 Operation and maintenance manuals for other major components where applicable, including:
  - .1 Door operator;
  - .2 Emergency brake;
  - .3 Communication system;
  - .4 Safeties & governor;
  - .5 Hoist machine & motor;
  - .6 Cylinders;
  - .7 Hydraulic pump machine and internal components;
  - .8 Hall kiosks, including step-by-step instructions for re-programming;
  - .9 In-car monitors, position indicators and display screens, including step-by-step instructions for re-programming;
  - .10 Hall kiosk special screen features and codes (i.e. to call a specific car to a floor, to call a specific car to a floor for cleaning or other maintenance functions, etc.).
  - .13 Supplier and part name for other parts (ex: travelling cable, restrictors, retainers, interlocks, car top inspection station, guide means, etc.), excluding minor or generic items such as screws, bolts, hinges, etc;
  - .14 Full instructions for any special maintenance procedure, repair protocol, adjustment or test not addressed by Code (including the A17.2 and the Elevator Industry Field Employee's Safety Handbook);
  - .15 Manufacturer's recommended maintenance intervals for each major component.
  - .16 A copy of the Maintenance Control Program.

## **1.6 Coordination with other trades**

- 1.6.1 Where the work joins another trade, provide drawings showing the actual dimensions and the method of joining the work to the work of the other trade and information such as anchors, templates and details for cast-ins.
- 1.6.2 Provide access and assistance as required, at no extra charge, in relation to work by other trades.

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**1.7 Fixture type**

- 1.7.1 Provide, unless otherwise indicated in the Specifications or Drawings, signal fixtures, such as push buttons and position indicators, from your standard range of products.
- 1.7.2 Provide push buttons with metal targets.
- 1.7.3 Provide, unless otherwise indicated in the Specifications or Drawings, signal fixtures in an illumination colour selected by the Owner.
- 1.7.4 Submit illustrations of those types available and provide at least one physical button sample of the type selected by the Owner for final approval.

**1.8 Finishes: stainless steel**

- 1.8.1 Provide, unless otherwise indicated in the Specifications or Drawings, Exelsior XL Blend 'S' stainless steel for high-traffic applications for visible natural metal finishes.
- 1.8.2 Arrange, unless otherwise indicated in the Specifications or Drawings, that the brush or grain direction of finishes of visible natural metals be in the vertical direction (for horizontal sections the brush or grain shall be in the direction of the longer surface dimension).
- 1.8.3 Remove all protective film prior to turnover of the unit to the Owner.

**1.9 Progress payments**

- 1.9.1 Progress payments will be based on the percentage of the work complete as determined by the Consultant.
- 1.9.2 Ten percent of the contract value will be assigned to the provision of manuals and close-out documents and the correction of deficiencies.
- 1.9.3 A 10% holdback will apply to payments, this holdback to be released within a period as set out in the applicable legislation.

**1.10 Acceleration of the Work**

- 1.10.1 If the Work falls behind the schedule, take action as necessary to meet the schedule, including, but not limited to, extra personnel and overtime work.
- 1.10.2 Pay any costs associated with this action unless the delay is caused by acts of government, riot, civil commotion, war, malicious mischief, act of God or any cause beyond the control of the contractor.

**1.11 Acknowledgments**

- 1.11.1 The proposer acknowledges that the proposer has found no discrepancies nor any ambiguities in the specifications.

**1.12 Assignments**

- 1.12.1 Do not assign nor sublet the contract without the written consent of the Owner.
- 1.12.2 Do not assign any payment due or to become due as a result of this contract without the written consent of the Owner.

**1.13 Certificates of inspection**

- 1.13.1 Obtain and pay for certificates of approval and all other necessary permits and inspections.
- 1.13.2 Prior to Substantial Performance, arrange and pay for an acceptance inspection of the equipment by a government authority or, if that is not available, by a recognized independent private professional inspection organization.
- 1.13.3 Submit, prior to Substantial Performance, the acceptance inspection report.
- 1.13.4 Should more than one inspection for a licence or approval be required due to deficient work by others give sufficient advance notice of such deficient work to allow the Work to be completed prior to the time of the subsequent inspection.
- 1.13.5 If sufficient advance notice of such deficient work has not been given, assume the cost of the additional inspections.

**1.14 Changes in Work**

- 1.14.1 The Owner, without invalidating the contract, may order extra work or make changes by altering, adding to, or deducting from the Work, the contract sum being adjusted as agreed.
- 1.14.2 Execute all such work under the conditions of the original contract except that any claim for extension of time caused thereby shall be adjusted at the time of ordering such change.
- 1.14.3 The Consultant shall have authority to make minor changes in the Work, not involving extra cost and not inconsistent with the purpose of the contract.
- 1.14.4 Otherwise do no extra work nor make any change unless in pursuance of written order from the Owner.

**1.15 Clean-downs**

- 1.15.1 Provide clean-downs of all construction dust and debris (i.e. control/machine room, hoistway, cab, escalator interior, etc.) to occur as follows:
  - .1 Prior to turnover inspection of an individual elevator by the Authority Having Jurisdiction;
  - .2 Once upon building substantial completion, at the commencement of the warranty period.

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**1.16 Claims for extra cost**

- 1.16.1 Provide any claims for extra cost due to instructions or otherwise, to the Owner in writing within a reasonable time after the instructions and in any event before proceeding with the work.
- 1.16.2 No such claim shall be valid unless so made and authorized in writing by the Owner.

**1.17 Codes and ordinances**

- 1.17.1 Supply equipment and do work in accordance with building codes, by-laws, regulations and requirements of the local, provincial and federal authorities in effect at the time of the execution of the work.
- 1.17.2 Supply equipment and do work in accordance with the Code, and any other code which may govern the requirements of the installation.
- 1.17.3 Provide labour and material, whether or not specifically mentioned in this specification, that may be necessary to provide an installation conforming to the applicable codes and regulations.
- 1.17.4 Prior to submission of the proposal and throughout the duration of work, give prompt notification in writing of any regulations or requirements known to be in process which might affect the acceptability of the work.
- 1.17.5 If changes in codes or regulations result in extra costs, those taking effect subsequent to the date of proposal submission shall be treated as an extra to the contract.
- 1.17.6 Requirements of the Authority Having Jurisdiction applicable at the time of proposal submission shall be deemed to be included in the contract, unless specifically excluded herein.
- 1.17.7 Should changes in codes, changes in legislative requirements or changes to the requirements of the Authority Having Jurisdiction be announced prior to the date of proposal submission but with a delayed adoption date, those changes shall be deemed to be included in the contract, unless specifically excluded herein.

**1.18 Completion schedule**

- 1.18.1 Submit with the proposal, a detailed schedule including specific dates for equipment delivery times, start of site work, completion of each unit and resolution of all noted deficiencies.
- 1.18.2 During the construction period give the following information to the Consultant:
  - .1 Revisions, if necessary, to the completion schedule;
  - .2 A progress report every month showing the progress being made and the percentage of the job completed;
  - .3 Two weeks advance notice for inspection by the Consultant.
- 1.18.3 Schedule a job site meeting every two weeks during the construction period.

**1.19 Contract Documents**

- 1.19.1 The Contract Documents shall consist of general conditions, instructions to bidders, the Drawings, Specifications (including alternates and addenda) and completion schedules.
- 1.19.2 Execute the work in accordance with the Owner's contract documents, any supplemental conditions and these specifications.
- 1.19.3 Where there is a conflict between the documents the Owner's contract documents will take precedence over the other documents and any supplemental conditions will take precedence over these specifications.

**1.20 Defective work and non-performance**

- 1.20.1 The Owner reserves the right to correct any defective work and to charge the cost to the contractor.
- 1.20.2 Should the contractor fail to execute any of the Work set out in the contract the Owner reserves the right to do the Work and to charge the cost to the contractor.
- 1.20.3 The Owner reserves the right to withhold payment in the event of non-performance or to pay only for that portion of the Work that has been executed.
- 1.20.4 The Owner will give reasonable notice in writing prior to taking such action unless the defective work or non-performance prejudice the safety of people or the installation.

**1.21 Drawing and sample submittals**

- 1.21.1 Drawing and sample submittals are required for exposed finishes and fixtures.
- 1.21.2 Submit for review samples of metals, glass, paint colours, plastic laminates and finishes, of 200 mm (8") by 300 mm (12") approximate size, properly identified as to project, location and material.
- 1.21.3 Submit for review, as a minimum, the following:
  - .1 General arrangements;
  - .2 Details of areas where the work joins the work of other trades;
  - .3 Machine room layouts showing the location of the equipment;
  - .4 Hoistway layouts showing the location of the equipment, car platform dimensions, cab interior dimensions and net inside cab area;
  - .5 Hoistway sections showing overhead, pit equipment, car and frame and entrances;
  - .6 Cab details including the cab shell, platform, interior panels, ceiling, entrance, lighting and finishes;
  - .7 Details of control panels such as central control consoles or fire control panels showing the layout and detailing the design of switches and indicator lights;
  - .8 Details of intercom system station types detailing the controls;
  - .9 Details of any display devices complete with examples of proposed displays, symbols and layout;



.10 Fixture brochures.

1.21.4 Show on the general arrangement or separately, details of frames, doors, sills and supports, lanterns and gongs, including views showing the relationship of hall stations, lanterns and entrances.

1.21.5 Provide as built information at job completion prior to Substantial Performance.

1.21.6 Reviews do not include the checking of measurements and do not imply approval of variations from the specifications.

## **1.22 Electrical diagrams**

1.22.1 Supply wiring diagrams and data as required for the execution of the Work including schematics for speed control, dispatching system, interfaces, printed circuit boards.

1.22.2 Incorporate, as part of the schematic diagrams, a reference index ('road map') giving the location of electrical components and wiring interconnections for relay coils, relay contacts, field equipment, integrated circuits and other such devices, so that the position on the schematics of any of these items can be readily determined.

1.22.3 Supply, prior to the Substantial Performance inspection, three prints and one reproducible of the wiring and schematic diagrams revised to show changes that have been made.

1.22.4 If changes are subsequently made to the wiring or control, supply an additional two sets of marked-up prints of the schematics and field wiring diagrams showing the changes.

## **1.23 Environmental considerations**

1.23.1 Where practicable, recycle material replaced in the course of the work.

1.23.2 Provide a list of materials to be removed from site and their proposed recycling or disposal location for approval prior to commencing work.

1.23.3 Where practicable, provide new materials manufactured by methods that do not adversely affect the environment by, for example, generating residual deposits of heavy elements and greenhouse gases.

1.23.4 Use materials on site, such as low VOC (Volatile Organic Compound) adhesives and paint, that will not negatively affect the in-building environment.

## **1.24 Equipment insurance**

1.24.1 The Owner's insurance policy covers equipment actually in place in the building and accepted by the Owner.

1.24.2 All other material and equipment is not included in the Owner's policy and such material and equipment is stored at the Contractor's own risk.

**1.25 Equipment moving**

- 1.25.1 Provide floor protection and bracing so that equipment moving causes no damage to the building.

**1.26 Failure to perform**

- 1.26.1 If the contractor shall neglect to prosecute the work properly or fail to perform any provision of the contract, the Owner after ten days written notice to the contractor may, without prejudice to any other remedy the Owner may have, make good such deficiencies and may deduct the cost therefrom from payment due to the contractor.

**1.27 Generic maintenance**

- 1.27.1 Arrange that the equipment can be maintained and adjusted by any competent elevator company without the use of proprietary tools, information or equipment or, if such tools, information or equipment are required, provide them (these shall become the property of the Owner).
- 1.27.2 Do not incorporate any running time, cycle counters or trip counters that would cause the equipment to shut down or alter its operation in any way.

**1.28 Hoistway protection**

- 1.28.1 Provide, maintain and, after the Work is complete, remove any partitions required in the hoistway.
- 1.28.2 Provide, maintain and, after the Work is complete, remove protective hoarding required at openings into the hoistway.

**1.29 Inability to complete contract**

- 1.29.1 Should there be a reasonable doubt that the work will be completed within the scheduled time because of labour disputes or any other cause, the Owner reserves the right, at the Owner's option, to cancel the contract.
- 1.29.2 In the event this option is exercised, the payments for the work shall be made on a pro rata basis for materials and labour supplied to the time of cancellation and such material and work performed shall become the property of the Owner.
- 1.29.3 Prior to exercising this option, the Owner shall give two weeks notice in writing of intention to cancel.

**1.30 Information with proposal**

- 1.30.1 Provide the following information, where relevant, with the proposal:
- .1 The model and manufacturer of such items as solid state drives, fixtures, control systems, door operators and other purchased material (with the exception of miscellaneous minor items);
  - .2 The current rating of the solid state drives;
  - .3 The KVA rating of the transformers feeding the solid state drives;
  - .4 Certification from an independent testing laboratory detailing the line pollution generated by the solid state drives;

- .5 Certification from an independent testing laboratory detailing the extent to which the control systems are protected against external electromagnetic radiation;
- .6 Brochures, descriptions and manuals (where applicable) for the major items;
- .7 Renderings or samples of the fixtures and exposed materials;
- .8 Detailed completion schedule for the work;
- .9 A copy of your health and safety policy as issued to your employees;
- .10 Mechanic and team regular and overtime hourly rates.

**1.31 Inspection and acceptance**

- 1.31.1 Furnish a team of competent personnel to assist the Consultant with an inspection of each elevating device prior to Substantial Performance to verify that the work is in compliance with the Specifications.
- 1.31.2 If the results of these inspections do not meet the requirements of the Specifications, make the appropriate corrections, and provide, as set out above, for another inspection.

**1.32 Key switches**

- 1.32.1 Where possible supply switches and keys compatible with the vertical transportation equipment portfolio of the Owner, unless otherwise noted herein.
- 1.32.2 Engrave or mechanically fasten collar rings to clearly mark key-switch functions, positions and key required.
- 1.32.3 Prior to placing any units into service for the public, provide to the Owner six copies of each key-switch key type defined in the Code as being Security Group 2, 3 and 4.
- 1.32.4 Engrave the key number on each key provided to the Owner and group the keys by Security Group and key type.

**1.33 Labour laws**

- 1.33.1 Comply with applicable provisions of federal, provincial and local labour laws and with applicable union regulations.

**1.34 Liability insurance**

- 1.34.1 Provide, during the period this contract is in force, premises liability, including public liability insurance and property damage insurance in the amount of \$5,000,000 inclusive, to be covered against any claims for damage to property or for personal injury, including death, which may arise from operation under this contract, whether such operation is by yourself or by any sub-contractor or anyone directly or indirectly employed by you.
- 1.34.2 Upon completion of the contract, have in force a completed operations and products liability insurance, in the amount of \$5,000,000 inclusive, to be covered against any claims for damages to property or for personal injury, including death, which may arise after the premises liability is terminated.

- 1.34.3 Maintain the insurance in force for a minimum period of two years after completion of the contract.
- 1.34.4 List the Owner as an additional insured.
- 1.34.5 The certificates shall state that the insurance will not become ineffective without sufficient written notice to the Owner.
- 1.34.6 Submit certificates of such insurance with the Owner before work is begun.

**1.35 Liens and affidavits**

- 1.35.1 The final payment and any part of the retained percentage shall not become due until a complete release of liens arising out of this contract or receipts in full in lieu thereof have been delivered to the Owner.
- 1.35.2 Furnish an affidavit to the Owner that the release or receipts include labour and materials for which a lien could be filed.
- 1.35.3 If any lien remains unsatisfied after all payments are made, refund to the Owner monies that the Owner may be compelled to pay in discharging such a lien, including costs and reasonable legal fees.

**1.36 Maintenance tasks**

- 1.36.1 Perform and bring all routine maintenance tasks required by the Inspecting Authorities up to date (i.e. monthly, quarterly, semi-annual, annual, 5-year, Category 1, Category 3, Category 5 requirements, etc.) prior to turning over the elevator for public use.
- 1.36.2 Arrange for Category 5 test bench marking with the Henning alternative testing tool or approved equivalent tools.
- 1.36.3 Complete the Category 5 test bench marking at the same time that full speed and full load testing is performed.
- 1.36.4 Provide electronic records confirming the successful completion of the tests.

**1.37 Materials and workmanship**

- 1.37.1 Provide all new materials and equipment.
- 1.37.2 Install equipment in a neat, accurate, workmanlike manner.

**1.38 Measurements**

- 1.38.1 In the execution of the work, verify all dimensions with the actual conditions in order to do a perfect job.

**1.39 Operation by persons with physical disabilities**

- 1.39.1 Ensure that controls and fixtures comply with Appendix E of the Code.

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**1.40 Operating environment**

- 1.40.1 Provide material and equipment to function normally within the requirements of the specifications when the ambient temperature is between 5.0 and 32.0 degrees Celsius (41 and 90 degrees Fahrenheit).
- 1.40.2 Provide material and equipment to function normally and within the requirements of the specifications when the ambient relative humidity is between 25% and 95% non-condensing.
- 1.40.3 Provide material and equipment to function normally and within the requirements of the specifications when the supply voltage is within minus 10% and plus 10% of the nominal voltage and the frequency is within 5% of the nominal frequency.
- 1.40.4 Provide equipment needed to meet the specified voltage operating parameters (e.g. filters, isolation transformers, transient voltage surge suppression, etc.).
- 1.40.5 Arrange that the equipment meet the seismic requirements.
- 1.40.6 Perform necessary equipment adjustments related to building compression up to and including building compression of 2mm (0.08 in.) over a 4,000 mm (157.5 in.) floor-to-floor height.

**1.41 Organization chart**

- 1.41.1 Provide to the Owner an organization chart from the local supervisory level up.
- 1.41.2 Provide to the Owner the names, positions and experience of the field and supervisory personnel associated with this project.
- 1.41.3 During the course of the work when organization changes are made, provide the Owner with updated information.

**1.42 Overtime premium**

- 1.42.1 In the event that the Owner, for whatever reason, pays for overtime worked to complete the work as set out in the Specifications, the Owner will pay the added cost of the overtime.
- 1.42.2 The added cost shall be the difference between the overtime cost and straight time cost at contract rates.
- 1.42.3 Obtain from the Owner prior written authorization for overtime to be worked and chargeable, as described above, to the Owner, this authorization to be for specific amounts and for specific times.
- 1.42.4 Submit time sheets for such overtime worked for approval to the Owner or the designated representative of the Owner within 48 hours of the time that such overtime is worked.
- 1.42.5 If the procedures as set out above are not followed, assume the costs of the time worked.

**1.43 Owner's General Terms and Conditions**

1.43.1 Abide by the Owner's General Terms and Conditions.

1.43.2 Where there is a conflict between the Owner's General Terms and Conditions and these specifications the Owner's Terms and Conditions take precedence.

**1.44 Parts**

1.44.1 Supply parts on request for a period of fifteen years subsequent to Substantial Performance of the project, at then prevailing prices.

1.44.2 Where purchased components are used, ensure that the original manufacturer's name and component designation are clearly marked on the part or in the parts catalogue.

**1.45 Patents**

1.45.1 Hold and save the Owner and its officers, agents, servants and employees harmless from liability due to patent or copyright infringement arising from the use of, in the performance of the work or in the completed installation, any invention, process, article, or appliance.

**1.46 Payment withheld**

1.46.1 Approval for payment may be withheld to such extent as may be necessary on account of:

- .1 Defective work not remedied;
- .2 Claims filed or reasonable evidence indicating probable filing of claims;
- .3 Failure of contractor to make payments properly to sub-contractors or for material and labour;
- .4 Failure to work to schedule;
- .5 A reasonable doubt that the contract can be completed for the balance then unpaid;
- .6 Damage to the building or another contractor by the elevator contractor or one of their subcontractors.

1.46.2 When the above grounds are removed, payment will be made for amount withheld.

**1.47 Personnel**

1.47.1 Supervise personnel so that they present a neat appearance and their movement in the building is within the requirements of their work.

1.47.2 Provide uniforms and photo identification for personnel.

1.47.3 The Owner reserves the right to reject or refuse access to personnel or contractors at its sole discretion.

1.47.4 Assign and maintain a dedicated service representative to the work, this representative to be responsible for liaison with the Owner and the Consultant.

1.47.5 Assign and maintain a dedicated service supervisor to the work, this supervisor to be responsible for technical communications with the Owner and the Consultant.

**1.48 Pre-inspection check list**

1.48.1 Upon completion of each group, review each page of the specifications and initial each page at the bottom left to indicate that the work has been completed in compliance with the Specifications.

1.48.2 Submit this initialled copy of the Specifications to the Consultant prior to requesting an inspection by the Consultant.

**1.49 Preliminary information**

1.49.1 Submit, within 30 working days after awarding of contract, the information and details, including reactions, power requirements, ventilation requirements, cutouts, access requirements, light and outlet locations, quantity, location and size of external wires required to inter-connect the equipment, and all other information required to complete the work to be performed by others in conjunction with the installation of the equipment.

**1.50 Protection of the Work and property**

1.50.1 Maintain protection of the Work and protect the Owner's property from injury or loss arising out of the execution of this contract.

1.50.2 Make good any injury or loss caused by the Contractor's agents or employees.

1.50.3 Take all necessary precautions to ensure that the Work is done in a manner that does not endanger any person.

**1.51 Removal of rubbish**

1.51.1 Remove rubbish, keep the building and premises clean during the progress of the work, and leave the premises at completion in perfect condition as far as the work under the specifications is concerned.

**1.52 Request for payment**

1.52.1 Submit applications for payment with the necessary data, information, waivers and affidavits including certificates of compliance and appropriate statutory declaration.

**1.53 Singular and plural**

1.53.1 In all cases singular and plural shall be interchangeable and shall be applied as required to meet the sense and intent of the Specifications.

1.53.2 Where the singular is employed it shall be interpreted as necessary, unless otherwise indicated, to apply to all equipment and devices required to produce a complete installation.

**1.54 Special tools and access codes**

- 1.54.1 If any special tools (i.e. tools that are not readily purchased from a hardware supplier) are used to maintain or adjust the equipment or are required for any aspect of the work on the equipment, list these tools with details on the proposal form and provide such tools to the Owner prior to Substantial Performance.
- 1.54.2 If any access codes are used to maintain or adjust the equipment or are required for any aspect of the work on the equipment (including the reading and resetting of error codes and logs) list these access codes with details on the proposal form and provide such access codes to the Owner prior to Substantial Performance.
- 1.54.3 Do not change the access codes without the written consent of the Owner and, when changed, provide to the Owner the new access codes.

**1.55 Subcontractors**

- 1.55.1 Bind subcontractors to all applicable portions of the Specifications.
- 1.55.2 The contractor shall be responsible for all actions and all work performed by its subcontractors to the same extent as the contractor is itself responsible under the Specifications.

**1.56 Submission of proposal**

- 1.56.1 Submission of a proposal will be considered presumptive evidence that the proposer is conversant with local facilities and conditions, requirements of the Contract Documents and of pertinent provincial and local codes, state of labour and material markets, and in the proposal has made due allowance for all contingencies.

**1.57 Taxes**

- 1.57.1 Include applicable local, provincial and federal taxes or assessments in effect at the time of the signing of the contract.
- 1.57.2 Show on the proposal form the amount of each tax included.
- 1.57.3 The Contractor is liable for the above mentioned taxes or assessments whether or not specifically mentioned in his proposal or in the final contract document.
- 1.57.4 In the event new taxes or assessments, to become due on completion of the contract, are imposed after the signing of the contract these are to be paid, in addition to the original contract amount, by the Owner to the Contractor, who in turn is to pay them to the proper authorities.
- 1.57.5 In the event taxes or assessments in effect at the signing of the contract should be revoked before consummation of the contract rebate to the Owner the amount of such taxes and assessments included in the original contract.



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**1.58 Technical seminar**

- 1.58.1 Before the time of Substantial Performance, arrange with the Owner to provide a seminar for the Owner's staff.
- 1.58.2 Include in the seminar a complete review of the documentation, operation of the equipment and demonstration of any special features including programming of any display devices.

**1.59 Trade marks**

- 1.59.1 Do not apply trade marks visible to the general public on any piece of equipment.

**1.60 Unit inspection by the Consultant**

- 1.60.1 Advise the Consultant in writing two weeks prior to the completion of a unit so as to arrange an inspection by the Consultant at a mutually convenient time.
- 1.60.2 Assist the Consultant in the performance of this inspection to verify that performance figures, workmanship and equipment furnished are in compliance with the Specifications.
- 1.60.3 Provide the necessary test weights to carry out full load tests and a team of competent persons to assist the Consultant in making the necessary tests and inspections.

**1.61 Warranty of work**

- 1.61.1 Warrant that the materials, performance and workmanship are in accordance with the industry standard in every respect.
- 1.61.2 Make good defects not due to improper use which may develop within one year from the date of Substantial Performance of the project.
- 1.61.3 Warrant that the equipment performs to the standards set out herein.
- 1.61.4 Neither the final payment nor any provision of the Contract Documents diminishes the responsibility for negligence or faulty materials or workmanship within the extent and period provided by law.
- 1.61.5 Upon written notice remedy defects and pay expenses for damage to others resulting from defects.

**1.62 Withdrawal or rejection of proposals**

- 1.62.1 The Owner reserves the right to reject any or all proposals or to waive any conditions.
- 1.62.2 Proposals may not be withdrawn until sixty days after the scheduled date for the receipt of the proposals.

**1.63 Work by other trades**

1.63.1 In the event that work by other trades is required and work by others as set out herein is in conflict with or inadequate for your equipment or design, so state on the proposal form with all necessary details.

1.63.2 If no exceptions are noted on the proposal form, pay the costs of all modifications necessary to suit your equipment and design.

**1.64 Work completion and maintenance turnover**

1.64.1 At the completion of the work and prior to turning over the unit for public use:

- .1 So as to ensure a smooth and harmonious turnover, arrange with the existing elevator maintenance provider a walkthrough of the installation, this walkthrough to be carried out jointly by your supervisor and the existing elevator maintenance provider's maintenance supervisor.
- .2 Provide to the Owner and Consultant the Test Data Forms signed by both your supervisor and the existing elevator maintenance provider's supervisor together with a signed confirmation that the work has been checked by both parties and both parties are in agreement that the work has been completed satisfactorily and poses no problems for ongoing maintenance.

**1.65 Work site protection**

1.65.1 Provide, maintain and, after the work is complete, remove protective hoarding around the work site.

1.65.2 Arrange the protective hoarding so as to prevent public access to the work site.

**1.66 Work under division 02 (Site Preparation)**

1.66.1 A lockable storage space during the installation period.

**1.67 Work under division 03 (Concrete)**

1.67.1 Properly framed hoistways with a variation from nominal well dimensions of not more than +25 mm (1").

1.67.2 A structure designed for the following estimated reactions (including a provision for impact) generated by each device:

per unit	Reactions at the car buffer (kN)		Reactions at the counterweight buffer (kN)		Reactions in the overhead (kN)	
Elevator	138	31,000	116	26,000	147	33,000

1.67.3 Gross openings for hoistway entrances exceeding the clear door dimensions by 250 mm (10") on each side and above.

- 1.67.4 Blocking in of entrance frames following installation.
- 1.67.5 Supports for the sill support angles, flush with the inside hoistway wall, a minimum of 150 mm (6") in depth, capable of sustaining a minimum unit load equivalent to the capacity of the elevator.
- 1.67.6 Adequate support for the guide rail fastenings and installation of guide rail bracket inserts where required.
- 1.67.7 Sleeves and coring for electric ducts and oil lines in the hoistway, machine space and control space as required.
- 1.67.8 Pockets, as required, to permit fastening of rail brackets to building structure. Pockets to be filled after brackets installed.
- 1.67.9 Fire-resistant control/machine room with a concrete floor and access door.

**1.68 Work under division 04 (Masonry)**

- 1.68.1 Grouting under hoistway sills.

**1.69 Work under division 05 (Metals)**

- 1.69.1 Supports for the guide-rails at each floor and in the overhead.
- 1.69.2 For machine -room-less elevators, for hoistway walls not made of concrete, intermediate supports for the guide-rails where guide-rail reinforcement cannot be installed by the elevator contractor and where floor heights exceed 3650 mm (12' 0").
- 1.69.3 A hoisting beam at the top of the hoistway parallel to the hoistway doors and located in the middle of the hoistway plan, and capable of sustaining a 35 kN (7,500 lb) load.
- 1.69.4 An access ladder in the elevator pit.

**1.70 Work under division 07 (Thermal and Moisture Protection)**

- 1.70.1 Means to limit the presence of water, gases and odours in the pit.
- 1.70.2 Waterproofing of the pit.

**1.71 Work under division 08 (Doors and Windows)**

- 1.71.1 For the elevator control/machine room, a full height self-locking and self-closing access door.

**1.72 Work under division 09 (Finishes)**

- 1.72.1 Initial painting of the control/machine room floors.
- 1.72.2 Sealing of the control/machine room ceilings and walls to reduce dust.
- 1.72.3 Painting of the hoistway entrances, where required.
- 1.72.4 Tile flooring for the elevator cabs.

**1.73 Work under Division 22 (Plumbing)**

- 1.73.1 A pit drain with connection to the building drainage system, drains to have a capacity of 11.3 m<sup>3</sup>/h (3,000 gal/h) per shared elevator hoistway having a positive means to prevent water, gases and odours from entering the hoistway.
- 1.73.2 A cover for the pit drains secured to and level with the pit floor.
- 1.73.3 Any sprinkler systems employing water if installed in the machine rooms, control rooms or hoistway to be arranged to operate at a higher temperature (approximately 20% higher) than the fire alarm sensors.
- 1.73.4 If required by the applicable regulations, means to limit the presence of smoke in the hoistway of the designated firefighters' elevator.

**1.74 Work under Division 15 (Mechanical)**

- 1.74.1 Heating and cooling in order to maintain continuously (i.e. 24 hours a day) a temperature of greater than 13 degrees Celsius and less than 29 degrees Celsius based on the estimated heat generated by the elevator equipment as follows:

	control room		top of hoistway	
	kW	BTU/hr	kW	BTU/hr
Elevator	0.8	2,750	0.5	1,750

- 1.74.2 Do not locate ventilation equipment directly above elevator equipment and ensure air conditioning exhaust ducts do not direct conditioned air directly onto elevator wire ropes.

**1.75 Work under division 26 (Electrical)**

- 1.75.1 A grounded power supply sufficient to start and run each unit at rated speed and capacity, and including the following:
  - .1 A disconnect means located in view of the elevator controller near the access to the control/machine room.
  - .2 For machine-room-less elevators, a disconnect means located in view of the elevator equipment at the top of the hoistway.
  - .3 Wiring between the disconnect and the elevator power input point (elevator transformer or controller).
  - .4 Protection of the feeder cables for designated firefighters' elevators.
  - .5 The power supply should be capable of absorbing the regenerated power from the system where necessary.

- 1.75.2 A power supply capable of supplying for each unit the following estimated starting and running currents in amperes based on the power supply noted:

Full load up currents	Power supply (V)	Starting current (Amps)	Running current (Amps)
Elevator	600	30	12

- 1.75.3 In the elevator control/machine room, one 15 A 120 V, single phase circuit breaker for each elevator, located adjacent to the lock side of the control/machine room door, to power cab ventilation and lighting equipment, the power for the lighting circuit being derived from the emergency power supply if available.
- 1.75.4 In the elevator control/machine room, one 15 A 120 V, single phase circuit breaker for each elevator, located adjacent to the lock side of the control/machine room door, to power the cab interior duplex GFCI receptacle and auxiliary equipment (e.g. camera).
- 1.75.5 An auxiliary disconnect contact with wiring to the controller, to indicate if the disconnect is on or off.
- 1.75.6 In the elevator control/machine room, protected LED lights controlled by a switch located adjacent to the lock side of the space access door, located at approximately 2500 mm (8') from floor level as required to give a minimum illumination of 200 lx at floor level and within the controller, the power for the lighting circuit being derived from the emergency power supply if available.
- 1.75.7 In the elevator control/machine room, duplex GFCI receptacles mounted on the wall and spaced at approximately 5000 mm (16') intervals.
- 1.75.8 In the elevator control/machine room, a duplex GFCI receptacle (to power intercommunication equipment) mounted on a controller and connected to the emergency power supply if available.
- 1.75.9 In the elevator pit, duplex GFCI receptacles mounted on the wall, spaced at approximately 5000 mm (16') intervals and located clear of elevator equipment.
- 1.75.10 In the elevator pit, protected LED lights, controlled by a light switch located adjacent to the pit entrance, located clear of elevator equipment to give a minimum illumination of 100 lx at pit level, the lowest lamps to be within 500 mm (20") of the pit floor. The power for the lighting circuit to be derived from the emergency power supply if available.
- 1.75.11 In the elevator overhead of machine-room-less elevators, protected LED lights, located in front of and behind the machine and associated equipment as required to give a minimum illumination of 200 lx on the equipment. The light switch to be located in the hoistway at the point of entry. The power for the lighting circuit to be derived from the emergency power supply if available.
- 1.75.12 In the elevator overhead of machine-room-less elevators, duplex GFCI receptacles mounted on the wall and spaced at approximately 5000 mm (16') intervals.

## Procurement Section

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|---------|---|
| 1.75.13 | Fire alarm initiating devices (FAIDs) on the recall floor.  |
| 1.75.14 | Fire alarm initiating devices (FAIDs) on all other floors.  |
| 1.75.15 | Fire alarm initiating devices (FAIDs) at the top of the hoistway.   |
| 1.75.16 | Fire alarm initiating devices (FAIDs) in the pit.   |
| 1.75.17 | Fire alarm initiating devices (FAIDs) in the control/machine space.   |
| 1.75.18 | A connection from the fire alarm initiating devices (FAIDs) on the recall floor to the elevator controller.   |
| 1.75.19 | A connection from the fire alarm initiating devices (FAIDs) on all other floors to the elevator controller.   |
| 1.75.20 | A connection from the fire alarm initiating devices (FAIDs) at the top of the hoistway to the elevator controller.  |
| 1.75.21 | A connection from the fire alarm initiating devices (FAIDs) in the pit to the elevator controller.  |
| 1.75.22 | A connection from the fire alarm initiating devices (FAIDs) in the control/machine space to the elevator controller.  |
| 1.75.23 | An active telephone line to the control/machine room, capable of operating during a power failure for a minimum of four hours. An internet connection in the machine/control room, capable of operating during a power failure for a minimum of four hours. Do not mount auxiliary equipment such as security controllers or elevator telephone cabinets on elevator controller cabinets. |
| 1.75.24 | Where applicable, a security system for the elevator and associated car and hall card readers.  |
| 1.75.25 | Where applicable, a closed circuit camera system for the elevator.  |
| 1.75.26 | Conduit between the elevator hoistway, control/machine room and any remote equipment locations, terminated outside the hoistway at the basement level (or other level designated by the Owner) at a junction box (junction box to be provided by the elevator contractor).  |
| 1.75.27 | Pulling of wire between the elevator hoistway, control/machine room and any other remote equipment locations.   |
| 1.75.28 | Coordinate with the elevator contractor any controller interconnections needed for the security system and associated card readers.   |
| 1.75.29 | Electric power during erection, for illumination, operations of tools and hoist, starting, testing and adjusting.   |

## **2. SEPARATE PRICES**

### **2.1 Separate price submission requirements**

2.1.1 Submit prices to provide the following:

### **2.2 Maintenance: five years**

2.2.1 Provide full maintenance of the equipment for a period of five years beginning at the end of the maintenance included in the contract.

2.2.2 The services agreement will continue on a month-to-month basis at the expiration of the original term unless notice in writing is provided by either party, at least 60 days in advance of the expiration date, notifying the other party of their intent to not continue with the services agreement beyond the original term mandate or any subsequent monthly mandates.

2.2.3 Provide this service at a flat monthly price without escalation.

2.2.4 Provide this service in conformity with the Maintenance Specifications.

**END OF SECTION**

## 1. GENERAL

### 1.1 General instructions

#### 1.1.1 Read and conform to:

- .1 Division 1 requirements and documents referred to therein.

### 1.2 General requirements

- 1.2.1 Conform to Section Section 14 00 00.

### 1.3 Scope

- 1.3.1 Provide labour, materials, products, equipment and services necessary for the full maintenance of the equipment.

### 1.4 Definition of terms

- 1.4.1 The term "Owner", as used herein, refers to Region of Peel.
- 1.4.2 The term "Consultant", "elevator consulting engineer", "consulting engineer" or "engineer", as used herein, refers to KJA Consultants Inc.
- 1.4.3 The term "elevator contractor" or "contractor", as used herein, refers to any person, partners, firm or corporation having a contract with the Owner to furnish labour and materials for the execution of the work herein described.
- 1.4.4 The term "sub-contractor", as used herein, refers to any person, partners, firm or corporation having a contract with the contractor to furnish labour and materials for the execution of the work herein described.
- 1.4.5 The term "inspecting authorities", as used herein, refers to authorized agents of governments and of insurance groups which are charged with the responsibility of carrying out periodic inspections and tests on vertical transportation equipment.
- 1.4.6 The term "unit", as used herein, means any elevator, dumbwaiter, escalator, platform lift, moving walk or similar device mentioned in this Specification.
- 1.4.7 The term "Code", as used herein, refers to the CAN/CSA-B44-19 Safety Code for Elevators and Escalators with updates and including Nonmandatory Appendices (which are deemed mandatory herein).
- 1.4.8 All terms in the Specifications that are not otherwise defined shall have the definitions as given in the Code.

### 1.5 Purpose

- 1.5.1 The purpose of the maintenance program is to maintain the equipment in substantially new condition, to secure the Owner's equity and to provide safe, trouble-free service.



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**1.6 Regulatory authority submissions**

- 1.6.1 Complete any submissions to the regulating authorities that may be necessary for the continuing use and operation of the equipment.

**1.7 Contract duration**

- 1.7.1 Provide full maintenance on the equipment to the maintenance procedures set out in the Specifications for such periods as may be defined in the Contract Documents.

**1.8 Minimum standard**

- 1.8.1 As a minimum standard, perform to the Specifications and to the Code.  
1.8.2 Maintain the equipment at all times in the same or better condition as at the commencement of the maintenance work.

**1.9 Reliability**

- 1.9.1 Ensure that the average number of callbacks does not exceed 6.0 per elevator per year.  
1.9.2 Ensure that the average number of entrapments does not exceed 1.5 per elevator per year.  
1.9.3 Ensure that the average number of callbacks does not exceed 3.0 per escalator per year.

**1.10 Extra to contract work**

- 1.10.1 Give any claims for extra to contract work, due to instructions or otherwise, to the Owner in writing within a reasonable time after the work is completed.  
1.10.2 No such claim shall be valid unless so made and authorized by the Owner.  
1.10.3 Where extra to contract work is approved and done at the Owner's expense:  
.1 Bill the work at hourly rates in accordance with the Contract.  
.2 Do not charge for more than a total of forty (40) minutes of travel time per site visit.  
.3 Do not add miscellaneous charges (e.g. mileage, parking charges, truck charges, sundry charges, fuel charges, etc.).  
1.10.4 For extra to contract work in buildings that are more than 75 kilometers driving distance away from the city center of a city with a population of more than 50,000:  
.1 Bill the work at hourly rates in accordance with the Contract.  
.2 Charge travel time based on the lesser of the actual time traveled or the shortest travel time to the nearest city with a population of more than 50,000.  
.3 Charge travel expenses based on the lesser of the actual distance traveled or the shortest travel distance to the nearest city with a population of more than 50,000.  
.4 Do not add miscellaneous charges (e.g. hotels, parking charges, truck

charges, sundry charges, etc.).

- .5 Charge mileage at a rate that does not exceed the prevailing tax deduction rate established by federal tax authorities.

#### **1.11 Regular hours of work**

- 1.11.1 Regular hours of work are from 07:00 to 17:00 Monday to Friday, excluding holidays.
- 1.11.2 Carry out noisy work, work creating excessive odours or work that creates a disturbance to the building tenants outside of regular hours or at such other times as selected by the Owner and include in your submission the costs for such overtime work.

#### **1.12 Defective work and non-performance**

- 1.12.1 The Owner reserves the right to correct defective work and to charge the cost to the Contractor.
- 1.12.2 Should the contractor fail to execute any of the Work set out in the contract the Owner reserves the right to do the Work and to charge the cost to the Contractor.
- 1.12.3 The Owner reserves the right to withhold payment in the event of non-performance or to pay only for that portion of the Work that has been executed.
- 1.12.4 The Owner will provide 30 days notice in writing prior to taking such action, except where the defective work or non-performance prejudice the safety of people or the installation, in which case the Owner need only provide 5 days notice in writing.
- 1.12.5 The Contractor may correct the defective work within the notice period but shall provide confirmation in writing to the Owner prior to the end of the notice period, or the Contractor shall still bear direct charges incurred by the Owner to correct the defective work.

#### **1.13 Contract cancellation**

- 1.13.1 The Owner may elect, at its option, to cancel the contract prior to its normal termination:
- .1 If the maintenance is not executed in accordance with the Specifications, as evidenced by the report of a recognized independent elevator consultant, and if, within four weeks of written notice, the necessary corrective action has not been completed;
- .2 If there is a continuing failure to perform as evidenced by more than two negative reports in any twelve month period with no positive or neutral reports in the same twelve month period. (A negative report is one which defines the level of contract performance as less than 95% of the specified requirements.)
- 1.13.2 In the event of such cancellation, the Owner may, at its option, elect to use another company to restore the equipment to the Specifications standards and to charge the cost of this to the elevator contractor.

- 1.13.3 The Owner has the option to cancel the contract upon one month's written notice if there is a significant change in the circumstances of the contract (e.g. a change in ownership of the equipment, a modernization or replacement at the Owner's cost of equipment components, a change in ownership of the maintenance company); this option to be available to the Owner for a period of three months from the date on which the changed circumstances become known to the Owner.

**1.14 Protection of the Work and property**

- 1.14.1 Maintain protection of the Work and protect the Owner's property from injury or loss arising out of the execution of this contract.
- 1.14.2 Make good any injury or loss caused by the Contractor's agents or employees.
- 1.14.3 Take all necessary precautions to ensure that the Work is done in a manner that does not endanger any person.

**1.15 Liability insurance**

- 1.15.1 Provide, during the period this contract is in force, premises liability, including public liability insurance and property damage insurance in the amount of \$5,000,000 inclusive, to be covered against any claims for damage to property or for personal injury, including death, which may arise from operation under this contract, whether such operation is by yourself or by any sub-contractor or anyone directly or indirectly employed by you.
- 1.15.2 Upon completion of the contract, have in force a completed operations and products liability insurance, in the amount of \$5,000,000 inclusive, to be covered against any claims for damages to property or for personal injury, including death, which may arise after the premises liability is terminated.
- 1.15.3 Maintain the insurance in force for a minimum period of two years after completion of the contract.
- 1.15.4 List the Owner as an additional insured.
- 1.15.5 The certificates shall state that the insurance will not become ineffective without sufficient written notice to the Owner.
- 1.15.6 Submit certificates of such insurance with the Owner before work is begun.

**1.16 Assignments**

- 1.16.1 Do not assign nor sublet the contract without the written consent of the Owner.
- 1.16.2 Do not assign any payment due or to become due as a result of this contract without the written consent of the Owner.

**1.17 Access codes**

- 1.17.1 If the contract is cancelled, provide to the Owner, for those elevators and escalators or components that have access codes or access tools for commissioning, programming or other purposes, the access tools and a hard copy listing of the access codes.

1.17.2 If the Owner provides access codes or access tools, preserve these codes and tools confidential for use only on the particular equipment for which the Owner has provided them.

1.17.3 Change access codes only when authorized in writing by the Owner.

#### **1.18 Directives**

1.18.1 Advise the Owner of directives received from the Inspecting Authorities and from the Regulatory Authorities.

1.18.2 Carry out directives from the Inspecting Authorities and from the Regulatory Authorities within the period of time set out on the directives, working in overtime if necessary to meet the required date, except for those items that are:

- .1 The responsibility of the Owner;
- .2 Directives resulting from changes to the existing regulations.

#### **1.19 Payment**

1.19.1 Submit invoices at the end of each month for the work performed in that month.

1.19.2 Invoices will be paid when the assigned work has been completed and the Consultant has been notified by the Contractor to that effect.

1.19.3 The invoice will be paid only if the maintenance work for the month has been executed as confirmed in the report data; otherwise there will be no payment made for the month.

1.19.4 The invoice will be paid only if deficiencies outstanding for more than two months have been corrected; otherwise there will be no payment made for the month.

1.19.5 The invoice will be paid only if those directives that are the responsibility of the elevator contractor have been addressed within the required time limit; otherwise there will be no payment made for the month.

#### **1.20 Maintenance fee reduction**

1.20.1 If the regular maintenance is not carried out for any unit for any given month issue a credit for the maintenance for that unit for that month.

#### **1.21 Delay in making repairs**

1.21.1 Execute promptly the necessary repairs to return non-functioning units to service.

1.21.2 Return units to service when answering service calls unless return visits are necessary for additional troubleshooting or to source replacement parts.

1.21.3 Where return visits are necessary, promptly return to the site on the next business day upon availability of the necessary replacement parts.

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**1.22 Deficiencies not corrected**

- 1.22.1 If there is a failure to carry out instructions of the inspecting authorities (except for those items that are the responsibility of the Owner and directives resulting from changes to the existing codes) within the period of time allowed by the authorities issue a credit to the Owner for any costs, including the cost of the inspecting authority reinspection, incurred by the Owner as a result of this failure.

**1.23 Coordination with Owner**

- 1.23.1 Before each routine maintenance visit contact a representative specified by the Owner.
- 1.23.2 Discuss the operation of the equipment with the Owner's representative and take immediate action on problems.
- 1.23.3 Should a problem be of a nature that cannot be satisfactorily resolved during the inspection or trouble call, report back to the Owner's representative to explain why it was not possible to correct the problem and when the problem will be resolved.

**1.24 Routine maintenance**

- 1.24.1 Provide labour, materials, products, equipment and services necessary to complete maintenance testing and inspections required by the Authority Having Jurisdiction at the appropriate intervals.
- 1.24.2 Where required, perform the following:
- .1 All Category 1 tasks at intervals not to exceed 12 months.
  - .2 All Category 3 tasks at intervals not to exceed 36 months.
  - .3 All Category 5 tasks at intervals not to exceed 60 months.
- 1.24.3 All other maintenance tasks required by Code with no prescribed frequency shall be completed at intervals not to exceed 12 months.
- 1.24.4 Perform periodic maintenance inspections once every three months, at a minimum.
- 1.24.5 In the course of the examination, should faulty parts be discovered replace them at once, and should any unusual operations or noises be found take corrective action immediately.
- 1.24.6 Schedule parts showing excessive wear for replacement on the next regular examination.

**1.25 Personnel**

- 1.25.1 Supervise personnel so that they present a neat appearance and their movement in the building is within the requirements of their work.
- 1.25.2 Provide uniforms and photo identification for personnel.
- 1.25.3 The Owner reserves the right to reject or refuse access to personnel or contractors at its sole discretion.

- 1.25.4 Assign and maintain a dedicated service representative to the work, this representative to be responsible for liaison with the Owner and the Consultant.
- 1.25.5 Assign and maintain a dedicated service supervisor to the work, this supervisor to be responsible for technical communications with the Owner and the Consultant.

#### **1.26 Repairs**

- 1.26.1 For scheduled repair work, outside of the regular maintenance procedure, give the Owner at least two weeks prior notice.
- 1.26.2 For unscheduled repair work, outside of the regular maintenance procedure, give the Owner immediate notice.
- 1.26.3 Communicate, in writing, the status of repairs to the Owner at the beginning and close of the normal working day.
- 1.26.4 Where possible indicate the time required for completion of repairs.

#### **1.27 Mis-adjustment**

- 1.27.1 Do not change any of the adjustments in such a way as to lead to a deterioration of the equipment performance.
- 1.27.2 Do not, in the course of routine maintenance or trouble shooting, re-adjust any of those settings which affect either the performance or the safety of the equipment.
- 1.27.3 Should it appear that some setting has changed or some problem has arisen such as to alter the performance of the equipment, arrange that a qualified adjuster with the appropriate tools, manuals and training make the necessary re-adjustments in an organized, systematic way.
- 1.27.4 Do not allow ad hoc adjustments to the equipment.

#### **1.28 Safety devices**

- 1.28.1 At no time permit the equipment to operate while any of the safety devices, mechanical or electrical are in-operative.

#### **1.29 Codes and ordinances**

- 1.29.1 Supply equipment and do work in accordance with building codes, by-laws, regulations and requirements of the local, provincial and federal authorities in effect at the time of the execution of the work.
- 1.29.2 Supply equipment and do work in accordance with the Code, and any other code which may govern the requirements of the installation.
- 1.29.3 Provide labour and material, whether or not specifically mentioned in this specification, that may be necessary to provide an installation conforming to the applicable codes and regulations.
- 1.29.4 Prior to submission of the proposal and throughout the duration of work, give prompt notification in writing of any regulations or requirements known to be in process which might affect the acceptability of the work.

- 1.29.5 If changes in codes or regulations result in extra costs, those taking effect subsequent to the date of proposal submission shall be treated as an extra to the contract.
- 1.29.6 Requirements of the Authority Having Jurisdiction applicable at the time of proposal submission shall be deemed to be included in the contract, unless specifically excluded herein.
- 1.29.7 Should changes in codes, changes in legislative requirements or changes to the requirements of the Authority Having Jurisdiction be announced prior to the date of proposal submission but with a delayed adoption date, those changes shall be deemed to be included in the contract, unless specifically excluded herein.

**1.30 Equipment defects**

- 1.30.1 Should a defect in the equipment or the design of the equipment become apparent based on experience with this installation or similar installations elsewhere, advise the Owner immediately in writing setting out the steps to be taken to correct the problem.
- 1.30.2 Forward to the Owner copies of any memoranda, internal or external, published or unpublished, dealing with actual or potential flaws in the equipment and design.

**1.31 Call-back service**

- 1.31.1 Include, as part of the maintenance program, regular and emergency call-back service.
- 1.31.2 Provide regular and emergency call-back service 24 hours per day, seven days per week.
- 1.31.3 An emergency is a situation such as:
  - .1 An entrapment;
  - .2 An incident;
  - .3 An accident;
  - .4 A shut down of more than one elevator in a group;
  - .5 The absence of elevator service to a floor.
- 1.31.4 At the time the call is placed the Owner may choose to indicate that the call can be handled during regular hours; otherwise, answer the call immediately whether it be in overtime or regular time.
- 1.31.5 Respond only to calls placed by the Owner except in the case of emergency calls.
- 1.31.6 Provide an answering service staffed twenty-four hours per day.
- 1.31.7 Provide, where applicable, an answering service inclusive of two-way non-verbal communication and the means to monitor video.
- 1.31.8 Ensure that calls received by the answering service are transmitted immediately to a responsible person for action.

1.31.9 Provide regular call-back response within a maximum of two hours from the time a call is placed until the arrival of a maintenance person at the site.

1.31.10 Provide emergency call-back response within a maximum of 45 minutes from the time a call is placed until the arrival of a maintenance person at the site.

**1.32 Maintenance: assistance for inspections & testing**

1.32.1 Provide all necessary co-operation and assistance to allow inspections of the equipment by the Consultant and by the Inspecting Authorities.

1.32.2 Provide all necessary co-operation and assistance, either in regular time or overtime, to allow testing of those systems associated with the equipment such as smoke detectors, fire detectors, heat detectors, emergency power, firefighters emergency operation, communication systems, security systems and other systems ancillary to the equipment.

1.32.3 In the event that this requires the supply of one crew for more than an average of three hours per unit per year, submit a request to the Owner for an extra to contract payment.

1.32.4 Should the tests fail because of problems with the elevator or escalator equipment provide any necessary additional assistance at no extra charge.

**1.33 Safety inspections**

1.33.1 Carry out instructions of the inspecting authorities within the period of time allowed by the authorities or, if no period is designated, 30 days of notice of deficiency except for those items that are the responsibility of the Owner and directives resulting from changes to the existing codes.

**1.34 Manufacturers' parts**

1.34.1 Supply replacement parts identical in make and model to the original parts where at all possible.

1.34.2 Where identical parts are not available or a better substitute is available submit the alternative part for the approval of the Owner.

**1.35 Substitute parts**

1.35.1 Where items visible to the general public, in particular exposed finishes and fixtures, are to be replaced, submit drawings, photographs or samples, as required, in ample time for consideration and review.

1.35.2 Submit samples of metals, plastic laminates and finishes properly identified as to project, location and material.

1.35.3 Supply materials in accordance with the reviewed samples.

1.35.4 The review does not include the checking of measurements nor the approval of variations from the Specifications or the Contract Documents.



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**1.36 Parts stocked locally**

- 1.36.1 Arrange that the following spare parts are available on site (in a metal cabinet with a baked enamel finish), in a service vehicle or from the local maintenance office and allow the Owner, at his request, to inspect these parts:
- .1 Hall fixtures: two complete hall station assemblies (with call registered light assemblies), four button heads, and a hall lantern of each type;
  - .2 Car operating panel fixtures: three complete car push button switch assemblies (with call registered light assemblies), four button heads, and one position indicator;
  - .3 Car door equipment: two car door sheaves and one set of door gibs;
  - .4 Hall door equipment: one complete hoistway door closer assembly, two interlocks, four hall door sheaves, and two sets of door gibs;
  - .5 Three fuses of each size used in the controller and in the main line disconnect;
  - .6 Relays: one complete relay of each type with spare contacts and coils;
  - .7 An adequate supply of cleaning solvent, wipers, general purpose oil and door operator oil.

**1.37 Parts available as required**

- 1.37.1 Arrange that the following spare parts are available within 48 hours on site and provide to the Owner, at their request, the methods and procedures used to ensure that this delivery time can be met:
- .1 A printed circuit board of each type used, completely assembled and verified;
  - .2 One complete door operator assembly;
  - .3 One complete door protective device assembly;
  - .4 One complete roller guide assembly of each size used;
  - .5 Spares for parts used in quantity on the equipment in the ratio of one spare for every 100 such parts.

**1.38 Tools maintained locally**

- 1.38.1 Arrange that the following tools are available in a service vehicle or from the local maintenance office and allow the Owner, at their request, to inspect these tools:
- .1 One blower;
  - .2 One door pressure gauge;
  - .3 One rechargeable fluorescent portable light;
  - .4 Signs stating "REGULAR MAINTENANCE BEING PERFORMED";
  - .5 One vacuum cleaner;
  - .6 One step ladder;
  - .7 Twelve cable pullers;
  - .8 Two chain blocks or lift pulls;

- .9 Two sets of feeler gauges;
- .10 One sound level meter;
- .11 A micrometer;
- .12 One F.E.T. volt-ohm-millimeter;
- .13 One paging unit for each maintenance mechanic;
- .14 Four wire rope slings;
- .15 One stop watch;
- .16 One tachometer;
- .17 Test weights totaling 2000 kg (4500 lb) and a hand cart for transportation.

**1.39 Parts cabinet**

- 1.39.1 Provide a maintenance parts cabinet in the machine room.
- 1.39.2 Provide a cabinet of steel finished in baked enamel and of a minimum 0.15 cubic metres capacity.

**1.40 Building log**

- 1.40.1 Complete required entries for building log systems.

**1.41 Maintenance log book**

- 1.41.1 Provide a maintenance log in a permanently bound journal having pre-numbered pages.
- 1.41.2 Indicate in the journal the following information: date, time, name of maintenance technician, regular maintenance, regular time callback, over time callback, action taken, work completed, and further repairs required.
- 1.41.3 The journal is the property of the Owner.
- 1.41.4 Maintain the journal current, on the premises, and available for inspection by the Owner at any time.
- 1.41.5 Make entries in ink, legibly, consecutively and without blanks.

**1.42 Time tickets**

- 1.42.1 Indicate the section of the normal maintenance schedule on each time ticket with details of the portion of the section completed.
- 1.42.2 Submit time tickets for each call-back detailing the cause of the call-back and the action taken.
- 1.42.3 If electronic time tickets are used, make these tickets accessible to the owner through internet at all times.

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**1.43 Accidents and claims**

- 1.43.1 In the event of an accident causing death, personal injury or property damage, arising out of or in connection with the equipment or the performance of the Work whether on or adjacent to the site, advise the Owner immediately giving a verbal report and submit to the Owner within 24 hours of the accident signed written reports from each of the maintenance personnel involved.
- 1.43.2 In the event of an injury to anyone working on or using the equipment, take whatever immediate action is necessary to aid the injured person and to prevent further injury to others.

**1.44 Maintenance manual**

- 1.44.1 Supply to the Owner and the Consultant at the start of the contract a maintenance manual.
- 1.44.2 Incorporate in the manual a description of the controller user interface, fault and error codes, troubleshooting and diagnostic procedures, methods of use and the adjustment of programmable parameters together with their settings at the time of final adjustment.
- 1.44.3 Update the maintenance manual annually and supply to the Owner and Consultant a copy of the updated maintenance manual.

**1.45 Electrical diagrams**

- 1.45.1 Supply wiring diagrams and data as required for the execution of the Work including schematics for speed control, dispatching system, interfaces, printed circuit boards.
- 1.45.2 Incorporate, as part of the schematic diagrams, a reference index ('road map') giving the location of electrical components and wiring interconnections for relay coils, relay contacts, field equipment, integrated circuits and other such devices, so that the position on the schematics of any of these items can be readily determined.
- 1.45.3 Supply, prior to the Substantial Performance inspection, three prints and one reproducible of the wiring and schematic diagrams revised to show changes that have been made.
- 1.45.4 If changes are subsequently made to the wiring or control, supply an additional two sets of marked-up prints of the schematics and field wiring diagrams showing the changes.

**1.46 Maintenance Control Program**

- 1.46.1 Provide to the Owner and the Consultant a copy of the Maintenance Control Program for each device type.
- 1.46.2 During the course of the maintenance contract update the Maintenance Control Program as necessary and forward to the Owner and the Consultant a copy of the updated Maintenance Control Program.

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- 1.46.3 The Maintenance Control Program is the property of the Owner.
- 1.46.4 Store the Maintenance Control Program on site in accordance with the requirements of the Authority Having Jurisdiction.
- 1.46.5 Do not use electronic Maintenance Control Programs without explicit permission of the Owner.
- 1.46.6 Execute the maintenance in accordance with these specifications and the Maintenance Control Program.
- 1.46.7 As a minimum, perform tasks as required by the Authority Having Jurisdiction at the appropriate intervals.
- 1.46.8 Where maintenance and testing frequencies in the Maintenance Control Program are less frequent than the intervals defined in these specifications, these specifications shall take precedence and such frequencies shall be reflected in each device-specific Maintenance Control Program.
- 1.46.9 The Owner may approve changes to these specifications provided that the minimum requirements of the Authority Having Jurisdiction are respected.
- 1.46.10 In advance of performing Category 5 testing, submit to the Owner and Consultant a written plan outlining:
- .1 Step-by-step instructions of how the testing will be performed;
  - .2 Names and qualifications of personnel selected to perform the testing;
  - .3 Incremental testing procedures;
  - .4 Alternative testing means, if applicable and accepted by the Authority Having Jurisdiction;
  - .5 Schedule of the work.
- 1.46.11 As part of the Category 5 testing:
- .1 Perform pre-testing of the safeties prior to full load testing by testing application of the safeties at inspection speed with no load in the cab.
  - .2 Perform alternative testing and provide the results to the Owner in an acceptable electronic format (e.g. PDF), and provide a hard copy printout in the Maintenance Control Program, for record keeping and to establish a baseline for future testing.
  - .3 Take reasonable steps to protect the cab finishes from damage (i.e. laying down plywood or using rubberized weights).
  - .4 If completion of the test on an elevator requires that adjacent elevators in the same group be removed from service, perform the testing outside of regular hours at a time approved by the Owner.
  - .5 If testing is performed prior to submitting an adequate plan and receiving approval from the Owner, or testing deviates from the requirements herein, the Contractor is responsible for correcting any and all damage that may result from the testing (i.e. including building damage).
  - .6 The contractor is responsible to repair or replace any elevator components that may be damaged or fail as a result of testing.

**1.47 Annual report**

1.47.1 Each year, on the anniversary date of the contract, submit to the Owner a report consisting of the following items:

- .1 A complete summary of the activity for the year including, but not limited to, call backs, repair work, complaints;
- .2 A certification that the various items listed herein were checked at the specified times and that they were found to be functioning correctly or, if not functioning correctly, notations of the problems and the corrective action taken;
- .3 An evaluation of the standard of maintenance for the year as compared to prior years and to the standards of the industry for similar installations.

**1.48 Software and firmware updates**

1.48.1 Check each January with the control manufacturer for software and firmware updates.

1.48.2 Advise the Owner of the status of these updates.

1.48.3 Obtain and install updates.

**1.49 Major parts replacement report: elevator**

1.49.1 Each year, on the anniversary date of the contract, submit to the Owner a report on the anticipated life expectancy of the major equipment components and the budget provisions for their replacement, including following items:

- .1 Elevator suspension means;
- .2 The machine.

1.49.2 Six months prior to termination of the maintenance contract, submit to the Owner a report on the major equipment components that will require replacing in the next five years and, if these components will not be replaced before the end of the contract, reimburse the Owner for the usage on a prorated basis based on the expected lifespan of the equipment.

**1.50 Consultant's inspections**

1.50.1 From time to time the Consultant will carry out inspections to verify that the Work is being carried out in accordance with the specifications and with industry standards.

1.50.2 The Consultant will prepare a report listing deficiencies.

1.50.3 Carry out such maintenance, repair and replacement to correct the deficiencies listed on the Consultant's Report within 30 days or, if it is anticipated that the corrective measures will require more time, advise the Consultant of this and obtain their approval of the extension.

**1.51 Maintenance tasks: electric elevators**

1.51.1 Check the following elements during each periodic maintenance visit:

- .1 Car ride and general operation;
- .2 Levelling;
- .3 Hall and car door operation;
- .4 Alarm bell;
- .5 Communication system;
- .6 Door open button;
- .7 Door force (maximum of 135 Newtons [30 lb]);
- .8 Door re-opening device;
- .9 Position indicators;
- .10 Car operating panel devices;
- .11 Commutator brushes.

1.51.2 Perform the following duties at least once every six months:

- .1 Clean pit;
- .2 Clean tops of car;
- .3 Clean the machine removing any oil from the gland packing drip tray;
- .4 Check and lubricate the governor tension sheave;
- .5 Check and lubricate the governor;
- .6 For oil buffers, check the buffers and the buffer oil;
- .7 For chain compensation, check the chain fastening and the chain release safety switch.
- .8 For group operation, check the door open pause times to ensure that they are consistent from one car to another in a group;
- .9 Check the door open pause time cancellation (i.e. monitor) circuit;
- .10 Check the load weighing devices;
- .11 Check the suspension means and governor rope.

1.51.3 Perform the following duties at least once every year:

- .1 Check the machine and motor;
- .2 Check and lubricate machine bearings, where necessary, in accordance with manufacturer's recommendations;
- .3 Check the operation of the emergency brake;
- .4 Check suspension means hitches;
- .5 Inspect suspension means for wear in accordance with standards for elevator suspension means inspection;
- .6 Lubricate the hoist ropes and compensation ropes in accordance with the rope manufacturer's recommendations;
- .7 Check suspension means tension and adjust if necessary;
- .8 Check for stretch in the suspension means and remove buffer blocks or

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- shorten suspension means if required;
- .9 Clean the machine with vacuum and blower;
  - .10 Check the tachometer;
  - .11 Check rotating electrical equipment connections;
  - .12 Remove the covers of the car operating panels and check the internal components and connections;
  - .13 Lubricate and clean car door tracks;
  - .14 Clean control room and control room floor;
  - .15 Check the car door contacts;
  - .16 Check the hoistway door interlocks.
  - .17 Check the car door rollers and eccentrics;
  - .18 Check the car door clutch assembly;
  - .19 Check door operator, clean and lubricate pivot points;
  - .20 Clean guide rails and guide rail fastenings;
  - .21 Vacuum hoistway from top to bottom;
  - .22 Replace the filters on the controller air inlets;
  - .23 Clean and check safety mechanism;
  - .24 Perform a test of the safeties;
  - .25 Check sheaves and shafts for soundness and wear;
  - .26 Check the terminal slowdown device;
  - .27 Strip, clean and lubricate the brake;
  - .28 Check that the brake stops the elevator from full speed in the up direction with an average deceleration of approximately 0.1g without shock or jar;
  - .29 Check to ensure that the brake spring setting is correct;
  - .30 Ensure that the brake operates quietly so that no noise can be detected either in the elevator cab, at the top floor landing or outside the closed machine room door;
  - .31 For oil buffers, check the buffer oil levels, check for water in the oil and test the buffers;
  - .32 Check travelling cables for wear;
  - .33 Check hangers and junction box connections;
  - .34 Check guide rail fastenings;
  - .35 Check the speed, acceleration and jerk profiles and if necessary adjust the drive parameters;
  - .36 Measure performance parameters (noise levels, vibration, operating times) and re-adjust if required;
  - .37 Check components and fastenings that under failure might create a dangerous situation (e.g. sheave bolts and welds, gear bolts, car slings et cetera);
  - .38 As required, clean and paint machine room and pit floor (perform not less

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than once every five years);

- .39 Check the emergency power or battery lowering device operation.
- .40 Check the emergency fire recall operation.
- .41 Check the functioning of the in Firefighters' Emergency Operation.
- .42 Submit a report to the Owner confirming that the annual checks have been carried out, listing the items checked and the measured performance parameters.

1.51.4 When replacing the elevator suspension means:

- .1 Ensure that the number of rope rotations does not exceed:
  - .1 1.5 rotations per 30.5 m (100 ft.) for a 1:1 roping arrangement;
  - .2 3 rotations per 30.5 m (100 ft.) for a 2:1 roping arrangement.
- .2 Use wedge type cable clamps for suspension means;
- .3 Within six to eight weeks, inspect the suspension means and shorten as necessary.

**END OF SECTION**  
**END OF DIVISION**



**1. GENERAL****1.1 General instructions**

1.1.1 Read and conform to:

.1 Division 1 requirements and documents referred to therein.

**1.2 General requirements**

1.2.1 Conform to Section Section 14 00 00.

**1.3 Scope**

1.3.1 Provide a single machine-room-less traction passenger elevator having the following characteristics.

Passenger Elevator		
number of units	1	
designation	-	
application	passenger	
rated speed (m/s, fpm)	0.76	150
capacity (kg, lb)	1360	3000
motor power (kW, HP)	8	10
operation	Simplex	
machine type	Machine-room-less traction	
machine location	Within hoistway	
drive type	Solid state regenerative	
emergency brake	Provide	
car governor	Provide	
counterweight governor	None	
roping ratio	2:1	
control system	Microprocessor	
control location	Within control room	
front entrances	L1, L2	
rear entrances	None	
door type	Single speed side opening	
hoistway door fire resistance	1.5 hours	
lobby sill material	Aluminum	
cab sill material	Aluminum	
entrance width (mm, ")	1067	42
entrance height (mm, ")	2135	84
entrance markings	Provide	
cab width (mm, ")	2030	80

cab depth (mm, “)	1450	57
cab height (mm, “)	2360	93
car door restrictor	Provide	
door safety retainers	Provide	
entrance protection	B44-19 compliant	
door operator	Closed-loop	
interlocks	Provide	
main car station	Applied	
auxiliary car station	None	
verbal annunciation	Provide	
car position indicator	Digital	
cab emergency lighting	Provide	
cab communication	Hands-free phone	
two-way video communication	Provide	
in-cab video display system	None	
car closed circuit camera	Provisions	
car call security	Provisions	
hall call security	None	
hall stations (typical)	Single riser	
hall stations (main floor)	Single riser	
hoistway access switches	Provide	
cab ventilation	Provide	
cab finishes	Provide	
hall door finish (typical)	Stainless steel	
hall door finish (main floor)	Stainless steel	
car door finish	Stainless steel	
hall lanterns	None	
in-car lanterns	Provide	
hall position indicator	None	
lobby panel	None	
CACF panel	None	
central control monitor	None	
car top inspection station	Provide	
load weighing device	Provide	
car guiding	Sliding shoes	
counterweight guiding	Sliding shoes	
guide rails	Provide	
compensation	None	
emergency recall (phase I)	Automatic	

firefighter's operation (phase II)	Provide
emergency power	Battery-rescue device
car top railing	Provide
operating time	16.0 seconds
acceleration rate	0.8 m/s/s

## 2. PRODUCTS

### 2.1 Dimensions

2.1.1 Provide equipment to suit the control room, hoistway, pit and overhead dimensions shown on the architectural drawings.

### 2.2 Prone stretcher requirement

2.2.1 Arrange the elevator to meet the requirement for accommodating and providing adequate access for a patient stretcher 2010 mm (79") long by 610 mm (24") wide in the prone position.

### 2.3 Speed

2.3.1 Arrange the elevators to run under any condition of loading, except the case of overload, within 1.5 percent of the rated speed.

### 2.4 Machine: MRL (Machine-Room-Less)

- 2.4.1 Provide a machine of the single-wrap traction type including an AC motor, electromechanical brake, sheave shaft and traction sheave properly aligned.
- 2.4.2 Mount the machine in the hoistway.
- 2.4.3 Provide a machine with a proven record, over a period of at least seven years, of satisfactory operation on other installations of the same speed, capacity and counterweighting.
- 2.4.4 Provide equipment which will deliver its rated output continuously with a temperature rise not to exceed 50 degrees C (122 degrees F).
- 2.4.5 Provide, as a minimum, Class B insulation.
- 2.4.6 Submit with the proposal the horsepower and torque ratings of the elevator motor.
- 2.4.7 Provide a traction sheave to suit the suspension means.
- 2.4.8 Provide a brake actuated switch to indicate to the control system the state of the brake: that is, lifted or applied.
- 2.4.9 Provide sound and vibration isolation pads or springs arranged so that there is no solid contact between the machine and the building structure.

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**2.5 Brake spring**

- 2.5.1 After the brake is adjusted for correct operation and prior to the performance of safety tests and checks by the inspecting authorities, seal it with a numbered seal so as to prevent un-authorized re-adjustment and record the date and seal number in the log book.

**2.6 Elevator suspension means**

- 2.6.1 Provide elevator suspension means such that the addition of 50 per cent of the rated load to the car cab will cause no more than a 0.04 per cent elongation in the suspension means.
- 2.6.2 Where multiple suspension elements are used in parallel to share a load, ensure that the elements are all from one manufacturing run.
- 2.6.3 Provide sufficient removable counterweight buffer blocking to allow adjustment for suspension means stretch without requiring shortening of the suspension means.
- 2.6.4 Where the suspension means do not permit for measurement of wear or visual observation of replacement conditions, provide a method to establish the preventative replacement condition(s).
- 2.6.5 Where wire hoist ropes are utilized:
- .1 Provide means during and after installation to prevent the ropes turning; do not use swivel connections.
  - .2 Ensure that the number of rope twists do not exceed the manufacturer's recommendations.
  - .3 Adjust the rope tension of each rope to the average of the set plus or minus 5%.
  - .4 Use wedge type cable clamps.
- 2.6.6 Where combustible suspension means are utilized (such as noncircular elastomeric-coated or polyurethane-coated steel belts):
- .1 Provide suspension means meeting not less than an FT-1 rating when tested to the vertical burn test requirements of UL 62, CSA C22.2 No 49 or approved equivalent.
- 2.6.7 Suspension means shall be designed for not less than 2,500,000 trips based on site-specific equipment and arrangement.
- 2.6.8 Where suspension means replacement criteria are based on trip counts, the replacement criteria shall be not less than 2,000,000 trips.
- 2.6.9 A "trip" shall be defined as travel starting at one floor and ending at any other floor, with no stops at intervening floors.

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**2.7    Solid state motor drive: regenerative**

- 2.7.1 Provide a regenerative solid state drive to control the speed of the elevator.
- 2.7.2 Provide circuits to cause the elevator to regenerate power, under negative load conditions, to the normal building power supply with a minimum 0.95 power factor.
- 2.7.3 Provide dynamic braking resistors arranged to absorb power regenerated under negative load conditions when the elevator runs on the building's emergency power generator.
- 2.7.4 Provide a drive system to meet the EN12015 standards and the recommended guidelines of IEEE-519 for generated harmonics and power factor measured at the disconnect switch.
- 2.7.5 Provide pre-torquing.
- 2.7.6 Arrange that the system in responding to a unit step function does not overshoot by more than 21 percent.
- 2.7.7 Arrange that the error signal does not, in normal operation, exceed 2.5 percent.
- 2.7.8 Provide means to shut down the unit in the event that the error signal exceeds 5.0 percent.
- 2.7.9 Provide means to limit the increase in noise level during acceleration to less than 12 decibels (A scale) as measured in the centre of the machine room.
- 2.7.10 Provide electronic feedback circuits to limit the current through the motor and the solid state power devices.
- 2.7.11 Arrange that under low voltage conditions the unit does not exceed the current limits.
- 2.7.12 Provide safety circuits to prevent runaway in the event of closed loop feedback circuit failure.
- 2.7.13 Arrange these circuits so that:
  - .1 With a partial or complete loss of the feedback signal the elevator will come to a stop before the governor jaws are tripped;
  - .2 If the elevator is in the levelling zone with the door interlock circuit open, the elevator will come to a stop prior to leaving the levelling zone.
- 2.7.14 Test these circuits by opening the feedback circuit while the elevator is running at contract speed no load up and while the elevator is levelling into the floor no load up.
- 2.7.15 Provide means for dissipating the heat generated by solid state devices.
- 2.7.16 Provide safety circuits to shut down the unit in the event of overheating.
- 2.7.17 Design the equipment so that power loss or power fade (brownout) does not cause fuses to blow.
- 2.7.18 Provide means to protect the solid state power devices against surge currents.
- 2.7.19 Provide filters and circuits to reduce the line pollution so that the distortion generated by the solid state power device is within the following limits as measured at the disconnect switch:
  - .1 The 5th harmonic voltage does not exceed 6 percent;

- .2 The 5th harmonic current does not exceed 20 percent;
  - .3 The total harmonic voltage does not exceed 10 percent;
  - .4 The total harmonic current does not exceed 25 percent;
  - .5 Line voltage notching of duration greater than 1 millisecond is less than three per cent of the peak sine wave voltage measured from zero reference;
  - .6 The notch depth is less than 10 per cent;
  - .7 The notch duration is less than 2 milliseconds.
- 2.7.20 Provide filters and circuits to reduce the electromagnetic noise level at any frequency with the elevator running, to not more than 0.1 db above the ambient electromagnetic noise level (with the elevator stopped), as measured in the centre of the machine room using a calibrated radio frequency receiver designed in accordance with CSA Standard C108.1.1 together with a calibrated rod or loop antenna.
- 2.7.21 Provide filters and circuits to reduce the electromagnetic noise level at 10 KHz with the elevator running, to not more than 0.01 db above the ambient electromagnetic noise level (with the elevator stopped), as measured in the centre of the machine room using a calibrated radio frequency receiver designed in accordance with CSA Standard C108.1.1 together with a calibrated rod or loop antenna.
- 2.7.22 Arrange the equipment so that any vibration generated is not transmitted directly to the building structure.

## **2.8 Solid-state hardware**

- 2.8.1 Mount solid-state devices, except for high power silicon controlled rectifiers, on removable printed circuit boards.
- 2.8.2 Gold plate the contact points of edge connectors.
- 2.8.3 Use G10 glass epoxy with minimum equivalent 57 gram (2 ounce) copper.
- 2.8.4 Coat the circuits with tin-lead.
- 2.8.5 Provide a solder resist screen.
- 2.8.6 Provide plated through holes for double sided boards.
- 2.8.7 Make all connections to the printed circuits on the printed circuit boards by means of properly dimensioned pads.
- 2.8.8 Do not provide "patched" connections.
- 2.8.9 Design solid-state devices for a high level of noise immunity.
- 2.8.10 Incorporate electrical noise suppression devices in the power supplies and the inputs and outputs associated with the solid-state circuits.
- 2.8.11 Provide filters and circuits to limit the generated electromagnetic noise level at any frequency to not more than 0.1 db above the ambient electromagnetic noise level, as measured in the centre of the machine room using a calibrated radio frequency receiver designed in accordance with CSA Standard C108.1.1 together with a calibrated rod or loop antenna.

- 2.8.12 Provide filters and circuits to limit the generated electromagnetic noise level at 10 KHz to not more than 0.01 db above the ambient electromagnetic noise level, as measured in the centre of the machine room using a calibrated radio frequency receiver designed in accordance with CSA Standard C108.1.1 together with a calibrated rod or loop antenna.

## **2.9 Auxiliary slowdown devices**

- 2.9.1 Provide auxiliary slowdown devices compatible with the solid state speed control and so arranged that, if the normal slowdown devices fail to operate correctly, the elevator will be brought to a controlled stop at the terminal landing with an acceleration not exceeding 0.3 g.
- 2.9.2 Arrange the control circuits so that, if the auxiliary slowdown devices were required to act to stop the elevator, the elevator parks at the terminal landing until the system is checked by a maintenance technician.

## **2.10 Position transducer**

- 2.10.1 Provide a position transducer device to transmit to the control system the position of the elevator.
- 2.10.2 Arrange that the device transmit a minimum of 10 counts per 25 mm (1") of travel.
- 2.10.3 Provide a device having an overall precision within  $\pm 1.0$  mm ( $\pm 0.04$ ").
- 2.10.4 Arrange the elevator controls so that the output from this device is read at least every 5 ms.
- 2.10.5 Transmit the signal from this device either in serial format using a standard protocol (e.g, CAN) or in parallel format using low impedance (less than 10 kilohms) inputs.
- 2.10.6 If the transducer is a relative (pulse counter) type rather than an absolute encoder type:
- .1 Provide gray encoding so as to indicate the direction of movement of the car and to offset 'false' counts caused by vibration;
  - .2 In the event of a counter error reset the position with an accuracy within  $\pm 2.5$  mm ( $\pm 0.1$ ") by returning the car at low speed to a fixed point in the hoistway.

## **2.11 Emergency machine dual brake**

- 2.11.1 Provide an emergency braking device to prevent uncontrolled movement of the elevator.

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**2.12 Governor: automatic reset**

- 2.12.1 Provide an automatic reset governor located so that it can be maintained from the top of the elevator car and tested without special access arrangements.
- 2.12.2 Arrange that the governor, once tripped, will be reset when the car is moved up off the car safeties.

**2.13 Controller**

- 2.13.1 Provide a micro-processor based controller designed to give the required operation as herein specified.
- 2.13.2 Mount panels securely on substantial, self supporting steel frames designed for floor or wall mounting.
- 2.13.3 Provide completely enclosed controllers with covers.
- 2.13.4 Do not mount equipment on the covers unless:
  - .1 Its wiring is designed to support bending caused by opening and closing the cover;
  - .2 Its wiring is protected against damage;
  - .3 If damage happens to the equipment mounted on the cover or the wiring of this equipment, the unit will continue to operate normally.
- 2.13.5 Where relays are used, provide those having a design electrical life and mechanical life equivalent to thirty years operation in the given application, with their contacts designed for maximum conductivity and wiping action.
- 2.13.6 Install wiring on the controller, whether control or field wiring, in a neat workmanlike order and make connections to studs and terminals by means of solder or solderless lugs, or similar connecting devices.
- 2.13.7 Mark relays, contactors, fuses, printed circuit boards and other components clearly and permanently with designations as shown on the schematics.
- 2.13.8 Mount the designations for plug in components on the controller adjacent to the component; do not mount the designation on the plug in component.
- 2.13.9 Provide a written guarantee from the control manufacturer that software and firmware updates will be provided for not less than 20 years at no charge to the Owner.
- 2.13.10 Install the controller in a dedicated control room and not within the hoistway.

**2.14 Computing devices**

- 2.14.1 Where computing devices are used, such as micro-processors or mini-computers, along with associated devices, design to the following requirements:
  - .1 Isolate the inputs from external devices (such as push-buttons) and isolate the outputs to external devices (such as indicators) by means of relays or optical devices;
  - .2 Provide the control program on read-only-memory with spare capacity to allow for future programming modifications and extensions;



- .3 Provide crystal regulation of frequency;
- .4 Provide for separate regulated power supplies to serve each micro-processor system.

## **2.15 Speed control**

- 2.15.1 Design and adjust the equipment so that the average acceleration over the period of constant acceleration is  $0.8 \text{ m/s}^2$  ( $2.6 \text{ ft/s}^2$ ) plus or minus 10%.
- 2.15.2 Design and adjust the equipment so that the average change in acceleration (jerk) is  $1.4 \text{ m/s}^3$  ( $4.6 \text{ ft/s}^3$ ) plus or minus 10%.
- 2.15.3 Design and adjust the equipment so that the rated speed is maintained with an accuracy of 1.5 percent.

## **2.16 Power interruption restart**

- 2.16.1 Provide means so that the elevator system will restart automatically in the event of power interruption.
- 2.16.2 Where volatile memories are provided for position and other data necessary to the continuing operation of the elevators, provide means of preserving this data on power failure or fading ('brownout') for a minimum of four hours and means of automatic recovery upon restoration of normal power.

## **2.17 Control circuits grounding**

- 2.17.1 Arrange the control circuits so that one side of the control power supply for external circuits is grounded to facilitate testing and trouble shooting.
- 2.17.2 An external circuit is defined as one wired outside micro-processors or solid-state devices, as for example, buttons, relays, lights, display screens, position indicators, lanterns, kiosks, limits, locks and such similar devices.
- 2.17.3 Arrange that accidental grounding in the control system will not defeat the safety circuits.

## **2.18 Main floor elevator markings**

- 2.18.1 Provide at the main floor, for each elevator designated as a Firefighter's Elevator, a suitable symbol such as a Firefighter's Hat.
- 2.18.2 Provide at the main floor for each elevator alphanumeric symbols indicating the designation of the elevator.
- 2.18.3 Provide markings as selected by the Owner.
- 2.18.4 Provide samples for review.

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**2.19 Entrance floor markings**

- 2.19.1 Provide, on each hall entrance jamb, raised tactile and braille metallic markings to designate the floor.
- 2.19.2 Provide markings as selected by the Owner.
- 2.19.3 Provide samples for review.

**2.20 Floor marking: hoistway**

- 2.20.1 Identify each landing by means of markings on the inside of the hoistway.
- 2.20.2 Use a stencil to ensure that the floor markings are neat and uniform in appearance.
- 2.20.3 Provide numerals and letters approximately 100 mm (4") high and of a clearly contrasting colour to the colour of the doors and fascias.

**2.21 Door type: single speed side opening**

- 2.21.1 Provide car and hoistway doors of the single-speed side opening, horizontal sliding type.

**2.22 Door friction**

- 2.22.1 Adjust the doors so that with the door closing device disconnected, the doors can be started into motion, from any position, with a force of less than 25 newtons (six pounds) per door panel applied horizontally at the mid-point of the door in line with the direction of movement of the door.

**2.23 Entrance: fire rating**

- 2.23.1 Provide entrances bearing a 1.5 hours fire rating approved by authorities having jurisdiction.
- 2.23.2 Provide a closure, including interlock mechanism and associated wiring, capable of operating for a period of at least one hour when the assembly is subjected to the standard fire exposure tests.

**2.24 Entrances**

- 2.24.1 Provide entrances consisting of frames, jambs, sills, sill support angles and brackets, struts, headers, fascias, toe guards, and sight guards and doors of approved design and size complete with guides and bumpers and all other items necessary to provide a completed installation.
- 2.24.2 Construct the doors of sheet steel a minimum of 1.3 mm (18 gauge) thick.

**2.25 Entrance installation**

- 2.25.1 Assume undivided responsibility for the entire installation of the entrances.
- 2.25.2 Handle, store, protect, install the entrances and associated equipment.
- 2.25.3 Set door frames in perfect alignment with the elevator car platform.

- 2.25.4 Fasten frames and headers to structural supports.
- 2.25.5 Set frames and sills in place prior to building walls.
- 2.25.6 Install frames within 1 mm (0.04") of plumb and sills within 2 mm (0.08") of level over the entrance width.
- 2.25.7 Fasten frames securely at the sill and header.
- 2.25.8 Fasten sills securely to the building structure by means of a support angle or substantial brackets.
- 2.25.9 Install struts, fascias, toe guards and other associated equipment required to complete the installation of the entrances.

**2.26 Entrance finish: stainless steel**

- 2.26.1 Provide stainless steel entrances finished so that spot welds or other surface defects will not show under reflected light.

**2.27 Entrances: door hardware**

- 2.27.1 Supply hoistway door hardware consisting of door hangers and tracks, interlocks, door closers, relating mechanism, operating linkages, gibs, and all other hardware necessary for the installation and operation of the hoistway doors.
- 2.27.2 Provide heavy duty constant force door closers at the main floor to minimize stack-effect from impacting elevator door operation and provide heavy duty constant force door closers at any other high stack-effect elevator lobbies.
- 2.27.3 Supply, for each sliding panel, sheave type, two point suspension hangers.
- 2.27.4 Supply sheaves not less than 75 mm (3") in diameter with ball bearings, properly sealed to retain grease lubrication, and mounted on stands arranged for direct attachment to the panels.
- 2.27.5 Equip hangers with adjustable ball bearing rollers to take the up-thrust of the doors.
- 2.27.6 Arrange the tracks and sheaves so that there is no metal to metal contact, and so that the doors operate properly without any regular lubrication.
- 2.27.7 Design all door hardware for a minimum of noise.

**2.28 Car door restrictor**

- 2.28.1 Provide a car door restrictor to mechanically prevent the opening of the car door from inside the cab unless the elevator is in the door unlocking zone.
- 2.28.2 Provide a device that does not require electrical or electronic components to function.

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**2.29 Car and hoistway door safety retainers**

- 2.29.1 Provide safety retainers at the top and bottom of horizontally sliding doors to retain the closed door panel in position if the primary guiding means fail.
- 2.29.2 Provide retainers that will prevent the displacement of the door panel top and bottom by more than 20 mm (0.8") when the door panel is subjected to a force of 5 000 N (1130 lbf) applied towards the hoistway at right angles to the panel over an area of 300 mm by 300 mm (12" by 12") at the centre of the panel.
- 2.29.3 Provide retainers that will withstand, without detachment or permanent deformation, a force of 1 000 N (225 lbf) applied upward at any point along the width of the door panel together with an additional concurrent force of 1 100 N (250 lbf) applied at right angles to the door at the centre of the panel over an area of 300 mm by 300 mm (12" by 12").
- 2.29.4 Arrange that the retaining means are not involved in the guiding of the panel and are not subjected to wear or stress during normal door operation.

**2.30 Hoistway entrance lunar key access**

- 2.30.1 Provide lunar key access for each hoistway entrance.
- 2.30.2 Provide a protective metal sleeve for each circular lunar key hole (where applicable).

**2.31 Reopening devices and detection of objects**

- 2.31.1 Provide a reopening device and entrance protection capable of detecting objects in the door path and objects approaching the doors.
  - .1 In jurisdictions that have adopted B44-19 or earlier, provide equipment in accordance with B44-19 Section 2.13.5.
  - .2 In jurisdictions that have adopted B44-22, provide equipment in accordance with B44-22 Section 2.13.5.
- 2.31.2 Arrange the doors to reopen (or remain open) when an object is detected.
- 2.31.3 Position detection receivers and emitters, when installed on the door, at least 25 mm (1") back from the leading edge of the doors to prevent accidental damage.
- 2.31.4 Provide a signal on the unit or in the machine room to indicate that a failure has occurred.
- 2.31.5 Supply a device, reliable and consistent in operation, not affected by dust or temperature changes, and having inherent long term reliability with minimum maintenance.
- 2.31.6 Arrange that the operation of the devices will not be affected by adjacent reflective, shiny or glass surfaces.
- 2.31.7 For a transom-mounted reopening device, if new cab interiors are being provided, install the device recessed into the transom substantially flush with the surface (i.e. do not surface mount).

**2.32 Door operator (harmonic)**

- 2.32.1 Provide a heavy duty door operator to open and close the car and hoistway doors simultaneously.
- 2.32.2 Provide either:
  - .1 An alternating current motor, either standard or linear induction type, with associated variable voltage and variable frequency solid state drive to control the speed and torque of the door operator, or;
  - .2 A direct current motor with associated solid state drive to control the speed and torque of the door operator.
- 2.32.3 Provide as a minimum a 375 W (0.5 HP) motor.
- 2.32.4 Provide dual drive arms for centre-opening doors.
- 2.32.5 Provide a solid state door operator control incorporating negative feedback circuits for position, acceleration, velocity and torque.
- 2.32.6 Provide event logging with non-volatile memory so as to retain the event log under power-off conditions.
- 2.32.7 Provide fully automatic installation algorithm profiles that self-adjust the motion profile for the relevant parameters.
- 2.32.8 Provide an output from the door control for a pre-start command to the elevator speed control system.
- 2.32.9 Provide optical isolation for input and output signals.
- 2.32.10 Provide signal line short circuit protection.
- 2.32.11 Provide a serial input to the door control to allow adjustment of speed, acceleration, torque and pre-start point using a notebook computer or keypad.
- 2.32.12 Provide the keypad or software for a standard notebook computer.
- 2.32.13 Arrange that the settings for the door operator can be uploaded to the keypad or notebook computer and then downloaded to another identical operator.
- 2.32.14 Provide an average door closing speed of 300 mm (12") per second, respecting the parameters for door force and door inertia as set out in the elevator code.
- 2.32.15 Provide an average door opening speed of 700 mm (28") per second.
- 2.32.16 Provide, either in the door operator control or in the main elevator control, means to automatically recycle the doors in the event that they stall during the opening or closing operations.
- 2.32.17 Design the door operator and associated components for a minimum of noise.

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**2.33 Car door equipment**

- 2.33.1 Provide car door header, hangers and tracks, door closers, door electrical contacts, master door operators, and all incidental devices necessary for the correct operation of the doors.
- 2.33.2 Provide, for each sliding car door panel, sheave type, two point suspension hangers.
- 2.33.3 Provide sheaves not less than 80 mm (3.25") in diameter with ball bearings, properly sealed to retain grease lubrication, and mounted on stands directly attached to the panels.
- 2.33.4 Equip hangers with adjustable ball bearing rollers to take the up-thrust of the doors.
- 2.33.5 Arrange the tracks and sheaves so that there is no metal to metal contact, and so that the doors operate properly without any regular lubrication.
- 2.33.6 Design all door equipment and associated components for a minimum of noise.

**2.34 Car station**

- 2.34.1 Provide one main car operating panel.
- 2.34.2 Provide in the panel the devices required for normal automatic operation, including the following:
  - .1 Floor push buttons;
  - .2 Door open button;
  - .3 Door close button;
  - .4 Alarm button;
  - .5 Emergency communication button.
- 2.34.3 Number the car call buttons to correspond to the floor served.
- 2.34.4 Provide in conjunction with the car buttons a call registered light for each button to be lighted when the button is pressed and extinguished when the car stops at the selected floor.
- 2.34.5 Secure tactile markings using hidden fasteners.
- 2.34.6 Provide a Firefighters' Emergency Operation cabinet on the main car station in accordance with the Code.
- 2.34.7 Provide a locked service cabinet, its size and location to match the Firefighters' Emergency Operation cabinet, containing the following:
  - .1 Light key switch;
  - .2 Fan key switch;
  - .3 Independent service key switch;
  - .4 Inspection key-switch;
  - .5 Voice annunciation on/off key-switch;
  - .6 Emergency lighting test switch;
  - .7 GFCI duplex receptacle (Run the wires for this receptacle separately from the wires for the other car light and ventilation equipment and connect it

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to a separate breaker in the machine room).

- 2.34.8 Provide, only when required by the prevailing codes, a stop switch located in the service cabinet, arranged to stop the elevator and to duplicate the functions of the alarm button.
- 2.34.9 Engrave the car station with markings and signage such as car capacity, elevator number and other markings required by the prevailing codes and local regulations including remote location of device licenses where available.
- 2.34.10 Ensure that engravings and button designations are easily read when viewed at an angle from any normal standing position in the elevator cab within arms reach of the car station.
- 2.34.11 Hinge the car station faceplate so that it can be swung open towards the adjacent cab side wall to allow access for servicing of the inner components of the car station.
- 2.34.12 Provide a hinge capable of supporting without distortion a test weight of minimum 11 kg resting on the panel non-hinged edge with the panel swung open.
- 2.34.13 Secure the car station in the closed position using countersunk spanner head fasteners or approved equivalent.
- 2.34.14 Arrange the car station so that it can be swung open without interference from the cab flooring, cab wall, cab handrails or other cab appurtenances.

## **2.35 Signal lights**

- 2.35.1 Provide LED position indicators and call registered lights having a minimum contrast ratio of 8:1 throughout a life expectancy greater than 100,000 hours.
- 2.35.2 The contrast ratio is to be determined by subtracting the brightness of the indicator background from the brightness of the marking and then dividing the result by the brightness of the background.
- 2.35.3 Arrange that the variation in intensity and contrast ratio between position indicators does not exceed 5 percent.
- 2.35.4 Arrange that the variation in intensity and contrast ratio between call registered lights does not exceed 5 percent.
- 2.35.5 All measurements are to be made in ambient lighting conditions meeting Code requirements.

## **2.36 Automatic cab lighting and fan control**

- 2.36.1 Arrange that the cab lights and fan are turned off in not more than five minutes when:
  - .1 The elevator is level at a floor;
  - .2 The elevator doors are closed;
  - .3 The elevator has not been selected to answer a call;
  - .4 The elevator is on automatic operation;
  - .5 The elevator safety circuit (including interlocks) is intact.

- 2.36.2 Ensure cab lighting has an efficacy of not less than 35 lumens per Watt.
- 2.36.3 Should any of the above conditions no longer obtain or when emergency communication devices are initiated, turn the car lights and fan on within 0.5 seconds.

**2.37 Car position annunciator**

- 2.37.1 Provide automatic verbal announcement to announce the floors and to provide floor passing tones.
- 2.37.2 Provide a unit to meet the requirements of the Code.
- 2.37.3 Provide means in the service cabinet to adjust the volume over a range from 55 and 70 decibels.
- 2.37.4 Use a female voice for the announcements.

**2.38 Car position indicator**

- 2.38.1 Provide a digital car position indicator mounted in each car operating panel.
- 2.38.2 Arrange the indicator to display a number or symbol at least 50 mm (2") high.
- 2.38.3 Indicate the position of the car at all times, corresponding to the landing through which the car is passing or at which it is stopped.
- 2.38.4 Provide an LCD position indicator screen or a segmented display using light emitting diodes with a minimum of 16 segments per character.
- 2.38.5 Arrange the circuits so as to provide continuous indication of car position.

**2.39 Emergency lighting**

- 2.39.1 Provide a back-up battery power system for alarm bell operation and emergency cab lighting.
- 2.39.2 Install the emergency lighting lamp at the top or upper reaches of the car station unless otherwise required by the site Architectural cab design.
- 2.39.3 Provide a lighting level of at least 11 lux of illumination at the car operating panels for a minimum period of four hours, using at least four LED lamps of equal rating.
- 2.39.4 Cause the lamps to be immediately energized in the event of a power failure or electrical fault de-energizing the normal elevator lighting circuit.
- 2.39.5 Provide for the automatic disconnection of the lamps and the automatic recharging of the lighting unit when normal power is restored to the elevator lighting circuit.
- 2.39.6 Provide a rechargeable battery of the hermetically sealed type, or of a type which provides a reserve of electrolyte, capable of operating unattended and requiring no addition of water or electrolyte for a period of not less than ten years, with provision for visual checking of the electrolyte level without opening the battery or removing caps or fittings.



- 2.39.7 Arrange the battery charging to operate automatically upon restoration of normal power to the unit, to remain in operation until the battery is fully recharged and to maintain the battery at full rated capacity at all times when the unit is not in operation.
- 2.39.8 Provide a pilot lamp to indicate that the normal power supply to the unit and battery charging is in operation.
- 2.39.9 Arrange that the unit can be conveniently tested and operated manually.
- 2.39.10 Install the unit as part of the car so that it is not readily removed.
- 2.39.11 Do not provide portable equipment.
- 2.39.12 Install the lamp fixture above the car station.
- 2.39.13 Provide an emergency lighting test switch in the car service cabinet or behind the car swing return.

## **2.40 Telephone: hands-free operation**

- 2.40.1 Provide a hands-free telephone with automatic dialer capable of initiating and receiving calls.
- 2.40.2 Integrate the telephone into the car station.
- 2.40.3 Provide a push button to initiate the telephone connection.
- 2.40.4 Arrange that the telephone connection can be initiated by an external call.
- 2.40.5 Provide an indicator light to confirm that communication has been established.
- 2.40.6 Pierce the car station for the push button and indicator light with the indicator light mounted flush with the panel.
- 2.40.7 Provide a speaker/microphone for communication.
- 2.40.8 Pierce the car station in front of the speaker with multiple holes 3 mm (1/8") in diameter to allow passage of sound to and from the speaker.
- 2.40.9 Identify the telephone and the button with a raised symbol and Braille.
- 2.40.10 Provide wiring for the telephone from the cab to the machine room.
- 2.40.11 Provide a communication station in the machine room.
- 2.40.12 Connect the wiring on the car to a terminal block mounted in or adjacent to the telephone box.
- 2.40.13 Terminate the wiring in the machine room at a separate enclosed external terminal block mounted on the controller.
- 2.40.14 Provide the terminal block and its enclosure and locate it so that personnel other than elevator mechanics can easily run their conduit and wiring to these terminals without interfering with or touching the elevator wiring or controls.
- 2.40.15 Where more than one controller is in a common machine room bring wiring to one common terminal block.
- 2.40.16 Clearly mark the terminal block.

- 2.40.17 Provide wiring of the twin conductor shielded type with grounded shields.
- 2.40.18 Provide equipment and wiring compatible with and acceptable to the telephone company providing service to the project.
- 2.40.19 Provide material and labour as necessary so as to ensure that the communication system meets the requirements of the Code.

**2.41 Two-way communication system: verbal and non-verbal**

- 2.41.1 Provide a two-way emergency communication system that permits verbal and non-verbal communication.
- 2.41.2 Provide a VoIP system (Voice over Internet Protocol) or approved alternative.
- 2.41.3 Integrate the system into the car station.
- 2.41.4 For verbal communication:
  - .1 Provide a speaker/microphone for communication.
  - .1 Utilization of the hands-free telephone system, including speaker/microphone, is acceptable provided it is compatible and all requirements are met.
- 2.41.5 For non-verbal communication:
  - .1 Provide a camera inside the elevator cab to permit authorized persons to observe the entire surface area of the elevator cab floor.
  - .2 Provide the video coverage required to meet the Code via a streaming service.
  - .3 Ensure that the video streaming service is only initiated by the operator and that streaming is stopped once terminated by the operator.
  - .4 Ensure that video recordings are not stored off-site (including "cloud"-based servers).
  - .5 If buffering of the video (or any other temporary storage for streaming purposes) is required, ensure that the video is immediately deleted at the end of the video streaming session.
  - .6 Install the camera in the elevator ceiling or in the car station and protect it from damage caused by impact.
  - .1 Utilization of existing closed circuit camera systems installed inside the elevator is acceptable provided it is compatible and all requirements are met.
  - .7 Provide a LCD display screen in the car station.
  - .1 Utilization of the car position indicator for the LCD screen is acceptable provided it is compatible and capable of displaying the car position during communication.
  - .8 Arrange the display screen to show authorized personnel when an emergency communication call is placed.
  - .9 Arrange the display screen to display the elevator cab floor surface area,

text messages transmitted by authorized personnel and text messages transmitted by passengers inside the elevator.

- .10 Provide means for the passengers inside the elevator to communicate non-verbally with authorized personnel by:

.1 A QWERTY style button input on the car station; or

.2 YES or NO buttons on the car station.

2.41.6 Provide a back-up battery power system for the communication system capable of operating the system for 4 hours in the event of a power failure.

2.41.7 Initiate the emergency communication system when the push-button on the car station for two-way emergency communication is pressed.

2.41.8 Arrange that the emergency communication system connection can be initiated by an external call.

2.41.9 Provide an indicator light to confirm that communication has been established.

2.41.10 Arrange the emergency communication system to dial to a location within the building staffed by authorized personnel when activated and, if not answered within 45 seconds, automatically forward the call to an off-site location staffed 24 hours per day by authorized personnel.

2.41.11 Provide, to authorized personnel, information that identifies where the call is coming when an emergency communication call is made.

2.41.12 Provide audible and visual communication failure signals within the same housing as the emergency recall switches and indicators and provide a key-switch in this housing to allow authorized personnel to temporarily deactivate the audible signal.

2.41.13 Supply wiring as necessary to connect the system to the elevator system.

2.41.14 Connect the wiring on the car to a terminal block mounted in or adjacent to the telephone box.

2.41.15 Terminate the wiring in the machine room at a separate enclosed external terminal block mounted on the controller.

2.41.16 Provide the terminal block and its enclosure and locate it so that personnel other than elevator mechanics can easily run their conduit and wiring to these terminals without interfering with or touching the elevator wiring or controls.

2.41.17 Where more than one controller is in a common machine room bring wiring to one common terminal block.

2.41.18 Clearly mark the terminal block.

2.41.19 Provide wiring of the twin conductor shielded type with grounded shields.

2.41.20 Provide equipment and wiring compatible with and acceptable to the telephone/IT company providing service to the project.

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- 2.41.21 Provide material and labour as necessary so as to ensure that the communication system meets the requirements of the Code.
  - 2.41.22 Provide any incidental elevator material and elevator work necessary to obtain a complete functioning communication system.
  - 2.41.23 Do not ground the system to an alternating current circuit.
  - 2.41.24 If the connecting wiring requires conduit external to the elevator hoistways and machine rooms coordinate with and assist as necessary the trades executing this work (these other trades are responsible for the provision of the conduit and the pulling of the wiring supplied by the elevator contractor).
  - 2.41.25 Provide standard, readily available hardware components.
  - 2.41.26 Submit for review brochures, details, wiring diagrams and description of the communication system.

**2.42 Web-based monitoring service**

- 2.42.1 Provide a web-based monitoring service to enable authorized personnel to initiate cab video monitoring or initiate non-verbal two-way communication.
- 2.42.2 Provide this monitoring service to the Owner for the maintenance period included herein (whether in the base scope or as an itemized or separate price).
- 2.42.3 If the web-based monitoring service requires fees for continued usage beyond the maintenance period included herein, such fees shall not exceed \$15 per device per month (adjusted annually from the date of substantial performance by an amount not to exceed the previous year's "all items" percentage change in the Consumer Price Index).
- 2.42.4 Ensure that the monitoring system does not require any other special licences, services, subscription or fees to remain functional.
- 2.42.5 Ensure that the monitoring service functions with the current version of all major operating systems and browsers.
- 2.42.6 Ensure that the monitoring system does not require the installation of any proprietary software.
- 2.42.7 Make the web-based monitoring service available to any call answering service selected by the Owner (including other elevator contractors), regardless of which company maintains the elevator equipment.
- 2.42.8 Guarantee that the web-based service shall be provided and maintained for not less than 15 years.

**2.43 Closed circuit camera security system**

- 2.43.1 A closed circuit camera (CCTV) will be installed in the cab by others.
- 2.43.2 Provide wiring from the camera in the cab to a designated point in the machine room as follows.

- 2.43.3 Provide one RG6/U stranded centre conductor coaxial cable and one pair 18 gauge stranded conductor cable within an overall braided shield or such other interconnections as may be required by the CCTV contractor.
- 2.43.4 Run the interconnecting wiring from the elevator security interface box in the machine room to the top of the elevator cab.
- 2.43.5 Provide an excess loop of 3050 mm (10') of cable at either end.
- 2.43.6 Provide a cable access hole in the top of the cab at the camera location.
- 2.43.7 Provide a 110 vac power source on the cab to power the camera.
- 2.43.8 Provide assistance to the CCTV contractor for the installation of the camera.

## **2.44 Security system**

- 2.44.1 Provide for the installation of an elevator card reader security system.
- 2.44.2 Provide accessible space, mounting supports and wiring for a security antenna in the cab main front return panel.
- 2.44.3 Provide a free space 100 mm (4") in height, 175 mm (7") in width and 75 mm (3") in depth centred behind the car panel insert for the security antenna installation.
- 2.44.4 Provide in front of the security antenna a translucent polycarbonate cover.
- 2.44.5 Provide an elevator security interface box in the machine room, complete with terminal blocks and wiring space for the interconnection of the security system to the elevator control system.
- 2.44.6 Provide wiring from the car station card reader to the security interface box using standard connectors.
- 2.44.7 Interface with the security system using serial data transfer.
- 2.44.8 Provide a signal, unique for each car call, to the security system when a car call "request" (which could either be by means of a button or touch screen) is entered and enter the car call when a return signal is received from the security system validating the request.
- 2.44.9 Arrange that the elevator system functions without restriction by the security system when Firefighters' Emergency Operation is operative.
- 2.44.10 Until such time as the security system is installed, arrange that the elevator system functions without restriction by the security system.
- 2.44.11 Provide any incidental elevator material and elevator work necessary to obtain a complete functioning elevator security system.
- 2.44.12 Submit for review, interface box drawings, location drawings and electrical schematics.

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**2.45 Hall push button stations: single riser**

- 2.45.1 Provide a single riser of hall push button stations.
- 2.45.2 Provide one station for each floor.
- 2.45.3 Provide at the intermediate floors, for each station, up and down push buttons located one above the other and call registered lights.
- 2.45.4 Provide at the upper terminal and lower terminal, for each station, a single button and call registered light.
- 2.45.5 Illuminate the call registered light only when there is an elevator in service to respond to the call.
- 2.45.6 Provide communication, emergency power and firefighters' switches, indicators and devices as necessary in the stations.
- 2.45.7 Secure the hall push button stations to the wall using countersunk spanner head fasteners or approved equivalent.

**2.46 Hoistway access switch**

- 2.46.1 Provide hoistway access switches in accordance with the Code.
- 2.46.2 Locate the switches in the entrance frame or in the sight guard in an inconspicuous place.
- 2.46.3 Locate the switches on the same side of the entrance frame as the pick-up roller assembly.

**2.47 Cab ventilation**

- 2.47.1 Provide an exhaust fan capable of developing 30 pascals (0.1" H<sub>2</sub>O) static pressure differential with a minimum capacity of 165 litres per second (350 cfm).
- 2.47.2 Provide a two speed motor for the fan with the speed control located in the car operating panel.
- 2.47.3 Ensure that the cab ventilation does not consume over 0.33 W/cfm at maximum speed.

**2.48 Cab: standard finishes**

- 2.48.1 Provide a cab including the following items:
  - .1 A reinforced metal cab shell allowing the use of the elevator without interior finishes;
  - .2 A ceiling finished in white baked enamel;
  - .3 Returns, transom, car door jamb, lintel and door finished in stainless steel;
  - .4 Aluminum car sill;
  - .5 A 3 mm (1/8") thick aluminum plate over a wooden sub-floor;
  - .6 For non-access walls, 19 mm (3/4") thick plywood panels covered with Scottish Quad pattern panels, with stainless steel reveals and binders;
  - .7 A solid suspended ceiling made of stainless steel panels, the number and dimensions of ceiling panels to correspond with the number and width of

- panels on adjacent cab walls;
- .8 A LED light fixture in each suspended ceiling panel;
- .9 Recess for tile flooring to be installed by others, flush with the car sill;
- .10 Flat stainless steel handrails of a thickness of at least 6 mm (1/4"), a height of 50 mm (2"), located at the maximum height allowed by Appendix E of the Code, extending the full length of non-access walls and with tapers at the ends;;
- .11 Hooks for protective pads.

2.48.2 Provide vandal-resistant finishes.

2.48.3 Supply any other material and labour necessary to provide a completed, installed cab including mounting strips, stay plates, base and sound-deadening material.

2.48.4 Provide cut-outs to accommodate the elevator equipment.

2.48.5 Submit for review shop drawings showing the finishes and design.

#### **2.49 Protective pads**

2.49.1 Provide protective pads covering all exposed wall surface, attached to inconspicuous pad hooks at the top of the cab and reaching to within 100 mm (4") of the car floor.

2.49.2 Provide stitched cut-outs within the pads to provide visibility and access to fixtures.

#### **2.50 Hall lanterns and gongs**

2.50.1 Provide hall lanterns complete with electronic gongs at each entrance to indicate the future direction of the elevator.

2.50.2 Provide a single light for the fixture at the upper terminal.

2.50.3 Provide a single light for the fixture at the lower terminal.

2.50.4 Provide separate up and down lights for the fixture at the intermediate landing.

2.50.5 Arrange the lanterns so that as soon as a car has reached a predetermined distance from the floor, and is going to stop at the floor, the corresponding hall lantern illuminates and the gong operates.

2.50.6 Arrange the controls so that the hall lantern provides a minimum five second advance notice of the arrival of a car.

2.50.7 Maintain the hall lantern illuminated until the car has stopped and the door open time has elapsed.

2.50.8 Do not illuminate the hall lantern on a door re-open unless the re-open is caused by a reversal of direction of travel of the car.

2.50.9 Arrange the operation of the lanterns and gongs to comply with requirements of Appendix E of the Code.

2.50.10 Sound the tone once to indicate the up direction and twice to indicate the down direction.

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|---------|---|
| 2.50.11 | Provide LEDs for illumination.  |
| 2.50.12 | Design the fixture so that the lamps may be readily changed.  |
| 2.50.13 | Do not mount any equipment to the covers; arrange that the covers can be removed completely without disturbing the electric wiring. |
| 2.50.14 | Locate the centre-line of the fixture a minimum of 1830 mm (72") above the floor.   |
| 2.50.15 | Provide lanterns of minimum 60 mm (2.4") size in the smallest direction.  |
| 2.50.16 | Provide means to adjust the gong volume in a range from 55 and 70 decibels.   |

**2.51 In car lanterns and gongs: applied**

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|--------|--|
| 2.51.1 | Provide in car lanterns complete with electronic gongs at each side of the elevator cab entrance to indicate the future direction of the elevator.   |
| 2.51.2 | Mount the lanterns on the car entrance columns.  |
| 2.51.3 | Arrange the lanterns and circuits so that as the car doors start to open in response to a call, the lanterns illuminate and the gong strikes.  |
| 2.51.4 | Sound the gong once to indicate the up direction and twice to indicate the down direction.   |
| 2.51.5 | Maintain the lantern illuminated until the car has stopped and the door open time has elapsed.   |
| 2.51.6 | Do not illuminate the lantern on a door re-open unless the re-open is caused by a reversal of direction of travel of the car.  |
| 2.51.7 | Arrange the operation of the lanterns and gongs to comply with requirements for persons with physical disabilities.  |
| 2.51.8 | Provide LEDs for illumination.   |
| 2.51.9 | Design the fixture so that the lamps may be readily changed. Do not mount any equipment to the covers; arrange that the covers can be removed completely without disturbing the electric wiring. |

**2.52 Car inspection devices**

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|--------|--|
| 2.52.1 | Provide, on the top of the car, a fixed lamp receptacle, with switch, outfitted with wire clamp guards, and a GFI duplex receptacle with safety ground connection.   |
| 2.52.2 | Provide, on the top of the car, an inspection station consisting of an emergency stop button, up, down and common inspection running buttons, on-off switch for the door operator and other devices necessary for top-of-car inspection operation. |



**2.53 Load weighing device**

- 2.53.1 Provide means to measure the load in the car within an accuracy of  $\pm 4\%$  of the elevator capacity.
- 2.53.2 Provide one of the following types of devices:
- .1 A device consisting of four strain gauge load cells located at each corner of the car platform and supporting a free floating car platform and cab with summing circuits to calculate the actual load under varying conditions of eccentric loading;
  - .2 If a flexible material is used for the car floor covering, a device consisting of membrane or similar switches located under the floor covering so as to indicate pressure at every 150 mm (6") by 150 mm (6") square of the floor with summing circuits to calculate from these switches the actual load in the car;
  - .3 A strain gauge device located on the crosshead arranged to measure the deflection of the crosshead and thus determine the load in the car;
  - .4 A device consisting of four strain gauge load cells supporting the weight of the elevator machine with summing circuits to calculate the actual load under varying load conditions;
  - .5 A device consisting of strain gauges mounted in the brake shoe pins so arranged as to measure the torque acting on the brake with summing circuits to calculate the actual load under varying load conditions;
  - .6 A Hall-effect device to measure the vertical movement of the cab on the supports as the load in the cab changes;
  - .7 A device to measure the tension in the elevator lift ropes and thus determine the load in the car.
- 2.53.3 Arrange that the output signal from the load weighing device be connected as an input to the speed control system.
- 2.53.4 Arrange the speed control system so that the output from this device is read, for purposes of pre-torque, after the doors are sufficiently closed that no further passengers can enter or leave and prior to the interlock circuit closing.
- 2.53.5 Transmit the signal from this device either in serial RS232C or current loop format or in parallel format using low impedance (less than 10 kilohms) inputs.
- 2.53.6 Arrange that the speed control system provide to the elevator motor sufficient torque, immediately prior to and during movement of the elevator, to offset the unbalanced load as determined by the load weighing device.
- 2.53.7 Arrange the speed control so that the elevator when leaving a floor does not move in the reverse direction for more than 3 mm (1/8").
- 2.53.8 Arrange that the load weighing device automatically resets itself when the control logic determines with certainty that the car is empty.
- 2.53.9 Arrange that the automatic reset occurs at least once every 24 hours.

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**2.54 Sliding guides**

- 2.54.1 Equip the car and counterweight with spring-loaded sliding guides mounted at both the top and the bottom of the car and counterweight frame.
- 2.54.2 Provide guide shoes of the self-aligning, self lubricating, swivel type with metal body and removable non-metallic liners to ensure smooth and quiet operation.

**2.55 Guide rails**

- 2.55.1 Provide standard section guide rails with tongued and grooved joints.
- 2.55.2 Provide guide rails of structural strength and rigidity sufficient to limit the horizontal deflection of the guide at any point to less than 0.6 mm (0.025") under normal conditions of operation.
- 2.55.3 Use substantial machined finished plates to form the rail joints.
- 2.55.4 Erect guide rails with a variation of not more than 1.6 mm (0.06") over any 6 m (20') section and with a maximum variation of not more than 0.8 mm (0.03") in 25 mm (1").
- 2.55.5 Install guide rails in a strong and substantial manner using brackets affixed to the building structure.
- 2.55.6 Clamp the guides to the bracket with clips.
- 2.55.7 Arrange each clip so as to resist a vertical force of less than 4500 N (1000 pounds) and so as to allow the rail to slide if the vertical force exceeds 9000 N (2000 pounds).
- 2.55.8 Arrange the clips to prevent any horizontal movement of the rail.
- 2.55.9 Extend rails to within less than 300 mm (12") and more than 150 mm (6") of the underside of the overhead slab.
- 2.55.10 Use all standard length rails unless shorter lengths are required to avoid bracket locations or to complete the rail run at the top of the hoistway.
- 2.55.11 Install and locate the rails so that joints do not interfere with the supporting brackets and clamps.

**2.56 Traction elevator emergency power device**

- 2.56.1 Provide a device to automatically move the elevator to a floor in the event of power failure.
- 2.56.2 Arrange that when normal power fails, sufficient power is provided by the device to lift the brake, cause the elevator to move to a floor, open the doors and then remove the elevator from service until normal power is restored.
- 2.56.3 Provide batteries complete with charging system to power the unit.
- 2.56.4 Provide batteries having a minimum life expectancy of ten years.

**2.57 Fascias**

- 2.57.1 Provide fascias to meet, as a minimum, the requirements of the Code.
- 2.57.2 Unless a car door interlock is provided and the strength of the car door meets the applicable requirements of the Code:
  - .1 Provide fascias from the header of one entrance to the sill of the entrance above for the complete travel of the elevator including any express zone;
  - .2 Provide fascias extending below the sill of the lowest landing and above the header of the highest landing.
- 2.57.3 Provide fascia plates extending on each side at least 75 mm (3") beyond the clear openings.
- 2.57.4 Provide fascia plates of sheet steel of minimum 1.5 mm (16 gauge) thickness.
- 2.57.5 Reinforce fascia plates properly.
- 2.57.6 Provide all necessary supports required to secure fascia plates in place.

**2.58 Car platform**

- 2.58.1 Provide a car platform of sufficient size to accommodate the cab and to give the required inside net area assuming typical 50 mm (2") wall thickness and 180 mm (7") for doors, sill and return.
- 2.58.2 Provide a car platform with a structural steel frame filled with wood, aluminum or steel flooring having a depression to receive the finished floor.
- 2.58.3 Mount the car platform on isolating pads to prevent the transmission of noise and vibration from the car frame to the car platform.
- 2.58.4 Install the equipment in such a way that there is no direct metal connection between the car platform or the car cab and the car frame except metallic flex, where required, run in such a way as to provide vibration isolation.

**2.59 Car frame**

- 2.59.1 Provide a car frame of steel channels and angles securely welded, bolted or riveted and substantially reinforced and braced so as to relieve the car enclosure of all strains.

**2.60 Cab installation**

- 2.60.1 Assume undivided responsibility for the entire installation of the cab.
- 2.60.2 Handle, store, protect and install the cab and all associated equipment.
- 2.60.3 Install the elevator cab on the platform plumb and in alignment with the hoistway entrances.
- 2.60.4 Sound isolate the cab from the car frame.
- 2.60.5 Provide additional material and labour as required for handling, storing and installing the cab so as to provide a complete job.

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**2.61 Car top guard**

- 2.61.1 For the safety of the technicians working on the top of the car, provide a car top guard consisting of the following.
- 2.61.2 Provide car top guard to meet, as a minimum, the requirements of the Code.
- 2.61.3 Provide a continuous guard around the sides and rear of the car top.
- 2.61.4 Provide a solid kickplate at the bottom of the guard rail extending from the car top to a height of 150 mm to prevent objects on the car top from falling over the side of the car.
- 2.61.5 Bolt the car top guard components together so that, if necessary, the guard can be temporarily removed.
- 2.61.6 Finish the guard with two coats of rust inhibiting primer and one finished coat of enamel.
- 2.61.7 So as to preserve the cab isolation affix the car top guard either to the cab top or to the car sling and frame but not to both.
- 2.61.8 If the car top guard is affixed to the car sling provide, where necessary, supports to the cab using vibration isolated mountings so arranged as to preserve the cab isolation.
- 2.61.9 If the car top guard is affixed to the cab provide, where necessary, supports to the car sling and uprights using vibration isolated mountings so arranged as to preserve the cab isolation.
- 2.61.10 Ensure that the installation of the car top guard does not reduce the overhead clearances to less than allowed by Code.

**2.62 Counterweight balance**

- 2.62.1 Statically balance the counterweight so that, at the centre of the travel, with the top guiding means removed, the counterweight hangs in the centre of the rails.
- 2.62.2 Arrange the equipment so that there is, in this position, with the guiding means properly adjusted, no pressure upon the guides.
- 2.62.3 Adjust the guiding means so that the pressure upon any guide at any point in the travel does not exceed 110 Newtons (25 pounds).

**2.63 Counterweight**

- 2.63.1 Provide a counterweight to counterbalance the elevator for smooth and economical operation.
- 2.63.2 Contain the weights in a structural steel frame.
- 2.63.3 Make the counterweight equal to the weight of the complete elevator car plus between 40 percent and 50 percent of the rated load.
- 2.63.4 In the elevator pit, where required by Code, provide counterweight guards as follows:
  - .1 Provide metal guards on all open sides of the counterweight except for:
    - .1 The side facing the elevator car where there is no space greater than 500 mm (20 in.).

- .2 In the pit where the bottom of the counterweight resting on its compressed buffer is 2130 (84 in.) or more above the pit floor.
  - .2 Provide guards extending from the lowest part of the counterweight assembly, when the counterweight is resting on the fully compressed buffer, to not less than 2100 (83 in.) and not more than 2450 (96 in.) above the pit floor.
  - .3 Provide guards for the full width of the area being guarded.
  - .4 Provide guards fastened to a metal frame and braced to be equal in strength and stiffness to 2 mm (0.074 in.) thick sheet steel.
  - .5 Where perforated metal guards are provided, they shall reject a ball 25 mm (1 in.) in diameter.
- 2.63.5 In the elevator hoistway, where required by Code, provide counterweight guards as follows:
- .1 Provide metal guards, where a counterweight is located between elevators, on the side next to the adjacent elevator.
  - .2 Provide guards that will not reduce the clearance between the guard and the counterweight below 25 mm (1 in.) when subjected to a force of 450 N (100 lbf) applied over an area of 100 mm x 100 mm (4 in. X 4 in.) at any location.
  - .3 Where perforated metal guards are provided, they shall reject a ball 25 mm (1 in.) in diameter and be made from material equal to or stronger than 1.110 mm (0.0437 in.) diameter wire.

## **2.64 Car balance**

- 2.64.1 Statically balance the car so that, at the centre of the travel, with the top guiding means removed, the car hangs in the centre of the rails.
- 2.64.2 Arrange the equipment so that there is, in this position, with the guiding means properly adjusted, no force upon the guides.
- 2.64.3 Make this test with empty car and car doors closed.
- 2.64.4 Locate and adjust devices such as the compensating devices, travelling cable hangers and cab balancing weights so that the force upon any guide at any point in the travel does not exceed 110 Newtons (25 pounds) with empty car and car doors closed.

## **2.65 Sheaves and supporting beams**

- 2.65.1 Provide sheaves, together with supporting beams or channels, necessary to obtain proper lead of the ropes to car and counterweight, accurately machined and grooved for the diameter of the ropes used.
- 2.65.2 Design and arrange the sheaves so that they can be readily serviced or removed.
- 2.65.3 Provide sound and vibration isolation pads or springs arranged so that there is no solid contact between the sheaves and the building structure.

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**2.66 Pit equipment**

- 2.66.1 Provide buffer extensions, support beams, work platform with ladder as necessary to accommodate the pit depth.
- 2.66.2 Where there is space below the hoistway that is accessible to persons, conform to section 2.6 or 3.6 of the Code.

**2.67 Limit switch dowelling**

- 2.67.1 After the final limit switches are adjusted and prior to the performance of safety tests and checks by the inspecting authorities, fasten, by throughbolting or dowelling, the final limit switches and final limit switch brackets so as to minimize the possibility of future incorrect adjustment.

**2.68 Car ride**

- 2.68.1 Arrange that the horizontal acceleration front to rear or side to side measured in the car with the elevator travelling, with a load of less than 10 per cent of capacity, from top to bottom and bottom to top does not exceed  $0.15 \text{ m/s}^2$  ( $0.5 \text{ ft/s}^2$ ) measured between two consecutive points of opposite value.
- 2.68.2 Arrange that the vertical acceleration measured in the car with the elevator travelling, with a load of less than 10 per cent of capacity, from top to bottom and bottom to top at contract speed, does not exceed  $0.10 \text{ m/s}^2$  ( $0.3 \text{ ft/s}^2$ ) measured between two consecutive points of opposite value.

**2.69 Painting**

- 2.69.1 Ensure that machine room and hoistway equipment, except for machined surfaces and non-rusting surfaces, is protected with two coats of a rust inhibiting primer of a neutral colour, each coat of 25 micron minimum thickness.
- 2.69.2 Paint the pit floor.

**2.70 External connections**

- 2.70.1 Provide a junction box on the external wall of the hoistway at a point to be designated later for connections for such items as telephones, CCTV, lobby panels, monitor systems, to external locations such as the NOT USED.
- 2.70.2 Locate this box as instructed and provide clearly marked terminal blocks for the wiring connections.
- 2.70.3 Supply the required wiring for the connections from this box to the external locations (provision of external conduit and pulling of wiring by others).

**2.71 Travelling cable**

- 2.71.1 Provide travelling cables with flame-retarding and moisture-resisting outer covers and stranded conductors.
- 2.71.2 Supply cables approved for elevator use.

2.71.3 Provide in the travelling cables:

- .1 14 AWG (1.5 square mm) conductors for current-carrying circuits;
- .2 18 AWG (0.75 square mm) conductors for signal circuits;
- .3 20 AWG (0.5 square mm) shielded pair conductors with shielding for telecommunications circuits and data circuits;
- .4 one RG6/U stranded centre conductor coaxial cable and one pair 18 gauge stranded conductor cable within an overall braided shield for closed-circuit television.

2.71.4 Provide ten percent additional minimum spare signal and current-carrying wires in each cable.

2.71.5 Terminate cables using terminal blocks or suitable connectors having identifying numbers to facilitate replacement and service.

2.71.6 Suspend light weight cables using a wire mesh sleeve to relieve strain in the individual conductors and heavier cables using a steel supporting strand if the suspended weight exceeds 35 kg (seventy-five pounds).

## **2.72 Electric wiring**

2.72.1 Provide wiring required to interconnect the equipment.

2.72.2 Provide copper wire.

2.72.3 Provide insulated wiring having a flame retarding and moisture resisting outer cover.

2.72.4 Where flexible conduit is used, supply it in aluminium.

2.72.5 Provide travelling cable to connect car operating panels and other car operating devices to the controller in the machine room.

2.72.6 Where shielded wire is specified, provide wire of not less than 0.52 mm<sup>2</sup> area (20 gauge) having individually shielded pairs with 100% shielding.

2.72.7 Provide colour or number coded wires in multiwire cables.

2.72.8 Provide waterproof terminal labels.

2.72.9 Provide stranded field wire except for the individual wires in multiwire cables which may be either stranded or solid.

## **3. EXECUTION**

### **3.1 Operation: simple**

3.1.1 Provide a micro-processor based simplex control for the elevator.

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**3.2 Operation: call response**

- 3.2.1 Store all hall and car calls in the control memory until answered.
- 3.2.2 Cancel a call when it is answered by a car.
- 3.2.3 Stop a running car at the first landing for which a car call is registered.
- 3.2.4 Stop a running car for a hall call registered for the same direction as the car is travelling, subject to higher priority assignments and to load in the car.

**3.3 Operation: dispatch recovery**

- 3.3.1 If a hall call remains registered for longer than 60 seconds and within that period the cars are not running, dispatch all cars and run without dispatch delay or assignment until all registered hall calls are cancelled.
- 3.3.2 Prevent nuisance car calls by:
  - .1 Not allowing car calls to be registered below the current position of an up travelling car;
  - .2 Not allowing car calls to be registered above the current position of a down travelling car;
  - .3 Or, by cancelling car calls when the car reverses direction.

**3.4 Operation: call initiation**

- 3.4.1 Control the elevator automatically by buttons in the car, marked to correspond with the respective landings served, and by the call buttons at the landing stations.
- 3.4.2 Register a call by momentary pressure of a button.

**3.5 Operation: high & low call return**

- 3.5.1 Cause the car to proceed to the calls until it has come to the limit of calls placed in the direction in which it is travelling, and having done this, subject to the assignment of the dispatch system, to reverse direction.
- 3.5.2 Do not stop the car, except in the case of high and low return, for hall calls in the opposite direction to the direction of the car.

**3.6 Operation: coincident calls**

- 3.6.1 Assign a hall call to an elevator with a car call at the same floor if the elevator is travelling in the same direction as the hall call.

**3.7 Operation: direction reversal**

- 3.7.1 Cause a car without registered car calls, arriving at a floor where both up and down hall calls are registered, to initially respond to the hall call in the direction that the car was travelling.
- 3.7.2 If, subsequent to the stop at this landing, there are no car or hall calls registered such as to require immediate travel in the same direction as before stopping at that landing, cause the car to close its doors, immediately reopen them and respond to the hall call in the opposite direction.



**3.8 Operation: fault recovery**

- 3.8.1 Provide a recovery circuit arranged to take the elevator at low speed to the next floor in the event of an overspeed condition, overload trip, or other similar fault condition.
- 3.8.2 Do not implement the recovery circuit if the movement of the car would endanger the passengers in the car.
- 3.8.3 Provide a circuit separate from the normal speed control circuits, with power derived through separate controls and limited in power by resistance or fixed devices to an appropriate low level.
- 3.8.4 Do not use, in this circuit, any solid state or other device which could fail in a mode that would allow an increase in applied power.
- 3.8.5 Upon arrival of the car level at the next floor, cause the doors to open and remain open, and turn off the car lights.
- 3.8.6 Leave the elevator in this state until the fault is corrected and the car restored to service.

**3.9 Operation: independent service**

- 3.9.1 Provide independent service.
- 3.9.2 On independent service:
  - .1 Remove the car from the automatic supervisory control system;
  - .2 Arrange the circuits so that the car does not respond to hall calls;
  - .3 Render the hall lanterns (if provided) inoperative;
  - .4 Cause the car to park with its doors open;
  - .5 Arrange the controls so that the car responds to any car calls registered if a button is held until the doors are closed and the interlocks made-up;
  - .6 Cause the doors to reopen if the button is released at any time up to the point at which the elevator starts to move;
  - .7 Render inoperative the normal door protective devices;
  - .8 Arrange the controls so that the attendant can select direction of travel;
  - .9 Cancel all registered car calls when the direction reverses or a car call is answered.
  - .10 Arrange the independent service operation so that it does not override security features or security systems.

**3.10 System clock**

- 3.10.1 Where operations or functions are subject to clock control or require clock input, provide a solid state clock.
- 3.10.2 Provide, in the machine room or at the central control console, means to indicate the current clock time.

- 3.10.3 Provide, in the machine room or at the central control console, means to readily reset the clock time.
- 3.10.4 Provide crystal regulation of frequency and voltage control adequate to maintain the time within an accuracy of plus or minus five seconds per month.
- 3.10.5 Provide software to automatically adjust the time for changes from standard to daylight saving time and from daylight saving time to standard time.
- 3.10.6 Provide battery back-up to maintain for a period of at least 24 hours accurate clock time in the event of power loss.

**3.11 Door protective device by-pass (nudging)**

- 3.11.1 Should a door protective device be operated continuously for more than 20 seconds after the elapse of the normal door open time, cause the doors to close slowly under reduced power and operate a buzzer in the car panel as a warning to the person obstructing the door.
- 3.11.2 Cause the 20 seconds to be reduced to 6 seconds until a normal door cycle is performed.

**3.12 Door open pause time**

- 3.12.1 Arrange the circuits so that when the car is stopped in response to a hall call the doors remain open a predetermined length [approximately 5 seconds for an elevator whose entrances are within 3 metres (10') of the hall push button and approximately 6 seconds for an elevator whose entrances are further than 3 metres (10') from the hall push button].
- 3.12.2 Arrange that this predetermined length of time is reduced to approximately 0.7 seconds if a person moves through the entrance (as indicated by the actuation of the door protective device).
- 3.12.3 Unless otherwise specified (e.g. to allow for advance hall lantern warning), arrange the circuits so that when the car is stopped in response to a car registered call the doors remain open a predetermined length of time (approximately 3 to 4 seconds).
- 3.12.4 Make the times separately adjustable over a range from 0.25 seconds to 15 seconds.
- 3.12.5 Arrange the circuits so that the door open pause time is cancelled if a car call button is pressed or the door close button is pressed.

**3.13 Operation: door protective device**

- 3.13.1 Arrange the door protective device so that, should it detect a person or any object in its path, at any point during the door closing operation, it will cause the doors to return to the open position.
- 3.13.2 Adjust both the detection device and the door operation so that an object or person in the way of the door will cause the doors to reverse without the door panel of either hall or car doors actually striking the object or person.

**3.14 Noise level: hoistway**

- 3.14.1 During an elevator operating cycle, including brake lift and brake application, arrange that the noise level in the hoistway is not more than 63 dBA measured at no closer than 1 m (3.3') from the hoist machine, and not more than 58 dBA measured at no closer than 1 m (3.3') outside the hoistway at the top landing.
- 3.14.2 Measure this noise level using an ANSI type 2 sound level meter on the "A" scale with an "F" response.

**3.15 Noise level: door operation**

- 3.15.1 Arrange the equipment so that the noise level, as measured within the cab, does not exceed 60 decibels at any time during a full door open, door close and door reversal cycle.
- 3.15.2 Initiate the door reversal by triggering the door protective device.
- 3.15.3 Measure the noise level using an ANSI type 2 sound level meter on the "A" scale with an "F" response.

**3.16 Noise level: cab**

- 3.16.1 Arrange that, with the elevator travelling from one end of the hoistway to the other, the noise level as measured within the elevator cab does not exceed 55 dBA for traction elevators and 58 dBA for hydraulic elevators.
- 3.16.2 Measure this noise level with an ANSI type 2 sound level meter on the "A" scale with an "F" response.

**3.17 Cab fan: operation**

- 3.17.1 Arrange that there is no discernible vibration in the car with the fan operating.
- 3.17.2 Arrange that the noise level developed by the fan, measured in the car with the fan running, does not exceed 55 dBA.
- 3.17.3 Measure this noise level with an ANSI type 2 sound level meter on the "A" scale with an "F" response.

**3.18 Noise level: control and machine room**

- 3.18.1 Design the equipment so that the noise level with the elevator running, as measured by a meter positioned in the centre of the control and machine rooms, does not exceed 80 decibels.
- 3.18.2 Measure this noise level using an ANSI type 2 sound level meter on the "A" scale with an "F" response.

**3.19 Transmitted vibration**

- 3.19.1 Arrange that the dose value of the transmitted vibration generated by the machine and associated sheaves in the frequency range from 0 to 100 Hz is less than 0.2 in any single axis and that the average of the dose values of the three axes is less than 0.15.

- 3.19.2 Measure the vibration over a period of ten seconds in both directions of travel at contract speed with empty car.
- 3.19.3 Record the vibration using an accelerometer transducer mounted on the machine beam adjacent to the machine.
- 3.19.4 Process the accelerometer output through a low pass digital or analogue filter to delete frequencies above 100 Hz.
- 3.19.5 Record the accelerations from 0 Hz to a minimum 200 Hz in the vertical axis and the two horizontal axes.
- 3.19.6 Calculate the vibration dose value by integrating the fourth power of the acceleration in m/s/s over the ten second period, dividing by the number of samples, and taking the fourth root of the result.

### **3.20 Levelling**

- 3.20.1 Cause the car to stop automatically at floor level, without overshoot, regardless of load or direction of travel so that the car sill is level, within 6 mm (1/4"), with respect to the hoistway sill.
- 3.20.2 When the elevator cab is stopped at a floor, correct for over travel or under travel or movement of the cab away from the floor, by returning the car imperceptibly to floor level.

### **3.21 Brake**

- 3.21.1 Arrange the brake to stop the elevator with full load in the car from full speed in the down direction with an average deceleration of approximately  $1.2 \text{ m/s}^2$  ( $4.0 \text{ ft/s}^2$ ) without shock or jar.
- 3.21.2 Adjust the brake to hold a minimum of 125 percent of the contract load.
- 3.21.3 Design and adjust the brake so that when it operates no noise can be detected either in the elevator cab, at the top floor landing or outside the closed machine room door.

### **3.22 Speed control**

- 3.22.1 Design and adjust the equipment so that the average acceleration over the period of constant acceleration is  $0.8 \text{ m/s}^2$  ( $2.6 \text{ ft/s}^2$ ) plus or minus 10%.
- 3.22.2 Design and adjust the equipment so that the average change in acceleration (jerk) is  $1.4 \text{ m/s}^3$  ( $4.6 \text{ ft/s}^3$ ) plus or minus 10%.
- 3.22.3 Design and adjust the equipment so that the rated speed is maintained with an accuracy of 1.5 percent.

### **3.23 Safety tests**

- 3.23.1 Arrange the safety so that the car stops at both no load and full load on a safety test without excessive acceleration and without damage to the equipment.

**3.24 Test data form: traction**

- 3.24.1 After completion of the Work, and prior to the inspection by the Consultant, submit a test data form certifying that the unit is complete and ready for inspection.
- 3.24.2 Arrange that this form be signed by the person responsible for the performance of the Work.
- 3.24.3 Include a check list of the items in the specifications as well as other performance data such as door times, operating times, brake-to-brake times, starting, running, stopping currents and voltages, slowdown and limit switch settings, governor settings, and, in general, settings of any adjustable devices.
- 3.24.4 List on this form safety devices, together with their settings and indicate whether they have been checked and adjusted.
- 3.24.5 Submit a soft copy of the data form in PDF (Acrobat Reader) format.

**3.25 Operating time**

- 3.25.1 Adjust the equipment so that the elapsed time to travel one typical floor does not exceed the time shown in the data table.
- 3.25.2 Measure this time under the following conditions:
  - .1 A typical floor height of less than 4000 mm (13');
  - .2 Floor levelling accuracy of  $\pm 6$  mm (1/4");
  - .3 Start time when the fully opened doors begin to close;
  - .4 Stop time when the car is stopped level with the next floor and the car and hall doors are 800 mm (32") open;
  - .5 Time measured with full load in the car and in both directions of travel;
  - .6 Power door operation for the hall and car doors conforms to the elevator code requirements.
- 3.25.3 Adjust the equipment so that the operating time is compatible with dependable, consistent operation without undue wear or excessive maintenance and so that this operating time can be readily maintained over the life of the elevator installation.
- 3.25.4 Adjust the equipment so that, with the control functioning so as to give the required time, the elevator operates under smooth acceleration and retardation and provides a comfortable and agreeable ride.

**3.26 Firefighters' Emergency Operation: automatic recall**

- 3.26.1 Provide Firefighters' Emergency Operation including:
  - .1 Phase I automatic Emergency Recall Operation;
  - .2 Phase I Emergency Recall Operation to an alternate level;
  - .3 Phase II Emergency In-Car Operation.

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3.26.2 Provide switches and indicators in the hall and car stations as required by Code.

**END OF SECTION**

**1. GENERAL**

**1.1 Related Work**

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

**1.2 Scope of Work**

- 1.2.1 Fire Suppression Contractor shall retain Professional Engineer registered in Province of Ontario to provide engineering design and field review services including signed and sealed CAD fire suppression drawings and hydraulic calculations.
- 1.2.2 The following specification is a "Performance Type" specification outlining the standard of the installation. The detailed design of the fire protection system shall be provided by the Fire Protection System Contractor and their Professional Engineer. This includes all fire suppression systems and requirements in this specification.
- 1.2.3 Fire Suppression Contractor's Professional Engineer shall provide field reviews of work on site as work progresses and provide Field Review Reports.
- 1.2.4 Submit documentation to Authorities Having Jurisdiction, arrange for, pay for and obtain trade permits prior to commencing installation work on site.
- 1.2.5 Obtain static and residual water supply pressure information from utility or municipality in writing and submit copy of information with shop drawings. If this information is not available, arrange for, pay for and perform hydrant flow test.
- 1.2.6 Fire Suppression Contractor shall install systems as outlined below and indicated on drawings throughout buildings including:
- .1 Wet sprinkler systems in heated areas.
  - .2 Dry sprinklers.
  - .3 Standpipe systems.
  - .4 Portable fire extinguishers.
  - .5 Piping servicing remote fire department siamese connections.
  - .6 Hangers and seismic bracing as indicated on drawings and as required by NFPA 13.
- 1.2.7 Refer to Code Consultant or Alternative Solution reports, obtain copies through Architect and provide fire suppression systems outlined therein.
- 1.2.8 Connect to dedicated fire suppression water main located as indicated on drawings.

- 1.2.9 Fire Suppression Contractor responsible for all work downstream of flange in water entry room.
- 1.2.10 Provide Commissioning, Identification, Insulation and Heat Tracing for fire suppression systems as described in associated specification Sections.

### **1.3 Codes, Bylaws, Standards and Approvals**

- 1.3.1 Installation, workmanship and testing shall conform to the following standards:
  - .1 Ontario Building Code.
  - .2 Ontario Fire Code.
  - .3 National Fire Protection Association NFPA 10 - Standard for Portable Fire Extinguishers.
  - .4 National Fire Protection Association NFPA 13 - Standard for the Installation of Sprinkler Systems.
  - .5 National Fire Protection Association NFPA 14 - Standard for the Installation of Standpipe and Hose Systems.
  - .6 National Fire Protection Association NFPA 25 - Standard for the inspection, testing and maintenance of water-based fire protection systems. Copy of standard must be inserted into maintenance manuals at completion of project.
- 1.3.2 Installation shall be subjected to design approval and inspection of Authority Having Jurisdiction.
- 1.3.3 System components shall be of one Manufacturer. Normally, materials and devices listed by nationally recognized fire test laboratories will be acceptable.

### **1.4 Document Submittals**

- 1.4.1 Provide a copy of Letters of Assurance signed and sealed by Fire Suppression Contractor's Registered Professional Engineer to Introba.
- 1.4.2 Submit a copy of static and residual water supply pressure information to Introba. Water supply date to be less than 12 months old at date of sprinkler permit application.
- 1.4.3 Submit digital copy drawings of fire suppression sprinkler systems, fire suppression standpipes, clean agent suppression systems, and other fire suppression or fire extinguishing systems designed by the contractor's design team and EOR to Introba for review.
- 1.4.4 Submit hydraulic calculations for water-based fire suppression sprinkler and standpipe systems to Introba for review.
- 1.4.5 Su
- 1.4.6 Submit "Contractor's Material and Test Certificate" for each underground and each aboveground section or zone of work in



accordance with Authority Having Jurisdiction test procedure requirements, to Consultant and local Authority Having Jurisdiction minimum of 10 working days prior to Occupancy.

- 1.4.7 Submit Backflow Prevention Test Certificate for backflow prevention devices to Introba for review.
- 1.4.8 Submit signed letter from firestopping installation firm on company letterhead certifying penetrations of fire suppression piping through vertical and horizontal rated separations have been firestopped in accordance with CAN4-S115. Refer to Submittals in Section 23 05 05 Firestopping for additional requirements to Introba for review.
- 1.4.9 Obtain from Electrical Contractor and submit copy of Fire Alarm Verification Certificate to the Consultant and Authority Having Jurisdiction minimum of 10 working days prior to Occupancy.
- 1.4.10 Submit maintenance data for systems and arrange for inclusion in project Fire Protection/Mechanical Maintenance and Operations Manuals as outlined below to Introba for review.
- 1.4.11 Submit As-Built (Record) Drawings, signed and sealed to Introba and Authority Having Jurisdiction at completion of project.
- 1.4.12 Submit Product Literature and shop drawings as noted below.
- 1.4.13 Submit samples as noted below.

## **1.5 Shop Drawings**

- 1.5.1 Submit a complete set of Product Literature and shop drawings as indicated below to Introba for review of the following items:
  - .1 Piping materials.
  - .2 Valves, fittings and couplings.
  - .3 Fire department Siamese connections.
  - .4 Backflow preventer.
  - .5 Sprinkler zone manifolds.
  - .6 Sprinkler heads and escutcheon plates.
  - .7 Fire extinguishers and cabinets.
  - .8 Fire hose valves.
  - .9 Heat Tracing Components.
  - .10 Insulation Materials.
  - .11 Firestopping component data sheets and ULC or Warnock Hersey listings.
  - .12 Hangers and Seismic Bracing.
- 1.5.2 Product literature to identify all pertinent features of the particular version/model of product to allow for review.
- 1.5.3 Incomplete and submittals not identifying the specific product will be rejected.

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**1.6 Maintenance Data**

- 1.6.1 Provide maintenance data for fire suppression systems complete with Table of Contents and coordinate with plumbing and HVAC trades for incorporation into designated section of project Mechanical Operation and Maintenance Manual. Refer to 23 05 00. Include a digital copy in PDF format with Table of Contents linked to applicable section or using bookmarks.
- 1.6.2 Include complete copy of National Fire Protection Association NFPA-25, Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems.
- 1.6.3 Detailed instructions for normal maintenance of installed equipment including operational procedures, frequency of operational checks, service instruction and troubleshooting instructions. Information provided must be suitable for incorporation into Fire Department's operation manual if requested by Authority Having Jurisdiction.
- 1.6.4 Local source of supply for each item of equipment, indicating Manufacturer's and local supplier's company names, addresses, phone numbers, faxes and e-mails.
- 1.6.5 Labelling and identification schedules.
- 1.6.6 Valve schedule including location, service type and normal position.
- 1.6.7 Warranties, certificates and miscellaneous reports.
- 1.6.8 Manufacturer's operating and maintenance brochures, including wiring diagrams.
- 1.6.9 Comprehensive description of operation of systems, including function of each item of equipment in system.
- 1.6.10 Lubrication schedule, indicating recommended lubricants and grades (grease or oil), for lubricated equipment components.
- 1.6.11 Shop drawings for components as listed in Shop Drawings clauses above.
- 1.6.12 Documentation as listed in Document Submittals clauses above.

**1.7 Connection Fees**

- 1.7.1 Arrange and pay for Municipal connection fees for new dedicated fire suppression water connection to Municipal water supply system if required for fire hydrant.

**1.8 Pipe, Fittings and Couplings**

- 1.8.1 Responsibility for including for pipe, fittings, couplings valves, nipples, drains, test connections and accessory pipe work for complete installation is to be included in this Section of work within base tender price.
- 1.8.2 No extra cost will be considered based on failure of Contractor to allow for extra pipe, fittings and pipe work as required during

construction to provide offsets to avoid structural components, and coordinate with other piping services, ductwork, cable trays, conduits or other obstacles.

- 1.8.3 All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
- 1.8.4 All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.
- 1.8.5 All mechanical jointing systems shall be spot-checked and inspected by the supplier's factory trained representative and inspection reports shall be provided along with materials and test certificates.

## **1.9 Sprinklers**

- 1.9.1 Responsibility for allowing for sprinklers for complete installation shall be included in base tender price. Layout on drawings shows general intention of work and sprinkler locations with respect to other ceiling elements such as ceiling tiles, lights and diffusers. However, Contractor shall provide additional sprinklers as required.
- 1.9.2 No extra cost will be considered based on failure of Contractor to allow extra sprinklers as required during construction to conform to NFPA requirements and Authority Having Jurisdiction.
- 1.9.3 Sprinklers shall be referred to on drawings, submittals, and other documentation, by the sprinkler identification or model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.

## **1.10 Clean Up**

- 1.10.1 Leave systems operating with work areas clean to satisfaction of Consultant, Architect or Owner's Representative at completion of project.

## **2. PRODUCTS**

### **2.1 General**

- 2.1.1 Materials shall be ULC Listed and meet project pressure rating for intended service and shall be supplied in original factory packaging. Manufacturer and brand for all pipe and fittings shall match and be based on one brand or manufacturer.

### **2.2 Hangers and Supports**

- 2.2.1 Hangers and supports including seismic restraints shall be ULC Listed and shall conform to appropriate NFPA standards.

- 2.2.2 Toggle hangers, strap hangers, and concrete inserts are unacceptable.
- 2.2.3 Power/powder actuated fastenings and drop-in anchors are not permitted to be used for tensile loading (i.e. suspension of mechanical equipment) or for seismic anchorage and/or restraint.

### **2.3 Firestopping**

- 2.3.1 Provide firestopping materials listed in accordance with CAN4-S115 at pipes penetrating horizontal and vertical fire rated separations. Refer also to Section 23 05 00 for additional requirements.
- 2.3.2 Refer to Section 23 05 05 Firestopping for firestop requirements.

### **2.4 Miscellaneous Metal related to Fire Protection System**

- 2.4.1 Miscellaneous metal related to fire suppression systems including metal back up plates, stands, brackets and supports for roof, floor or wall supported equipment and piping systems is part of this Section of work.
- 2.4.2 Provide two coats of heavy red oxide primer to steel components after fabrication, and touch-up on site after installation.
- 2.4.3 Hot Dipped galvanizing is required for all components that are exposed to the exterior elements.

### **2.5 Backflow Prevention Stations**

- 2.5.1 Provide ULC Listed backflow prevention assembly, type as required by the Authority Having Jurisdiction (i.e. double check valve assembly (DCVA), double check detector assembly (DCDA)).
- 2.5.2 Backflow prevention device shall be complete with OS and Y inlet and outlet shut-off valves if project requires a fire pump. In projects without a fire pump, butterfly isolation valves can be presented as an alternative, subject to the approval of the Engineer of Record.
- 2.5.3 Backflow prevention stations shall be in accordance with:
  - .1 Ontario Water Works Association Cross Connection Control Manual.
  - .2 CAN/CSA-B64.10-11 CAN/CSA-B64.10.1-11 Standard.
  - .3 Manual for the Selection and Installation of Backflow Prevention Devices.
  - .4 Manual for the Maintenance and Field Testing of Backflow Prevention Devices.
  - .5 Ontario Building Code – Part 7 Plumbing.
  - .6 EPA's Cross Connection Control Manual.
  - .7 AWWA Canadian Cross Connection Control Manual.
- 2.5.4 Isolation valves shall be provided with supervisory switches connected to supervisory signals at fire alarm system.

- 2.5.5 Reduced Pressure Backflow Preventers are required on systems for all glycol systems and systems with water cisterns requirements.

### **3 . EXECUTION**

#### **3.1 Grading and Drainage of Piping**

- 3.1.1 Provide low point drains on wet trapped piping greater than 5 US gal (19 L).
- 3.1.2 Grade fire suppression piping to be drained through drain cocks.
- 3.1.3 Pipe sprinkler system drains to floor drains in mechanical/service rooms.
- 3.1.4 Provide Drum Drips on dry systems in areas subject to freezing.
- 3.1.5 Dry System Grading:
  - .1 Branch Line must be pitched a minimum of ½" (15 mm) per 10'-0" (3 m) of pipe.
  - .2 Mains must be pitched a minimum of ¼" (6 mm) per 10'-0" (3m) of pipe.

#### **3.2 Building Movement**

- 3.2.1 Install piping systems, including take-offs installed within building, so piping and connected equipment will not be distorted by expansion, contraction or building settlement.
- 3.2.2 Provide offsets, Flex Joints, and/or piping expansion components at building expansion joints, building seismic joints and firewalls as required by NFPA 13.
- 3.2.3 For water systems, flexible couplings may be used in header piping to accommodate thermal growth and contraction, and for the elimination of expansion loops. In accordance with manufacturers installation instructions and as approved by the Engineer.
- 3.2.4 Provide seismic anchors where necessary to control pipe expansion and pipe movement.

#### **3.3 Pipe Sleeves and Escutcheons**

- 3.3.1 Supply and installation of pipe sleeves and escutcheons for fire suppression system piping is included in this Section of work.
- 3.3.2 Do not cast piping into concrete walls, slabs or masonry walls.
- 3.3.3 At exterior wall or slab penetrations, provide sleeves minimum 2 nominal pipe diameters larger than pipe (i.e. a 10" (250 mm) sleeve for nominal 6" (150 mm) diameter pipe).
- 3.3.4 Install pipe concentric with sleeves.

- 3.3.5 Remove plastic sleeves, where they are used, and prior to installation of pipe penetration. Resulting hole shall be classified as sleeves except in wet areas.
- 3.3.6 Provide minimum Schedule 10 steel pipe sleeves where piping penetrates masonry walls.
- 3.3.7 Extend sleeves 2" (50 mm) above floor slabs in wet areas. Wet areas include but not limited to penthouse equipment rooms, janitor's rooms, utility rooms and washrooms.
- 3.3.8 Seal penetrations through aboveground exterior walls, and underground exterior walls and slabs including slabs on grade, where no hydrostatic pressure exists, with flexible, non-hardening, weatherproof caulking compound. Seal around exterior circumference of sleeves and annular space between pipes and sleeves.
- 3.3.9 Provide Link Seal type wall gasket to seal exposed sides of opening between pipe and sleeve on foundation walls with caulking fill. Provide water proofing mastic seal on concealed side of opening.
  - .1 Acceptable Sealing Products: Garlock Link-Seal, Metraflex MetraSeal.
- 3.3.10 Install chrome-plated escutcheons on exposed piping passing through walls, floors and ceilings in finished areas.
- 3.3.11 Risers for fire suppression systems with horizontal branch takeoffs passing through sleeves set rigidly in structure adjacent to risers shall be set to accommodate long term structural movement.

### **3.4 Firestopping**

- 3.4.1 Provide firestopping to CAN4-S115 at pipes penetrating horizontal and vertical rated separations.
- 3.4.2 Smooth finished surface in neat workmanlike appearance.
- 3.4.3 Where ULC listed for fire protection CPVC sprinkler pipe may be used. Materials in contact with CPVC pipe and fittings shall comply with Manufacturers compatibility documentation.
- 3.4.4 Refer to Section 23 05 05 Firestopping for firestop requirements.

### **3.5 Core Drilling**

- 3.5.1 Fire Suppression Contractor shall be on site and coordinate sleeves and block-out requirements in accordance with project construction schedule to minimize coring.
- 3.5.2 Arrange and pay for costs of core drilling required for fire suppression systems in this Section.
- 3.5.3 Verify location of existing service runs and structural reinforcement within existing concrete floors and walls prior to core drilling and cutting. Core drilling and cutting of structural building components

shall only take place upon receipt of specific written approval of Structural Consultant. Repairs that may be required to existing services damaged during core drilling is included in this Section.

- 3.5.4 Penetrations up to 6" (150 mm) nominal pipe size in pre-cast concrete may be cored on site as per Fire Suppression Contractor. Larger penetrations shall be located and arranged for in pre-cast work with pre-cast Manufacturer prior to shipping to site.

### **3.6 Backflow Prevention Stations**

- 3.6.1 Install backflow prevention stations in complete accordance with "Ontario Water Works Association Cross Connection Control Manual". Mount backflow preventers maximum 5'-0" (1.5 m) above floor level for servicing.
- 3.6.2 Complete testing of backflow prevention devices shall be carried out under this Section of work prior to final acceptance of fire suppression systems. Submit certificate signed and witnessed that testing was satisfactorily completed and include copy in project Mechanical Operation and Maintenance Manual.

### **3.7 Hangers and Supports**

- 3.7.1 Provide hangers and supports as outlined in NFPA including supports to secure piping to restrict movement upon activation of fire suppression systems including activation of fire pumps and charging of systems through fire department Siamese connections.
- 3.7.2 Power/powder actuated fastenings and drop-in anchors are not permitted to be used for tensile loading (i.e. suspension of fire protection equipment) or for seismic anchorage and/or restraint.

### **3.8 Pressure Gauges**

- 3.8.1 Provide pressure gauges at the following locations and additional gauges as required by NFPA, Authority Having Jurisdiction and system configuration:
- .1 Water entry valve station both upstream and downstream of backflow preventer.
  - .2 Upstream and downstream of pumps.
  - .3 At top of fire suppression standpipe and sprinkler risers.
  - .4 Upstream and downstream of Primary Pressure Regulating valve assemblies.

### **3.9 System Pressure Ratings**

- 3.9.1 The system pipe, components, fittings valves etc. to meet the following maximum pressure rating requirements:
- .1 Low pressure system: 12.07 bar (175 psi (1,210 kPa)).

- .2 Mid pressure system: between 12.07 bar (175 psi (1,210 kPa)) and 20.6 bar (300 psi (2,068 kPa)).
  - .3 High pressure system: 20.6 bar (300 psi (2,068 kPa)).
- 3.9.2 System pressure in excess of those listed above require appropriately rated components (i.e. schedule 40 pipe, high pressure couplings, flanged connections, etc.).

### **3.10 Test and Inspection**

- 3.10.1 Fire Suppression Contractor shall provide testing of fire suppression and fire extinguishing systems including furnish labour, materials, equipment and instruments necessary for required tests. Work shall be subject to review by Consultant, Owner's Representative, and Authority Having Jurisdiction.
- 3.10.2 Provide testing for fire suppression piping, equipment and systems in accordance with NFPA 25 – Standard for the inspection, testing and maintenance of water-based fire protection systems, including the following:
- .1 Wet sprinkler systems.
  - .2 Dry sprinkler systems.
  - .3 Deluge sprinkler systems.
  - .4 Standpipes systems.
  - .5 Megger testing of heat tracing systems.
- 3.10.3 Tests on fire suppression systems shall include pressure tests and conform to standard of Authority Having Jurisdiction. Fire Department Siamese connection and fire pump test header lines shall also be hydrostatically tested.
- 3.10.4 Provide completed copies of Contractor's Material and Test Certificates for Aboveground Piping, and for Underground Piping, on a per zone basis, as per NFPA 13.
- 3.10.5 Fire Pump Manufacturer's authorized Representative shall provide testing of fire pump and jockey pump systems, including submission of report.
- 3.10.6 Manufacturer's authorized Representatives shall provide testing of pre-action, deluge, and/or clean agent fire suppression or fire extinguishing systems, including submission of report for each system.
- 3.10.7 Provide minimum 3 working days' notice for projects within 100 km (60 miles) of Introba Office and minimum of 5 working days' notice for projects greater than 100 km (60 miles) of Introba Office, in advance of making required tests.



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**3.11 Substantial Completion Requirements**

3.11.1 The following items must be completed with documentation prior to the date of Substantial Completion:

- .1 Fire protection system Engineer of Record inspection reports, including the most recent report has been made and submitted to the Consultant.
- .2 All seismic restraints checked and verified, a report submitted to the Consultant by the suppliers Fire Protection Contractor's Ontario Registered Engineer.
- .3 Fire Protection Contractor's Contractor Materials and Test Certificates submitted for above and below grade piping on a per zone basis.
- .4 Electrical Contractor's fire alarm system test and verification report has been submitted and copied to this Consultant.
- .5 Heat Trace Report for Sprinkler System that includes megger and capacitance tests on trace cable with verification from supplier for each circuit to this consultant.
- .6 Fire pump commissioning report submitted to this Consultant.
- .7 Special protection system commissioning report submitted to this Consultant.
- .8 All fire alarm shutdowns and emergency start-ups for HVAC systems have been tested, verified and commissioned, with a report submitted to this Consultant.
- .9 Backflow preventer/check valves at fire protection water supply has been tested, verified and commissioned, with a report submitted to this Consultant.
- .10 Final As-built Record drawings have been submitted to this Consultant for review.

**END OF SECTION**

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## 1. GENERAL

### 1.1 Related Work

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.
- 1.1.2 Also refer to Section 21 07 19 Fire Suppression Piping Insulation.

### 1.2 Scope of Work

- 1.2.1 In addition to piping and systems listed in Section 23 07 19, heat tracing for freeze protection on fire suppression piping systems in exterior or unheated areas, including the following:
  - .1 Fire suppression piping.
  - .2 Combined domestic water and fire suppression piping.
- 1.2.2 Provide heat trace controllers and coordinate with Electrical for monitoring of heat tracing systems as dedicated trouble signal on fire alarm annunciator panel.

## 2. PRODUCTS

### 2.1 Protection of Wet Fire Protection Systems from Freezing

- 2.1.1 Piping freeze protection system shall conform to CSA and ULC Standards in accordance with Electrical code requirements and the requirements of Ontario Fire Code and Ontario building Code.
- 2.1.2 System shall be complete with power connections, grommets, splices, end seals, splices and tee components in accordance with the Manufacturer's requirements complete with sealants.
- 2.1.3 Provide voltage monitor device for connection to fire alarm panel upon failure of heat tracing or power supply to heat tracing.
- 2.1.4 Alarm point on fire alarm annunciator panel shall consist of indicator light, audible alarm and test switch.
- 2.1.5 The self-regulating, heating cable.
- 2.1.6 The heating cable and controller shall be part of a ULC Listed (ULC category: VGNJ7)3for fire protection (mains and branch lines).
- 2.1.7 Manufacturer to provide connection kits for power, splice, tee and end seal.
- 2.1.8 All Splices, Tees & End Seals shall be installed above the insulation per Canadian Electrical Code (applicable edition).
- 2.1.9 Power Connection Kits shall be NEMA 4X rated to prevent water ingress and corrosion.

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- 2.1.10 Connection kits shall be UV stabilized for installation outdoors.
- 2.1.11 Connections kits shall be ULC Listed.
- 2.1.12 Heating cable shall be attached to metal fire sprinkler piping with manufacturer specified connections. Use of metal zip ties is prohibited for the attachment of the heating cable to the fire sprinkler piping.
- 2.1.13 Contractor shall provide Heating Tracing Labels every 10'-0" (3 m), opposite sides of pipe to identify fire sprinkler piping with heat tracing cable installed on it.
- 2.1.14 Controller
- .1 Unit shall be ULC approved for use on fire sprinkler piping including surge suppression.
  - .2 Unit shall operate at 100-277 VAC and rated @ 30A per circuit.
  - .3 Unit shall include a High-Resolution Display with integral display heater, front panel capacitive touch switches & LED Indication of Power, Load & Alarm.
  - .4 Unit shall include ON/OFF, PID or Manual power control with a selectable Soft Start program.
  - .5 Unit shall include two (2) sensors per circuit with one (1) for ambient temperature control and one (1) for monitoring on the Heat Tracing.
  - .6 Unit shall include 2 x common alarm outputs (1 x AC, 1 x DC), Alarms for Low/High Temperature & Current, GFEP (Ground Fault Equipment Protection), and Sensor Failure.
  - .7 Unit shall be housed in a NEMA 4X, fiberglass enclosure with hinged door.
- 2.1.15 Temperature Sensors
- .1 Provide one, 100 ohm, three wire, line sensing, temperature sensor 3" (80 mm) L x 3/16" (4.5 mm) D probe. Unit shall include 50'-0" (15 m) pigtail wire in a stainless steel sheath to protect wiring and 1/2" (15 mm) conduit fitting.
  - .2 Provide one, 100 ohm, three wire, ambient sensing, temperature sensor with copper sheathed probe with vented guard. Unit shall include 1/2" (15 mm) NPT fitting for mounting into conduit fitting by others.
- 2.1.16 Extent of tracing shall be to provide complete coverage of wet standpipe or sprinkler piping in unheated area. Coverage and attachment of cable to piping, fittings and valve bodies shall be in accordance with Manufacturer's recommendations.
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- 2.1.17 Provide pipe insulation on heat traced piping in accordance with Section 21 07 19 – Fire Suppression Piping Insulation or manufacturers requirements.
  - 2.1.18 The heat output shall be based on ambient air temperature of 8.6°F (-13°C).
  - 2.1.19 Insulation to be minimum 1" (25 mm) thick fibreglass media with suitable protection. On piping larger than 3" (80 mm), minimum of 2" (50 mm) thick fibreglass media shall be used. Provide full metal jacket on piping susceptible to damage in parkades.
  - 2.1.20 Heating circuits shall be thermostatically controlled and continuously monitored for loss of incoming supply voltage, loss of control power, ground fault and continuity.
  - 2.1.21 Provide ambient air-sensing thermostat protected from direct sunlight and moisture and complete with lockable enclosure.
  - 2.1.22 Provide voltage monitor device for connection to fire alarm panel upon failure of heat tracing or power supply to heat tracing.
  - 2.1.23 Alarm point on fire alarm annunciator panel shall consist of indicator light, audible alarm and test switch.
  - 2.1.24 Acceptable products: Chromalox, Raychem or ULC listed for fire protection equivalent.

**END OF SECTION**

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## 1. GENERAL

### 1.1 Related Work

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

### 1.2 General

- 1.2.1 Provide identification on fire suppression piping, equipment and systems including the following:
- .1 Wet sprinkler systems (mains).
  - .2 Dry sprinkler systems (mains).
  - .3 Standpipes systems.
  - .4 Piping with heat tracing cables.
- 1.2.2 Identification of all fire suppression systems must comply with the requirements of the applicable NFPA Standard where the requirements of that standard exceed these specifications.

### 1.3 Equipment Identification

#### 1.3.1 Manufacturer's Nameplates:

- .1 Each piece of manufactured equipment shall have metal nameplate, with raised or recessed letters. Mechanically fasten plate to equipment.
- .2 Manufacturer's nameplates shall indicate Manufacturer's name, equipment model, size, serial number and electrical characteristics and pertinent information for any other service connections.
- .3 Include Underwriters' Laboratories Canada (ULC) or Canadian Standards Association (CSA) registration logos and those of other agencies, as required by respective agencies.
- .4 Nameplates shall be located so they are easily read. Do not insulate or paint over name plates.

#### 1.3.2 System Nameplates:

- .1 Each piece of equipment shall be identified with its equipment schedule identification, e.g. fire pump FP-1, dry pipe valve DVP-1, zone control valve ZCV-1.
- .2 Identification letters shall be 2" (50 mm) high black letters on white background, sized to suit label or provide laminated plastic plates with black face and white centre of minimum size 3½" (90 mm) x 1½" (40 mm) x ⅜" (2.5 mm) engraved

with ¼" (6.0 mm) high lettering. Use 1" (25 mm) high lettering for major equipment.

- .3 Identify systems, and areas or zones of building being serviced.

#### 1.4 **Apply nameplates securely in conspicuous places**

##### 1.4.1 Piping Identification:

- .1 Each piping system shall be colour coded for identification and labelled with system identification code letters, including pressure, if applicable, and directional flow arrow in accordance with Pipe Identification Colour Schedule.
- .2 Identifying piping (pipe markers and direction arrows) at the following locations:
  - .1 Adjacent to major valves and where valves are in series at no more than 6'-6" (2.0 m) intervals.
  - .2 At least once in each room and 50'-0" (15 m) maximum spacing in open areas.
  - .3 On both sides where piping passes through walls, partitions and floors.
  - .4 Adjacent to major changes in direction.
  - .5 At point of entry and leaving each pipe chase and/or confined space and piping accessible at each access opening.
  - .6 At beginning and end points of each run and at each piece of equipment in each run.
- .3 Identification labels may be stencilled. Identification arrows, labels and letters may be vinyl cloth (Brady B500) or vinyl film (Brady B946), with adhesive compatible with surface temperature.
- .4 Identification colour bands for primary and secondary colours to indicate the type and degree of hazard shall be applied to overlap a minimum of 6" (150 mm). Ends to be stapled. Bands shall be Brady B550 vinyl cloth tape or Brady B946 vinyl tape, with adhesive compatible with surface temperature.
- .5 Identification may consist of semi-rigid plastic vinyl labels with surface printing. On pipes larger than 6" (150 mm) diameter total O.D., these labels shall be saddle style, and shall ship complete with 33½" (850 mm) long nylon cable ties for each label. Standard of acceptance: SMS Coil-Mark (<http://www.smillieltd.ca/pdfDocs/Identification-Systems/Coil-Mark.pdf>).

1.4.2 Valve Tags:

- .1 Provide valve identification tags and secure them using non-ferrous chain, braided band or plastic band (suitable for temperature). Tags may be of brass, aluminum, metalphoto, lamacoid or fibreglass, stamped or engraved, of 1" (25 mm) minimum diameter. Tags may also be 1 1/4" (32 mm) square, two-ply plastic with engraved black characters on white background. Standard of acceptance: SMS valve tags (<http://www.smillieltd.ca/pdfDocs/Identification-Systems/PHSVT.pdf>).
- .2 Valves to be tagged include:
  - .1 Valves within water entry and fire pump rooms.
  - .2 Valves on main piping.
  - .3 Valves on controlling standpipes.
  - .4 All floor zone control valves.
  - .5 Drain valves.
  - .6 Low point drains.
- .3 Schedule valve numbers using sequential numbering system indicating location, service and the normal position (open or closed). Numbers shall be prefixed by letter "FP" indicating valve is for fire protection.

**1.5 Ceiling Access Identification**

- 1.5.1 Secure 1/4" (6.0 mm) self-adhesive coloured dots (Brady Quik Dots or Avery Data Dots) to ceiling to identify location of access to equipment concealed above ceiling, according to the following schedule:

	Colour
Concealed equipment and cleaning access	Yellow
Control Equipment, including control valves	Black
Fire protection, including sprinkler equipment and drains	Red

- 1.5.2 When T-bar ceilings are installed, adhere coloured dots to T-bar framing, adjacent to panel to be removed.

**1.6 Identification Schedules**

- 1.6.1 Submit schedules of the following for review prior to framing:
- .1 Pipe Identification Colours.
  - .2 Valves.
  - .3 Ceiling Access Identification Colours.

1.6.2 Schedules will be required in water entry and/or fire pump room. Frame schedules under glass in matching frames and hang where directed.

- .1 Include one copy of schedules in each operating maintenance manual.

#### 1.7 Pipe Identification Colour Schedule

Service	Identification Lettering	Primary Colour	Secondary Colour
Fire Combined Standpipes	FP-SPR/S.P.	red	white
Fire Alternative Solution	FP-AL	red	white
Fire Sprinkler lines	FP-SPR	red	white
Fire Sprinkler lines (Dry)	FP-SPR (DRY)	red	white

#### 1.8 Pipe Identification Banding Colours

1.8.1 Letters:

- .1 ½" (15 mm) high - NPS 1¼ (32 mm) pipe and smaller.
- .2 1" (25 mm) high - NPS 1½ (40 mm) to NPS 2½ (65 mm) pipe.
- .3 2" (50 mm) high – NPS 3 (80 mm) and larger pipe.

1.8.2 Bands:

- .1 1½" (40 mm) wide, except arrow bands 2" (50 mm) wide.

1.8.3 Colours:

- .1 Horizontally hatched - primary colour.
- .2 Vertically hatched - secondary colour.
- .3 Black letters and arrows on yellow primary colour.
- .4 Background, white letters and arrows or red, blue or green backgrounds.

#### 1.9 Buried Piping Identification/Markers

1.9.1 Metallic Pipe: Provide continuously printed 4" (100 mm) wide x 0.15" (4 mm) thick "Blaze Orange" plastic tape with printing indicating type of service of buried pipe. Place tape at ±12" (300 mm) above buried pipe in backfill.

1.9.2 Non-Metallic Piping: Provide detectable multi-ply tape consisting of aluminum foil core between two (2) layers of 4" (100 mm) x 0.15" (4 mm) thick "Blaze Orange" plastic tape with printing indicating type of service of buried pipe. Place tape at ±12" (300 mm) above buried pipe in backfill lifts.

1.9.3 Where multiple small pipes are buried in a common trench and do not exceed an overall width of 18" (450 mm), install a single tape line marker.



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**END OF SECTION**

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1. **GENERAL**

1.1 **Related Work**

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.
- 1.1.2 Also refer to Section 21 08 00 Commissioning of Fire Suppression.

1.2 **Scope of Work**

- 1.2.1 Refer to Section 23 05 93 Testing, Adjusting and Balancing for HVAC. Comply with requirements of that Section of work as related to general requirements, products and execution.
- 1.2.2 In addition to systems listed in Section 23 05 93, provide testing, adjusting and balancing for fire suppression piping, equipment and systems in accordance with NFPA 25 – Standard for the inspection, testing and maintenance of water based fire protection systems, including the following:
  - .1 Wet sprinkler systems.
  - .2 Dry sprinkler systems.
  - .3 Standpipes systems.
  - .4 Carbon dioxide fire extinguishing systems.
  - .5 Megger testing of heat tracing systems.
- 1.2.3 Fire Suppression Contractor shall provide testing, adjusting and balancing of fire suppression and fire extinguishing systems.
- 1.2.4 Provide completed copies of Contractor's Material and Test Certificates for Aboveground Piping, and for Underground Piping, as per NFPA 13.
- 1.2.5 Manufacturer's authorized Representatives shall provide testing, adjusting and balancing of pre-action, deluge, clean agent, foam-water and/or carbon dioxide fire suppression or fire extinguishing systems, including submission of report for each system.

**END OF SECTION**

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## 1. GENERAL

### 1.1 Related Work

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.
- 1.1.2 Also refer to Section 21 05 33 Heat Tracing for Fire Suppression Piping.

### 1.2 Scope of Work

- 1.2.1 Provide piping insulation on wet fire suppression piping systems in exterior or unheated areas, including the following:
  - .1 Heat traced fire suppression piping.
  - .2 Heat traced combined domestic water and fire suppression piping.

### 1.3 General

- 1.3.1 Provide thermal insulation on piping, valves, and fittings, as called for and as scheduled. Note items listed that do not require insulation.
- 1.3.2 Journeyman insulation applicators with red seal or TQ designation in the heat and frost trade shall supervise the insulation work. This project requires the Mechanical Insulation Contractor to provide a BCICA Quality Insurance Certificate (QAC). The Mechanical Insulation Contractor shall register with BCICA and shall be in full compliance with the requirements of the QAC Program. Materials must be installed by tradespersons with a Red Seal or TQ Designation in the Heat and Frost Trade as detailed in the QAC Program.
- 1.3.3 Be responsible for ensuring sufficient space is provided to allow proper installation of insulation materials.
- 1.3.4 Install insulation and related materials and accessories in accordance with the suppliers and manufacturers recommended installation instructions and BCICA Standards where the specification exceeds BCICA Standards, this specification overrides the BCICA requirements.

### 1.4 Regulatory Requirements

- 1.4.1 Flame spread ratings and smoke developed classifications shall be as required by British Columbia Building Code, CAN/ULC-S102 and NFPA 90A. Generally, the flame spread rating throughout the material shall not exceed 25 and the smoke developed classification shall not exceed 50. Materials shall not flame, smoulder, glow, or smoke at temperature they are exposed to at service.

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- 1.4.2 Minimum insulation thickness and insulating values shall be in accordance with the schedule in this section.
- 1.4.3 Fibreglass pipe insulation shall comply with:
- .1 CAN/ULC-S102.
  - .2 CCG F1-304 (plain only).
  - .3 CBSB 51-GP-9M.
  - .4 CGSB 51-GP52M (jacket).
  - .5 ASTM C 547, Type I, Type IV.
  - .6 STM C 585 – Standard for inner and outer diameters.
  - .7 ASTM C 795 – Insulation in contact with austenitic stainless steel.
  - .8 ASTM C 1136 (jackets; Type I, II, III, IV).
  - .9 ASTM E-84, Surface Burning Characteristics, 25/50 Flame/Smoke.
  - .10 CAN/ULC-S102 “Test for Surface Burning Characteristics of Building Materials”.
- 1.4.4 PVC Fittings and Jacketing shall comply with:
- .1 CAN/CGSB – 51.53-95.
  - .2 CAN/ULC-S102.
- 1.4.5 All insulation products shall be formaldehyde-free.

## **1.5 Qualifications**

- 1.5.1 Submit Manufacturer’s documentation (and samples when requested) for materials, applications and finishing methods to establish they satisfy this specification and meet applicable code requirements, before commencing work.
- 1.5.2 Refer to Section 23 05 05 Firestopping for firestop requirements.

## **1.6 Quality Assurance**

- 1.6.1 Installer qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program.
- 1.6.2 Surface-Burning Characteristics: For insulation and related materials, UL/ULC Classified per UL723 or meeting ASTM E 84, by testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesives, mastic, tapes and cement material containers, with appropriate markings of applicable testing agency.
- .1 Insulation installed indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

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- .2 Insulation installed outdoors: Flame spread index of 75 or less, and smoke-developed index of 150 or less.
  - 1.6.3 Formaldehyde free: Third party certified with UL Environment Validation.
  - 1.6.4 Recycled content: A minimum 50 percent recycled glass content.
  - 1.6.5 Bio soluble: As determined by research conducted by the International Agency for Research on Cancer (IARC) supported by revised reports from the National Toxicology Program (NTP) and the California Office of Environmental Health Hazard Assessment. Certified by European Certification Board for Mineral Wool Products (EUCB).
  - 1.6.6 Low emitting materials: For all thermal and acoustical applications of Glass Mineral Wool Insulation Products, provide materials complying with the testing and products requirements of UL Greenguard Gold Certification.
  - 1.6.7 Living building challenge-declare red list free.
- 1.7 Definitions**
- 1.7.1 "CONCEALED" means insulated mechanical services in trenches, chases, furred spaces, shafts and hung ceilings (services in tunnels **are not** considered to be concealed).
  - 1.7.2 "EXPOSED" will mean not concealed, to include line of sight elements above 'cloud ceilings' and include piping in parkades, inside the building in unheated zones, and on roof or outside the walls.
- 1.8 Connections to Existing Piping**
- 1.8.1 Make good existing insulation disturbed or removed to facilitate alterations and additions to existing piping.
- 1.9 Heat Traced Piping**
- 1.9.1 Piping subject to freezing is specified to be heat traced. Insulation shall cover heat tracing, allow for oversized insulation as required for heat trace element thickness.

## **2. PRODUCTS**

### **2.1 Materials**

- 2.1.1 Products shall not contain lead, mercury or mercury compounds, if possible. They shall be UL Greenguard Gold or Indoor Advantage Gold, if possible.
- 2.1.2 Products shall be validated by UL/E to be formaldehyde free.

2.1.3 Products shall contain no less than 50% recycled content.

## **2.2 Pre-Formed Pipe Covering**

### **2.2.1 Mineral Fibre:**

- .1 Type I (849°F (454°C)) or Type IV (982°F (528°C)); Thermal conductivity at 75°F – 0.019 BTU/hr/ft/°F (24°C – 0.033 W/M/°C).
- .2 Glass mineral wool bonded with a bio-based thermosetting resin.
- .3 UL/ULC classified for Earthwool, FHC 25/50 per ASTM E84 for Redi-Klad. Living building challenge-declare red list free for Rediklad pipe or unjacketed Earthwool pipe only.
- .4 Comply with ASTM C585, ASTM C411, ASTM C795 and ASTM C547, Type I and Type IV, **without factory-applied jacket.**
- .5 Products shall be validated by UL/E to be formaldehyde free and have an EPD.
- .6 With integral vapour barrier jacketed and longitudinal lap.
- .7 Compatible with piping material.

## **2.3 Firestopping and Smoke Seal Materials**

2.3.1 Refer to Section 23 05 05 Firestopping for firestop requirements.

## **2.4 Accessories**

### **2.4.1 Insulation Fastenings:**

- .1 16 ga (1.61mm) galvanized wire or 16 ga (1.61 mm) thick copper wire as commercially available.

### **2.4.2 Jacket Fastenings:**

- .1 Thermocanvas and All Service:
  - .1 Staples (flare type), compatible jacket finishing tape, contact adhesives recommended by the jacket manufacturer.
- .2 Metal Jackets
  - .1 Sheet metal screws, pop rivets, bands.
- .3 PVC Jacket and Fitting Covers:
  - .1 PVC self-adhesive tape, plastic pop rivets, bonding cement.

### **2.4.3 Adhesives:**

- .1 Flexible elastomeric and flexible closed cell insulation adhesive.
- .2 Vapour barrier jacket adhesive.

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- .3 Fabric adhesive, to insulation pipe covering.
  - 2.4.4 Coatings:
    - .1 Vapour barrier coating on reinforcing membrane or on insulating cement.
    - .2 Flexible elastomeric and flexible closed cell insulation finish coating.
  - 2.4.5 Finish Jackets:
    - .1 Thermocanvas Jacket.
    - .2 All Service Jacket (with 0.0019" (0.3 mm) minimum thick foil).
    - .3 PVC Finishing Jacket (minimum 0.015" (0.38 mm) thick).
    - .4 Aluminum Jacket:
      - .1 22 ga (0.64 mm) thick stucco embossed or smooth aluminum jacketing with longitudinal slip joints and 0.0019" (0.3 mm) end laps with factory applied protective liner on interior surface.
  - 2.4.6 Pre-Formed Fitting Covers:
    - .1 Aluminum Fitting Covers:
      - .1 22 ga (0.64 mm) thick, die shaped components with factory applied protective liner on interior surface.
    - .2 PVC Fitting Covers:
      - .1 0.02" (0.50 mm) thick pre-moulded one-piece covers.

## **2.5 Scope of Insulation**

- 2.5.1 Fire protection pipes, fittings, valves:
  - .1 Insulate the following systems, unless otherwise noted:
    - .1 All drains, lines, stacks, fire standpipes and sprinkler mains in unheated areas (insulation shall cover heat tracing cables).
    - .2 Water valves, flanges, PRVs, check valves.
    - .3 Sprinkler/standpipe system from domestic water connection point to 16'-0" (5.0 m) downstream or to inlet alarm valve, whichever is less, using preformed fiberglass pipe insulation complete with continuous vapour barrier.
  - .2 DO NOT insulate the following, unless otherwise noted:
    - .1 Piping used exclusively for fire protection (unless in unheated spaces).
- 2.5.2 Pipe penetrations through walls and floors:

- .1 Material for stuffing, sealing and caulking of pipe penetrations shall be supplied and installed under this section.

## 2.6 **Pipe Insulation Schedule and Thickness Table – inches (mm)**

2.6.1 'Inside' means within the heated building envelope. Everywhere else is considered outside and unheated space.

Service	Design Operating Temperature	PIPE SIZE				
		< NPS 1 (25 mm)	NPS 1 (25 mm) & NPS 1¼ (32 mm)	NPS 1½ (40 mm) to NPS 3 (80 mm)	NPS 4 (100 mm) to NPS 6 (150 mm)	> NPS 6 (150 mm)
Self-Regulated Heat Traced Fire Protection Piping	Below 65°F (18°C)	1½" (40 mm)	2" (50 mm)	2" (50 mm)	2" (50 mm)	2" (50 mm)

Note 1: All piping forming part of the fire protection systems and located outside the building envelope shall be insulated. At a minimum of 2x thickness above. (This includes parkades and all/any unheated spaces within the building).

## 3. **EXECUTION**

### 3.1 **Application**

- 3.1.1 Apply insulation to piping only after tests have been made and systems accepted.
- 3.1.2 Apply insulation and insulation finish so finished product is smooth in finish, with the longitudinal seams concealed from view. Apply piping insulation materials, accessories and finishes in accordance with Manufacturer's recommendations. Pre-formed pipe fitting insulation sections shall be used on all elbows, tees and pipe joint/flange fittings. Where pre-formed insulation sections cannot be used or sourced, insulate to BCICA standards, including oversize insulation at mechanical pipe joints.
- 3.1.3 On piping NPS 2½ (65 mm) and larger with insulation and vapour barrier, install high density insulation above hanger shield. Insert to be slightly longer than length of shield. Maintain integrity of vapour barrier over full length of pipe without interruption at sleeves, fittings and supports. Provide oversize Clevis hangers as required. See Section 23 05 29.
- 3.1.4 Insulation and vapour barrier shall be continuous through both rated and non-rated separations.



- 3.1.5 Provide sealed bevelled cut-outs at all ball valve handles to allow free movement of handle without tearing insulation.
- 3.1.6 Provide high density insulation and shields at all riser clamps/seismic sway bracing connection locations for all cold piping with continuous vapour barrier.

### **3.2 Insulation Termination Points**

- 3.2.1 Terminate insulation 3" (80 mm) back from all uninsulated fittings to provide working clearance and terminate insulation at 90° and finish with reinforced scrim cloth vapour barrier mastic system. Cover onto pipe and over the insulation vapour barrier. The use of pre-formed PVC end caps and pre-formed PVC fittings are also acceptable.
- 3.2.2 Cut back insulation at 45° and finish with silicone caulking sealant around base of pressure gauges and flow switches.

### **3.3 Vertical Risers**

- 3.3.1 On vertical pipe over 3" (80 mm) provide insulation supports welded or bolted to pipe, directly above lowest pipe fitting. Thereafter, locate on 15'-0" (4.5 m) centres.

### **3.4 Cold Application 50°F (10°C) and Less**

#### **3.4.1 Piping:**

- .1 Install low/medium temperature pipe insulation with integral vapour barrier jacket to pipe and hold in place by securing jacket flap. Seal flaps with vapour barrier adhesive. Pipe insulation with integral self-sealing vapour barrier jacket does not require additional fastening.
- .2 Install strips of vapour barrier jacket over butt joints with vapour barrier adhesive. Over wrap butt strips by 50% for insulation OD 12" (300 mm) and above apply strip on 10" (250 mm) centres for additional securement.
- .3 Install strips of vapour barrier jacket over butt joints with vapour barrier adhesive. Over wrap butt strips by 50% for insulation OD 12" (300 mm) and above apply strip on 10" (250 mm) centres for additional securement. (Note: accessory items such as, but not limited to, thermometers, probes, actuators, etc. shall be insulated and sealed. Hangers shall be insulated from where they carry the pie to the point of attachment to the structure).

#### **3.4.2 Fittings:**

- .1 Insulate fittings to thickness of adjacent pipe insulation with section of pipe insulation mitred to fit tightly, or pre-formed insulation fittings (Shur-Fit), apply reinforcing membrane embedded barrier coating and apply finish vapour barrier

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coating. No insert or flexible blanket fitting insulation permitted.

3.4.3 Unions, Flange and Victaulic Fittings:

- .1 Insulate cold unions and flanges with oversized pipe insulation or mitred blocks to thickness of adjacent pipe covering, apply reinforcing membrane embedded in barrier coating and final coating of vapour barrier mastic.

**3.5 Pipe Insulation Finishes**

3.5.1 "Concealed" insulation in horizontal and vertical service spaces will require no further finish.

3.5.2 "Concealed" pipe insulation in damp locations, e.g. pipe trenches, shall have vapour barrier jacket, vapour sealed.

3.5.3 "Exposed" flexible insulation shall be painted with heavy brush coating of foam plastic white insulation coating.

3.5.4 Where KEEN Insulated Fittings and valve covers (available from Shur-Fit Products) have been used, no further finish is required.

3.5.5 "Exposed" insulation inside building shall be finished as follows:

- .1 Premium Finish (PVC Covers) PF-5 BCICA Standard:
  - .1 Over factory applied integral all-service type jacket on pipe insulation, apply PVC jacket.
  - .2 Over insulated fittings apply PVC fitting covers. Over insulated valve bodies, valves bonnets, strainers and flanges apply purchased PVC covers or field fabricate from PVC sheeting secured with solvent bonding cement.
- .2 Premium Finish with Canvas Wrap: BCICA PF-2 standard finish fabric with two coats of fabric coating. Canvas re-covering shall be applied with a minimum overlap of 1" (25 mm), and finished with two coats of flexible fabric paint, white.
- .3 Economy Finish:
  - .1 Apply pipe insulation with integral all-service type jacket. Cover longitudinal and circumferential joints with jacket finishing tape neatly applied. Alternately, secure jacketing longitudinal joint using integral self-sealing lap. Cover circumferential joints with jacket finishing butt strips. Over wrap strips by 50%. For insulation OD 12" (300 mm) apply trips on 10" (250 mm) centres for additional securement. PVC 0.02" (0.50 mm) thick should not be used as vapour barrier alone. Should have 'ASJ' or mastic system under it. Over insulation on

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short pipe runs and piping adjacent to fittings, valves, etc., jacket to be field applied.

- .2 Over insulated fittings apply tack coat of vapour barrier mastic and embed reinforcing membrane and cover with same mastic. Over insulated valve bodies, valve bonnets, strainers and flanges, apply all-service jacketing using necessary fastenings and jacket finishing tape and with reinforced mastic system on irregular surfaced.

3.5.6 "Exposed" outdoor insulation shall be finished as follows to BCICA PF-4 Standard:

- .1 Insulation shall have vapour barrier jacket.
- .2 Over pipe insulation jacket apply aluminum weather protecting jacket. The longitudinal seam shall be located to shed water. Secure the jacket using necessary metal banding on approximately 10" (250 mm) centres and at the overlaps. Screws are not permitted on cold operating systems.
- .3 Over insulated fittings, valve bodies, valve bonnets, strainers and flanges, apply metal jacket or pre-formed metal fittings to provide complete jacket system. Secure with necessary fastenings.
- .4 Seal outdoor jacketing watertight.

3.5.7 Provide Pacific Pressed fitting covers (available from Shur-Fit Products) for insulated grooved pipe.

### **3.6 Firestopping and Smoke Seals**

3.6.1 Refer to Section 23 05 05 Firestopping for firestop requirements.

**END OF SECTION**

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1. **GENERAL**

1.1 **Related Work**

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

1.2 **General**

- 1.2.1 Be responsible for the performance and commissioning of equipment supplied in Fire Protection. Commissioning is process of advancing installation static completion to full working order in accordance with contract documents and design intent. It is activation of completed installation.
- 1.2.2 In consultation with General Contractor, ensure sufficient time is allowed and fully identified on construction schedule for proper commissioning of mechanical systems.

1.3 **Scope of Work**

- 1.3.1 Provide testing, commissioning of fire suppression piping, equipment and systems including the following:
- .1 Wet sprinkler systems.
  - .2 Dry sprinkler systems.
  - .3 Standpipes systems.
  - .4 Heat tracing systems.
- 1.3.2 Fire Suppression Contractor shall provide testing of fire suppression and fire extinguishing systems.
- 1.3.3 Manufacturer's authorized Representative shall provide commissioning of the heat tracing systems, including submission of report for each system.

2. **PRODUCTS: NOT USED**

3. **EXECUTION**

3.1 **Commissioning and Demonstration**

- 3.1.1 Submit schedule for commissioning phase of work. Schedule shall show:
- .1 Equipment start-up schedule.
  - .2 Submission dates for documents required prior to substantial completion.

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- .3 Timing of various phases of commissioning, testing, and demonstration process.
  - 3.1.2 Commissioning is concluded when the fire protection system is operational and is in working order and acceptable for use. Work will include the following:
    - .1 Wet sprinkler systems.
    - .2 Dry sprinkler systems.
    - .3 Standpipes systems.
    - .4 Carbon dioxide fire extinguishing systems.
    - .5 Heat tracing systems.
  - 3.1.3 At conclusion of commissioning, demonstrate operation of systems to consultant and to Owner's Operating Staff.
  - 3.1.4 The verification process shall include the demonstration of the following:
    - .1 Ease of access provided for servicing pump(s) and valves.
    - .2 Location of and opening and closing of access panels.
    - .3 Operation of alarm and protective devices.
    - .4 Operation of equipment and systems under each mode of operating, and failure, including:
      - .1 Pumps.
      - .2 Valves.
  - 3.1.5 At completion of the commissioning, testing, and demonstration, submit the following to Consultant:
    - .1 Letter certifying that work specified is complete, clean and operating in accordance with specification and drawings.
    - .2 Completed copies of commissioning check sheets, copies of start-up reports from specialty Contractors and Vendors and functional performance test sheets.
    - .3 Record drawings as specified.
    - .4 Fire Suppression Contractor shall provide testing of fire suppression and fire extinguishing systems.
    - .5 Manufacturer's authorized Representatives shall provide commissioning of pre-action, deluge, clean agent, foam-water and/or carbon dioxide fire suppression or fire extinguishing systems, including submission of report for each system.
    - .6 Manufacturer's authorized Representative shall provide commissioning of the heat tracing systems, including submission of report for each system.

**END OF SECTION**

## 1. GENERAL

### 1.1 General

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

### 1.2 Scope of Work

- 1.2.1 Scope of work consists of the following:
- .1 Fire suppression standpipe system.
  - .2 Combined fire suppression standpipe/fire suppression sprinkler system.
- 1.2.2 Provide fire suppression standpipe system piping as indicated on drawings including fire department connections, fire pump test header/flow meters, risers, hose connections, hose stations, hose cabinets, roof hydrants, sprinkler zones, drain risers and other inlets and outlets that require piping connections for water-based fire suppression systems.
- 1.2.3 Connect fire suppression standpipe system piping to receive water supply from **dedicated fire suppression system main** located as indicated on drawings.
- 1.2.4 Coordinate with Architectural Division of work for enclosing those portions of fire suppression standpipe system risers located within scissor stairwells that supply 2½" (65 mm) fire department hose connections.

### 1.3 Related Work

- 1.3.1 Refer to Section 21 13 00 Fire Suppression Sprinkler Systems where combined fire suppression standpipe/fire suppression sprinkler system is involved, for requirements of work considered fire suppression sprinkler portion of system.
- 1.3.2 Coordinate with Electrical for connection of supervised isolation valves to supervisory signals, flow switches to alarm signals, and supervisory switches to supervisory signals on fire alarm system.
- 1.3.3 Refer to Section 21 05 33 for heat tracing and Section 21 07 19 insulation.

### 1.4 Fire Department Hose Threads

- 1.4.1 Unless noted otherwise nominal 1½" (40 mm) hose threads shall be 1½" (40 mm) NPSH and 2½" (65 mm) hose threads shall be 2½" (65 mm) BCT threads for fire department connections, standpipe hose connections, hose stations, and fire hose cabinet valves.

- 1.4.2 Municipal fire department requirements shall supersede above specifications.

## **2. PRODUCTS**

### **2.1 General**

- 2.1.1 Pipes, fittings, couplings, valves, devices and materials used in fire suppression standpipe system shall be of approved type, and from a single brand/manufacturer.
- 2.1.2 System components shall be rated for working pressure not less than maximum pressure to be developed at their corresponding locations within systems under any condition, including pressure that occurs when permanently installed fire pump is operating at shut-off pressure.
- .1 Refer to Section 21 05 06 for fire suppression system pressure ratings.

### **2.2 Piping and Fittings – Above Ground**

- 2.2.1 Combined potable water and fire suppression standpipe system portion of piping upstream of approved double check valve assembly backflow prevention device:
- .1 Pressure ratings to be in accordance with Section 21 05 06.
- .2 Special Class, ductile iron pipe, cement mortar lined, ULC Listed, minimum Class 54 to ANSI/AWWA C150/A23.50 and C151/A21.51, with rigid radius cuts grooves for use with cut grooved end mechanical joint couplings to form rigid joint.
- .3 Asphalt seal coating on inside of cement mortar lining to NSF-61 for use in potable water systems and specifically designed for use with ductile iron pipe surfaces.
- .4 Stainless steel track head bolts and stainless steel nuts.
- .5 Ductile iron fittings for AWWA size pipe, with rigid radius grooves in accordance with ANSI/AWWA C-606, NSF-61 Listed cement mortar Type 2 lining, and bituminous coating. Rated 350 psi (2,415 kPa) working pressure.
- .6 Acceptable Products must be ULC Listed for use in fire suppression systems.
- 2.2.2 Standpipe System Piping:
- .1 Fire suppression standpipe system piping (downstream of backflow preventer) shall be steel pipe, black or hot dipped galvanized, standard weight or light wall, material and IPS dimensions conforming to NFPA 14 and ASTM A53, ASTM A135 or ASTM A795.

- .2 Utilize minimum Schedule 40 wall thickness steel pipe for threaded or cut grooved joining methods up to 350 psi (2,415 kPa).

2.2.3 Standpipe Systems Fittings:

- .1 Compatible with piping material.
- .2 Listed for maximum pressures in system, but not less than 175 psi (1,210 kPa) working pressure.
- .3 Fittings shall be extra heavy pattern where pressures exceed 175 psi (1,210 kPa) except as specifically noted in NFPA-14.
- .4 Steel welding fittings shall comply with latest edition of ANSI B16.9 and B16.25 and ASTM A234.
- .5 Grooved end fittings, couplings and gaskets shall be of one Manufacturer.
- .6 The couplings shall consist of two ductile iron housing segments, pressure responsive gasket, and zinc-electroplated steel bolts and nuts.
  - .1 Rigid Type: Housings shall be case with offsetting angle-pattern bolt pads to provide rigidity and system support and hanging in accordance with NFPA 13. Couplings shall be fully installed at visual pad-to-pad offset contact (tongue and recess type couplings, or any coupling that requires exact gapping of bolt pads on each side of the coupling at specified torque ratings are not allowed).
    - .1 1¼" (32 mm) through 8" (200 mm): Installation-Ready, for direct slab installation without field disassembly.
  - .2 Flexible Type: For use in locations where vibration attenuation and stress relief are required, and for seismic applications.
- .7 Acceptable Products must be ULC Listed for use in fire suppression systems.

**2.3 Piping and Fittings – Below Ground**

2.3.1 Underground 4" (100 mm) and larger outside or inside building:

- .1 Pipe:
  - .1 Centrifugally spun cement lined cast-iron pipe with push-on rubber ring type joints for 200 psi (1,380 kPa) working pressure.
  - .2 Ductile iron cement lined Class 50 or Class 52 pipe with push-on rubber rings, or mechanical joints for 200 psi (1,380 kPa) working pressure in accordance with ANSI/AWWA C151/A21.51.



- .3 IPEX "Blue Brute" PVC Ring-Tite Class 150 pipe to AWWA Standard C-900. Materials in contact with CPVC pipe and fittings shall comply with Manufacturers compatibility documentation.
- .2 Fittings:
  - .1 Cast-iron with push-on or mechanical joints for 200 psi (1,380 kPa) working pressure.
  - .2 Fittings provided with integral tie lugs. Weld on lugs is not acceptable.
  - .3 Tie rods, bolts and nuts shall conform to ASTM specifications. Bolts shall have American Standard course screw threads with Class 2 free fit. Rolled threads are not acceptable.
- .3 Underground pipelines to or from fire department Siamese connections or fire pump test connections shall conform to aforementioned specification.
- .4 Polyvinyl chloride (PVC) piping used for underground water supply lines shall adapt to approved non-plastic material prior to penetration through exterior building wall or floor slab. Materials in contact with PVC pipe and fittings shall comply with Manufacturers compatibility documentation.
- .5 Where ULC Listed CPVC pipe is installed underground, pipe and fittings shall meet ASTM D2774 – Standard recommended practice for underground installation of thermoplastic pressure piping, as well we ASTM F645 – Standard guide for selection design and installation of thermoplastic water pressure piping systems. Acceptable for pipe sizes ¾" (20 mm) to 3" (80 mm) only. Materials in contact with CPVC pipe and fittings shall comply with Manufacturers compatibility documentation.

## **2.4 System Valves**

- 2.4.1 Gate – 175 psi (1,210 kPa) - ULC listed:
  - .1 ½" (15 mm) – 2" (50 mm): ULC listed and meeting project pressure rating requirements.
  - .2 2½" (65 mm) and Larger: ULC listed and meeting project pressure rating requirements.
- 2.4.2 Butterfly/Ball - 175 psi (1,210 kPa) - ULC listed:
  - .1 ½" (15 mm) – 2" (50 mm): Slow close butterfly valve with weatherproof actuator and indicator and integral supervisory switch.
  - .2 4" (100 mm) – 12" (300 mm): complete with weatherproof actuator, gear operator and indicator.

- .1 The stem on butterfly valves shall be offset from the disc centerline to provide full 360-degree circumferential seating, and the seat shall be pressure responsive.
- 2.4.3 Check - 175 psi (1,210 kPa) - ULC listed:
  - .1 2½" (65 mm) and larger: for all grooved end valves.
  - .2 Provide spool piece to ensure full check valve opening where adjacent alarm or gate valve.
- 2.4.4 Pressure Reducing - ULC listed:
  - .1 2½" (65 mm) In-Line Valve: Modulating piston type, field adjustable, pressure reducing valve, meeting space requirements. Acceptable Products: Zurn Z-5000 series or approved ULC listed alternative acceptable to the Consultant.
  - .2 4" (100 mm) – 8" (200 mm) In-Line Valve: Pilot operated type pressure reducing valve, meeting space requirements.
    - .1 Maximum outlet pressure, 165 psi (1,140 kPa).
  - .3 If pressure reducing valve is left in normally open position it shall be provided with either integral or separate supervisory switch.
  - .4 Outlet pressures on pressure reducing valves shall be set at 100 psi (690 kPa), unless otherwise indicated, at a discharge rate of 100 USgpm (6.3 L/s) for 1½" (40 mm) size and 500 USgpm (31.5 L/s) for 2½" (65 mm) size.
  - .5 Pressure reducing valves supplying two or more outlet connections shall be modulating piston type.
  - .6 Use of factory set pressure reducing valves is not recommended due to variability in water supply pressures that may change bonnet settings when the fire protection system is commissioned.
- 2.4.5 Pressure ratings to be in accordance with Section 21 05 06.
- 2.4.6 Grooved end valves shall be of one Manufacturer.

## **2.5 Hose Connections**

- 2.5.1 Fire department hose connection angle valves located in exit stairwells (and other locations as indicated on drawings).
- 2.5.2 Angle Valves:
  - .1 System Pressures less than 175 psi (1,210 kPa).
  - .2 ULC listed, 2½" (65 mm), forged brass, male outlet angle valve, rough chrome finish with red wheel handle, threaded brass cap and chain, 300 psi (2,070 kPa) rated.
- 2.5.3 Pressure regulating angle valves, for inlet pressures greater than 175 psi (1,210 kPa) to limit static and residual pressures:

- .1 Outlet pressure shall be set to a minimum of 100 psi (690 kPa) and maximum of 175 psi (1,210 kPa).
- .2 ULC listed and meeting project pressure rating requirements and space requirements, 2½" (65 mm), cast brass, angle valve, satin chrome finish with red wheel handle, threaded brass cap and chain, 400 psi (2,760 kPa) rated. Capable of field adjustment of the pressure. Not for installations in valve cabinets or hose cabinets.
- .3 ULC listed, 2½" (65 mm), cast brass, angle valve, satin chrome finish with red wheel handle, threaded brass cap and chain, 400 psi (2,760 kPa) rated. Factory set and not capable of field adjustment of the pressure. Use for installations where required to be installed in valve cabinets or hose cabinets.

## **2.6 Valve Cabinets**

2.6.1 Valve cabinets complete with hose connection angle valves, generally in floor areas outside of exit stairwells as indicated on the drawings:

- .1 Wall mounted valve only cabinet.
  - .1 14" (350 mm) wide x 14" (350 mm) high x 8" (200 mm) deep cabinet.
  - .2 Fully recessed steel cabinet with ½" (15 mm) turn back frame for 8" (200 mm) wall depth.
  - .3 Full length semi-concealed piano hinges for 180° swing.
  - .4 Flush stainless steel door latch with no exposed fasteners.
  - .5 18 ga (1.31 mm) baked enamel corrosion protected steel tub.
  - .6 14 ga (1.99 mm) baked enamel corrosion protected fully glazed steel door with 3/16" (4.8 mm) tempered glass panel. Doors hinged as indicated on drawings.
  - .7 Grey prime coated enamel finish ready for field painting; reconfirm colour with Architect prior to ordering.
  - .8 ULC listed cabinet.
  - .9 Valve: Refer to Subsection 2.5 and project drawings.
- .2 Refer to section above for pressure restricting hose valves and pressure regulating hose valves for system inlet pressures greater than 100 psi (690 kPa).

## **2.7 Hose Stations**

2.7.1 Hose stations and fire hose cabinets (FHC):

- .1 Recessed wall mounted combination double hose valve and extinguisher cabinet.
- .2 30" (762 mm) wide x 30" (750 mm) high x 8" (200 mm) deep cabinet.
- .3 Fully recessed steel cabinet with ½" (15 mm) turn back frame for 8" (200 mm) wall depth.
- .4 Full length semi-concealed piano hinges for 180° swing.
- .5 Flush stainless steel door latch with no exposed fasteners.
- .6 18 ga (1.31 mm) baked enamel corrosion protected steel tub.
- .7 14 ga (1.99 mm) baked enamel corrosion protected fully glazed steel door with ⅜" (5 mm) tempered glass panel. Doors hinged as indicated on drawings.
- .8 Grey prime coated enamel finish ready for field painting; reconfirm colour per Architect prior to ordering.
- .9 ULC listed, 1½" (40 mm), forged brass, male outlet, angle valve with hydrovent, rough chrome finish with red wheel handle, threaded brass cap and chain, 300 psi (2,070 kPa) rated.
- .10 ULC listed, 2½" (65 mm), forged brass, male outlet, angle valve, rough chrome finish with red wheel handle, threaded brass cap and chain, 300 psi (2,070 kPa) rated.
- .11 100'-0" (30 m) of ULC listed 1½" (40 mm) diameter ULC listed polyurethane lined fire hose and 1½" (40 mm) chrome-plated forged brass combination nozzle.
- .12 Appropriate aluminum alloy spanner wrench.
- .13 10 lb (4.5 kg) ABC dry chemical multipurpose fire extinguisher.
- .14 Refer to section above for pressure restricting hose valves and pressure regulating hose valves for system inlet pressures greater than 100 psi (690 kPa).

## **2.8 Fire Department Siamese Connections**

- 2.8.1 Refer to Section 21 13 00 Fire Suppression Sprinkler Systems.

## **2.9 Roof Hydrants**

- 2.9.1 Flush mounted fire department wall hydrant outlet connections at main roof level:
- .1 Flush mounted fire department wall hydrant outlet connection, cast brass body, no clapper valves, 4" (100 mm) inlet, 2 - 2½" (65 mm) outlet ports with brass plugs and chains. Threads per local Fire Department.
  - .2 Wall escutcheon plate 15" (375 mm) x 9" (225 mm) marked with 1" (25 mm) high raised letters "WALL HYDRANT."

- .3 ULC listed 4" (100 mm) non-rising stem cast-iron gate valve.
- .4 Brass valve control with valve stem coupling, steel extension rod, 1½" (40 mm) wall sleeve with lock nut, adaptor, brass cap and chain.
- .5 Wall escutcheon plate 7" (180 mm) x 7" (180 mm) marked with 1" (25 mm) high raised letters "VALVE CONTROL."

2.9.2 Acceptable Products: ULC listed meeting project pressure requirements.

## **2.10 Ball Drips**

2.10.1 Solid brass ¾" (20 mm) male threaded auto ball drips.

## **2.11 Air Vent**

2.11.1 An air vent is required near the high point(s) in the systems to allow air to be removed from that section of the fire protection system.

2.11.2 The following means are acceptable:

- .1 Manual valve, minimum ½" (15 mm) size,
- .2 Automatic air vent, or
- .3 Other ULC approved means

## **2.12 Extra Material Requirements:**

2.12.1 Provide two (2) of hose nozzles and hoses.

# **3 . EXECUTION**

## **3.1 Water Supply Connections**

- 3.1.1 Coordinate interface of scope of work with scope of Plumbing Contractor's work, Site Services Contractor's work, or municipal water connections, including scheduling of installation and exact locations of connections.
- 3.1.2 If water supply connections are in place prior to commencement of work, connect to and adapt to water supply connection and provide required material and size adapters, offsets, fittings, tie rods, thrust blocks, seismic restrains and other provisions for complete installation.
- 3.1.3 If this scope of work is provided prior to water supply connections being in place, provide capped connections, complete with tie rods, thrust bocks, seismic restraints and other provisions for complete installation. Clearly mark locations of capped ends both on as-built drawings and on site.

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**3.2 Piping and Fittings**

- 3.2.1 Provide thrust blocks and tie rods on underground sections of piping.
- 3.2.2 Welding shall be done in shop with welding fittings, and in accordance with welding procedures outline in NFPA 14. Field welding is not permitted.
- 3.2.3 Provide flanged pattern fittings for piping 8" (200 mm) diameter and larger and at fire department connections.
- 3.2.4 Groove joints shall be installed in accordance with the manufacturer's latest published installation instructions. The gaskets shall be suitable for the intended service and shall be molded and produced by the coupling manufacturer.
  - .1 The coupling manufacturer's factory-trained representative shall provide on-site training for the Contractor's field personnel in the proper use of grooving tools and installation of grooved joint products. The representative shall periodically visit the job site to ensure best practices in grooved joint installations are being followed. (A distributor's representative is not considered qualified to conduct the training.)
- 3.2.5 Provide expansion joints or flexible couplings at building expansion joints, building seismic joints and as otherwise necessary.
  - .1 For water systems, Victaulic or VGS (Viking Grooved System) flexible couplings may be used in header piping to accommodate thermal growth and contraction, and for the elimination of expansion loops. (In accordance with Victaulic/VGS installation instructions and as accepted by the Consultant.) If expansion loops are required, use Victaulic/VGS flexible couplings in the loops.
- 3.2.6 ULC listed CPVC buried pipe shall be installed in accordance with manufactures recommendations and requirements and as follows:
  - .1 The general installation procedure detailed here applies to ULC listed CPVC Fire Sprinkler pressure pipe that has solvent cement joints in size range ¾" (20 mm) – 3" (80 mm).
  - .2 Trenching: water filled pipe should be buried at least 12" (300 mm) below the maximum expected frost line.
  - .3 The trench bottom should be continuous, relatively smooth and free of rocks. Where ledge rock, hardpan or boulders are encountered, it is necessary to pad the trench bottom using a minimum of 4" (100 mm) of tamped earth or sand beneath the pipe as a cushion and for protection of the pipe from further damage.
  - .4 Sufficient cover must be maintained to keep external stress levels below acceptable design stress. Reliability and safety

of service is of major importance in determining minimum cover.

- .5 After ULC listed CPVC pipe has been solvent welded, pipe shall be snaked according to the following recommendations beside the trench during its required drying time. BE ESPECIALLY CAREFUL NOT TO APPLY ANY STRESS THAT WILL DISTURB THE UNDRIED JOINT.
- .6 Backfilling Underground pipe shall be thoroughly inspected and tested for leaks prior to backfilling. Backfilling should only be done early in the morning during hot weather when the line is fully contracted and there is no chance of insufficiently dried joints being subject to contraction stresses. The pipe shall be uniformly and continuously supported over its entire length on firm, stable material. Blocking shall not be used to change pipe grade or to intermittently support pipe across excavated sections.
- .7 Backfill materials free of rocks with a particular size of 1/2" (15 mm) or less shall be used to surround the pipe with 6" (150 mm) or 8" (200 mm) of cover.
- .8 Backfill shall be placed in layers. Each soil layer should be sufficiently compacted to uniformly develop lateral passive soil forces during the backfill operation. The pipe shall be under pressure, 15 psi (103 kPa) to 25 psi (170 kPa) during the backfilling process.
- .9 Sand and gravel containing a significant proportion of fine-grained material, such as silt and clay, shall be compacted by hand or, preferably by mechanical tamper.
- .10 Where the ULC listed CPVC pipe rises up through a slab on grade, provide a schedule 40 pipe sleeve sized to allow a 1/2" (15 mm) minimum to 1" (25 mm) maximum annular gap to be sealed with ULC listed CPVC caulk and walk® firestopping sealant.
- .11 Materials in contact with CPVC pipe and fittings shall comply with Manufacturers compatibility documentation.

### 3.3 **System Isolation Valves**

- 3.3.1 Provide ULC listed supervisory switch on isolation valves and zone valve controlling flow of water throughout fire suppression standpipe systems, for connection to supervisory signal on fire alarm system.
- 3.3.2 Provide isolation valves at base of each standpipe riser where building has more than one standpipe riser.

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**3.4 Flow Switches**

- 3.4.1 Provide ULC listed flow switch in mechanical room on main riser to fire suppression standpipe systems, for connection to trouble signal on fire alarm system.

**3.5 Pressure Gauges**

- 3.5.1 Provide 3½" (90 mm) pressure gauge complete with isolation/drain valve at top of each standpipe riser.

**3.6 Flushing of Standpipe Systems**

- 3.6.1 Flush underground water mains and fire department Siamese connection lines before connection to fire suppression standpipe systems.
- 3.6.2 Flush pipe lines until effluent is clear and free of debris.
- 3.6.3 Provide proper drainage for flushing operation.

**END OF SECTION**



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**1. GENERAL**

**1.1 General**

1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

**1.2 Description of Work**

1.2.1 Combined automatic sprinkler systems/wet standpipe systems.

1.2.2 Wet sprinkler systems.

1.2.3 Dry sprinkler systems.

**1.3 Sprinkler Contractor Qualifications**

1.3.1 Sprinkler Contractors intending to bid this project shall submit the following information not less than seven days before close of Sub-Trade tenders for Consultant review for acceptance. ANY FIRM THAT DOES NOT COMPLY WILL NOT BE ACCEPTED BY CONSULTANT.

- .1 List previous projects of similar scope with dates projects were executed, contract value and references.
- .2 Outline depth of firm including principals, years of operation, address and phone number.
- .3 List name of job site supervisor and provide resume of their specific work experience.
- .4 Name of individual who will prepare shop drawings and hydraulic calculations.

1.3.2 Contractor shall be regularly engaged in installation of sprinkler systems.

**1.4 Quality Assurance**

1.4.1 Provide sprinkler systems throughout building, in accordance with listed codes, bylaws, standards and approvals including NFPA 13, Ontario Building Code and Ontario Fire Code.

1.4.2 Obtain copy of Code Consultant's report and include equivalency requirements, glazing system requirements and other works described relative to fire suppression sprinkler systems.

1.4.3 Sprinkler fitter with Province of Ontario Tradesman Qualifications in sprinkler installations shall be on site at all times during system installation.

1.4.4 All grooved joint couplings, fittings, valves, and specialties shall be the product of a single Manufacturer. Grooving tools shall be of the same Manufacturer as the grooved components.

- 1.4.5 All castings for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

**1.5 Related Work**

- 1.5.1 Refer to Section 21 12 00 Fire Suppression Standpipes where combined fire suppression standpipe/fire suppression sprinkler system is involved, for requirements of work considered to be fire suppression standpipe portion of system.
- 1.5.2 Refer to Section 21 05 33 Heat Tracing for Fire Suppression Piping and Section 21 07 19 Fire Suppression Piping Insulation for area subject to freezing.
- 1.5.3 Coordinate with Electrical for connection of supervised isolation valves to supervisory signals, flow switches to alarm signals, and supervisory switches to supervisory signals on fire alarm system.
- 1.5.4 Coordinate work of this Section with HVAC trades, plumbing trades, electrical trades and ceiling trades.

**1.6 Sprinkler System Shop Drawings**

- 1.6.1 Fire suppression Sub-Contractor's Registered Professional Engineer shall prepare electronic AutoCAD fire suppression sprinkler system drawings, to scale. Drawings prepared by Consultant were done to show general features of systems, and general concepts of arrangement and locations of sprinklers and piping.
- 1.6.2 Fire suppression Sub-Contractor and Registered Professional Engineer shall include for sprinklers as required to fully comply with NFPA 13, Ontario Building Code and the Ontario Fire Code
- 1.6.3 Indicate on drawings information required by Authority Having Jurisdiction, including features of building construction, direction and size of beams, ceiling configurations, partition locations, light fixtures (noting the depths of surface mounted light fixtures where these occur) and diffuser locations.
- 1.6.4 Stipulate positions and elevations of sprinklers relative to floor elevation, temperature rating of sprinklers, spacing and types of hangers, drains and low point drains, test and flushing connections, types of sprinkler alarms, locations and types of sprinkler control valves, backflow preventers and other essential features of piping systems.
- 1.6.5 Sprinkler products shall be referred to on drawings, submittals, and other documentation, by the sprinkler identification or model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.

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- 1.6.6 Include detailed sprinkler plans and hydraulic calculations as described in NFPA 13.
  - 1.6.7 Only shop drawings that have been reviewed, signed and sealed by fire suppression Sub-Contractor's Registered Professional Engineer shall be submitted.
  - 1.6.8 Submit additional signed and sealed sets of shop drawings as requested by Owner for their use and for review by their insurer, and incorporate requirements indicated during review process.
  - 1.6.9 Submit to Authority Having Jurisdiction for review and/or approval, complete sets of shop drawings and hydraulic calculations for each area.
  - 1.6.10 Arrange for, pay for and obtain fire suppression system/sprinkler permit prior to commencing fire suppression system installation.
  - 1.6.11 Submit sealed seismic brace design details for the actual installation conditions and sealed Letter of Assurance from the Contractor's seismic bracing design engineer to Introba.
  - 1.6.12 Submit shop drawings for the following items:
    - .1 Piping materials.
    - .2 Valves, fittings and couplings.
    - .3 Fire department Siamese connections.
    - .4 Backflow preventer.
    - .5 Sprinkler zone manifolds.
    - .6 Dry pipe, pre-action and deluge valves.
    - .7 Supervisory switches.
    - .8 Flow switches.
    - .9 Pressure switches.
    - .10 Sprinkler heads and escutcheon plates.
    - .11 Fire extinguishers and cabinets.
    - .12 Firestopping component data sheets and ULC or Warnock Hersey listings.
    - .13 Test headers.
    - .14 Flow Meter equipment.
    - .15 Fire hose valves.
    - .16 Heat Tracing Components.
    - .17 Insulation Materials.
    - .18 Hangers and Seismic Bracing.

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## 2. PRODUCTS

### 2.1 General

- 2.1.1 Pipes, fittings, couplings, valves, devices and materials used in fire suppression standpipe system shall be of Code approved or acceptable type.
- 2.1.2 System components shall be rated for working pressure not less than maximum pressure to be developed at their corresponding locations within systems under any condition, including pressure that occurs when permanently installed fire pump is operating at shutoff pressure.
  - .1 Refer to Section 21 05 06 for fire suppression system pressure ratings.

### 2.2 Sprinkler Piping and Fittings – Above Ground

#### 2.2.1 Piping:

- .1 Steel pipe, black or hot dipped galvanized, standard weight or light wall, material and IPS dimensions conforming to NFPA 13 and ASTM A53, ASTM A135 or ASTM A795.
- .2 Seamless copper tube to ASTM B75, seamless copper water tube to ASTM B88, wrought seamless tube to ASTM B251 of wall thickness Type “K”, “L” or “M”. Brazing filler metal (Classification BCuP-3 or BCuP-4) to AWS A5.8.
- .3 Ductile iron pipe or copper pipe for combined potable water and fire suppression system upstream of ULC listed backflow prevention device, as per Section 21 12 00.
- .4 ULC listed CPVC for fire protection is acceptable when and where Fire Protection Contractor can show that they have certified training and 5 years of successful installations. Materials in contact with CPVC pipe and fittings shall comply with Manufacturers compatibility documentation.
- .5 Provide copper pipe where specifically indicated on drawings.

#### 2.2.2 Fittings:

- .1 Compatible with piping material and suitable for maximum pressures in system, but not less than 175 psi (1,210 kPa) working pressure.
- .2 Welded fittings shall conform to ANSI B16.5, B16.9, B16.11 and B16.25 and ASTM A234.
- .3 Threaded fittings conforming to ANSI B16.1, B16.3, and B16.4 are acceptable on minimum Schedule 40 steel pipe up to 6” (150 mm) diameter and minimum Schedule 30 steel pipe for 8” (200 mm) diameter and larger and shall have ULC corrosion resistance ratio of 1.00 or greater.

- .4 Grooved end fittings shall be short-pattern ductile iron conforming to ASTM A536, and shall provide full flow design. Fittings, couplings and gaskets shall be of one Manufacturer and shall provide a rigid joint.
- .5 Couplings shall consist of two ductile iron housing segments, pressure responsive gasket, and zinc-electroplated steel bolts and nuts.
  - .1 Rigid Type: Housings shall be cast with offsetting angle-pattern bolt pads to provide rigidity and system support and hanging in accordance with NFPA 13. Couplings shall be fully installed at visual pad-to-pad offset contact (tongue and recess type couplings, or any coupling that requires exact gapping of bolt pads on each side of the coupling at specified torque ratings, are not allowed).
    - .1 1¼" (32 mm) through 8" (200 mm): Installation-Ready, for direct stab installation without field disassembly.
    - .2 Flexible Type: For use in locations where vibration attenuation and stress relief are required, and for seismic applications.
- .6 Branch connections may be provided by bolted mechanical branch connection complete with synthetic rubber gaskets approved for line service.
- .7 Outlet tees shall have cast upper and lower housings and may be used for up to 1" (25 mm) branch outlets and individual sprinklers.
- .8 Pressfit Systems or systems utilizing Schedule 5 pipe and cold drawn carbon steel fittings with integral synthetic O-ring are not acceptable.
- .9 For dry pipe systems, use flush seal coupling gasket in rigid and flexible couplings where required by NFPA 13.
- .10 Gaskets for couplings:

Fire Protection Service	Temp. Range
Dry Systems	Ambient
Freezer Applications	-40°F (-40°C) to 0°F (-18°C)
Water/Wet Systems	Ambient

- .11 Submit requests for consideration of other products or systems in accordance with submittal procedures, prior to closing of tender.
- .12 Acceptable Products must be ULC Listed for use in fire suppression systems.

## **2.3 Hangers & Seismic Bracing**

2.3.1 Provide hanger locations based on piping materials and NFPA Standards. All hangers and their components shall be ferrous.

- .1 Steel Pipe, except threaded lightwall.
- .2 1" (25 mm), 1¼" (32 mm): Maximum Spacing 12'-0" (3.6 m).
- .3 1½" (40 mm) and larger: Maximum spacing 15'-0" (4.5 m).
- .4 Threaded Lightwall: Maximum Spacing 12'-0" (3.6 m).
- .5 Copper Pipe: ¾" (20 mm) to 1" (25 mm), - 8'-0" (2.4 m), 1¼" (32 mm) & 1½" (40 mm) - 10'-0" (3.0 m), 2" (50 mm) to 3" (80 mm) - 12'-0" (3.6 m), 4" (100 mm) or larger 15'-0" (4.5 m).
- .6 ULC listed CPVC Pipe: ¾" (20 mm) - 5'-0" (1.5 m), 1" (25 mm) - 6'-0" (1.8 m), 1¼" (32 mm) - 6'-6" (2.0 m), 1½" (40 mm) - 7'-0" (2.1 m), 2" (50 mm) - 8'-0" (2.4 m), 2½" (65 mm) - 9'-0" (2.7 m), 3" (80 mm) - 10'-0" (3.0 m).
- .7 Ductile Iron Pipe: 15'-0" (4.5 m).

2.3.2 Provide sway-bracing as required by NFPA and indicated on supplied engineered fire protection shop drawings.

- .1 4-way sway braces required at top of risers.
- .2 Lateral braces cannot exceed 40'-0" (12.2 m) on centre or as indicated on drawing or seismic brace calculations.
- .3 Longitudinal braces cannot exceed 80'-0" (24.4 m) on centre or as indicated on drawing or seismic brace calculations.

## **2.4 Sprinkler Piping and Fittings – Below Ground**

2.4.1 If piping is required to be routed below grade, refer to Section 21 12 00 Fire Suppression Standpipes and contact Consultant.

## **2.5 Valves**

2.5.1 Gate - 175 psi (1,210 kPa) - ULC Listed:

- .1 ½" (15 mm) - 2" (50 mm): ULC listed and meeting project pressure requirements.
- .2 2½" (65 mm) and Larger: ULC listed and meeting project pressure requirements.

2.5.2 Butterfly/Ball - 175 psi (1,210 kPa) - ULC Listed:

- .1 ½" (15 mm) - 2" (50 mm): with weatherproof actuator and supervisory switches.
- .2 2" (50 mm) - 12" (300 mm): with weatherproof actuator and factory installed double throw/double pole supervisory switches.
  - .1 The stem on butterfly valves shall be offset from the disc centerline to provide full 360-degree circumferential seating, and the seat shall be pressure responsive.

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- .3 4" (100 mm) - 12" (300 mm): ULC listed and meeting project pressure requirements.
  - 2.5.3 Pressure Regulating Sprinkler Zone Control Valve - 400 psi (2,760 kPa) - ULC Listed:
    - .1 Zurn 5000 Series cast brass, straight pattern valve, rough brass finish with red wheel handle, female threaded outlet, 400 psi (2,760 kPa) rated. Capable of field adjustment of pressure.
  - 2.5.4 Test and Drain Valves -175 psi (1,210 kPa) - ULC Listed:
    - .1 1" (25 mm) and 2" (50 mm): tapped gauge outlet and integrated sight glass.
    - .2 1" (25 mm) and 1¼" (32 mm): tapped ¼" (6 mm) gauge outlet, and integrated sight glass.
  - 2.5.5 Check - 175 psi (1,210 kPa) - ULC Listed:
    - .1 2½" (65 mm) and Larger: ULC listed and meeting project pressure requirements.
    - .2 Provide spool piece to ensure full check valve opening where adjacent to alarm or gate valve.
  - 2.5.6 Wet Sprinkler Pipe Valve Station:
    - .1 The wet sprinkler station shall be ULC listed for automatic wet sprinkler systems.
    - .2 Valve internal components shall be replaceable without removing the valve from the installed position.
    - .3 Valves shall be externally resettable.
  - 2.5.7 Valves shall be ULC listed for fire suppression systems.
  - 2.5.8 Where working pressure exceeds 150 psi (1,034 kPa) provide 300 psi (2,070 kPa) valves.
  - 2.5.9 Grooved end valves shall be of one Manufacturer.
  - 2.5.10 Drain valves shall be provided with hose end adaptors complete with caps and chains, and auxiliary drains shall be provided with drum drip.
  - 2.5.11 Dry Sprinkler Valve Station:
    - .1 The dry sprinkler valve station shall be ULC listed for automatic dry sprinkler systems.
    - .2 The dry valve station shall be complete with ULC, air compressor, excess pressure device, accelerator(s), starter, motor, disconnect valves, pressure gauges, electric alarm and water motor gong, all controls, etc., to NFPA standards. Electrical shall wire all motors, switches, etc.
    - .3 Valve internal components shall be replaceable without removing the valve from the installed position.
    - .4 Valves shall be externally resettable.

- .5 Required air pressure shall be 13 psi (90 kPa).

**2.6 Sprinkler Zone Control Manifolds**

- 2.6.1 The wet sprinkler station shall be ULC listed for automatic wet sprinkler systems.
- 2.6.2 Valve internal components shall be replaceable without removing the valve from the installed position.
- 2.6.3 Valves shall be externally resettable.

**2.7 Wet Sprinkler Zone Control Valve Cabinets**

- 2.7.1 Sprinkler Zone Control Valve Assemblies:
- .1 Cabinet shall be ULC listed recessed wall mounted 30" (750 mm) wide x 30" (750 mm) high x 8" (200 mm) deep cabinet.
  - .2 Fully recessed steel cabinet with ½" (15 mm) turn back frame for 12" (300 mm) wall depth.
  - .3 Full length semi-concealed piano hinges for 180° swing.
  - .4 Flush stainless steel door latch with no exposed fasteners.
  - .5 18 ga (1.31 mm) baked enamel corrosion protected steel tub.
  - .6 14 ga (1.99 mm) baked enamel corrosion protected full metal steel door. Doors hinged as indicated on plans, or if not shown, orient to maximize cabinet access and not obstruct exit doors or exit routes.
  - .7 Grey prime coated enamel finish ready for field painting; reconfirm colour per Architect prior to ordering.

**2.8 Sprinklers**

- 2.8.1 Quick Response sprinklers required in all Light Hazard Occupancies.
- 2.8.2 Sprinkler body shall be integrally cast with hex-shaped wrench boss to reduce the risk of damage during installation.
- .1 Wrenches shall be provided by the sprinkler manufacturer to directly engage the wrench boss on the fire sprinkler.
- 2.8.3 Sprinklers with rubber O-rings are not acceptable.
- 2.8.4 Upright: Plain brass, quick response, glass bulb in unfinished mechanical and service rooms without ceilings.
- 2.8.5 Upright: Chrome-plated, quick response, glass bulb in finished rooms and spaces without ceilings such as atriums, skylights and sprinklered exterior covered areas.
- 2.8.6 Extended coverage brass uprights in parkade, and storage areas.



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- 2.8.7 Recessed Pendent: Recessed, quick response, glass bulb, chrome-plated finish on sprinklers and escutcheons in finished areas with ceilings except noted below.
  - 2.8.8 Concealed Pendant: Concealed, quick response, chrome-plated flat cover plate, at locations as indicated on drawings.
  - 2.8.9 Extended coverage recessed pendants, chrome-plated in finished ceilings. Extended coverage is not permitted in unfinished shell spaces.
  - 2.8.10 Recessed Horizontal Sidewall: Recessed, quick response, glass bulb, chrome-plated finish on sprinklers and escutcheons.
  - 2.8.11 Extended Throw Sidewall: Recessed, glass bulb, quick response, chrome-plated finish on sprinklers and escutcheons.
  - 2.8.12 Dry Horizontal Sidewall: Recessed, glass bulb, quick response, chrome finish on sprinklers and escutcheons.
  - 2.8.13 Intermediate Temperature and High Temperature Sprinklers: Provide at top of each elevator shaft, elevator machine rooms and electrical rooms and other required locations as per NFPA 13, complete with wire guards.
  - 2.8.14 Dry Sprinklers: Provide dry pendant or dry sidewall sprinklers where serving exterior area or area subject to freezing from wet sprinkler system piping.
  - 2.8.15 Institutional Sprinklers: Pendant or sidewall institutional sprinklers with breakaway release mechanism for confined areas such as psychiatric rooms, holding cells and prison inmate areas.
  - 2.8.16 Sprinklers in exposed areas subject to viewing by occupants shall be chrome-plated finish with chrome-plated escutcheons. Sprinklers in service spaces, mechanical and electrical rooms and other such spaces shall be brass finish.
  - 2.8.17 Escutcheon plates shall allow accessible (T-bar) ceilings to be removed without removing sprinklers. Construction consists of cup and skirt, cup retaining sprinkler and skirt the removable portion around exterior perimeter of cup that covers tile hold. Finished escutcheon installation shall not project more than ¼" (6 mm) below finished ceiling surface. Recessed two-piece escutcheons and single piece escutcheons that are specifically manufactured with sprinklers to permit escutcheons and ceiling tile removable without sprinkler removal are acceptable. Escutcheons shall match sprinkler finish, be of same Manufacturer as sprinkler and coordinate with architectural features.
  - 2.8.18 Provide wire sprinkler guards in areas such as mechanical rooms, service rooms, elevator shafts, below lower level stair landings, gymnasiums, exterior locations, etc., where sprinklers are susceptible to mechanical damage or vandalism.

- 2.8.19 Escutcheons and guards shall be listed, supplied, and approved for use with the sprinkler, by the sprinkler Manufacturer.
- 2.8.20 Sprinklers shall be ULC listed for use in occupancies in which they are to be installed.
- 2.8.21 Sprinklers shall be quick response, unless otherwise noted.
- 2.8.22 Sprinklers shall be for commercial/institutional applications unless stated otherwise. Residential sprinklers are only permitted in residential areas of residential buildings including adjoining corridors.
- 2.8.23 Flexible sprinkler drops are to align with those identified on the approved design drawings.

## **2.9 Flow Switches**

- 2.9.1 ULC listed flow switches suitable for 24 V DC with one set of normally open and one set of normally closed contacts, time delay feature and paddle indicator specifically chosen and ULC listed for size of pipe in which flow switch is mounted.
- 2.9.2 Flow switch test and drain assembly immediately downstream of each flow switch in addition to normal inspector's test connections required by NFPA 13.
- 2.9.3 Flow switches shall be manufactured specifically for sprinkler systems rated minimum 175 psi (1,210 kPa).

## **2.10 Pressure Switches**

- 2.10.1 ULC listed pressure switches where indicated on drawings. Pressure switches shall be suitable for 24 V DC contact rating unless otherwise specified, rated minimum 175 psi (1,210 kPa).

## **2.11 Supervisory Switches**

- 2.11.1 ULC listed supervisory switches, complete with 1 set of normally open contacts and 1 set of normally closed contacts, or 2 sets of SPDT contacts.
- 2.11.2 Switches shall be suitable for 24 V DC contact rating unless otherwise specified, rated minimum 175 psi (1,210 kPa).
- 2.11.3 Looped cable devices are not acceptable.
- 2.11.4 Approved valves with integral and/or factory installed indicators and supervisory controls are acceptable products.

## **2.12 Air Vent**

- 2.12.1 An air vent is required near the high point(s) in the systems to allow air to be removed from that section of the fire protection system.
- 2.12.2 The following means are acceptable:
  - .1 Manual valve, minimum ½" (15 mm) size,

- .2 Automatic air vent, or
- .3 Other ULC approved means.

## 2.13 Air Compressors

2.13.1 Select air compressors for capacity as determined by hydraulic calculation design of dry sprinkler systems. Confirm electrical characteristics with electrical drawings and specifications.

2.13.2 If not hard-wired air compressor switch to be provided with a lockable type switch.

## 2.14 Spare Sprinklers

2.14.1 Provide red baked enamel steel cabinet containing minimum of two spare sprinklers of each pattern, but in addition, not less than the following of all types:

Number of Sprinklers	Total Spares
up to 300	6 minimum
300 - 1000	12 minimum
over 1000	24 minimum

## 2.15 Fire Department Siamese Connections

2.15.1 Provide Fire Department Connections (FDCs) as follows (refer to drawings for locations):

- .1 Sprinkler/Standpipe: main entrance.
- .2 Sprinkler/Standpipe: remote connection.
- .3 Size: 4" (100 mm) or 6" (150 mm) piping.
- .4 Finish: **Chrome-plated** for all exposed surfaces.

2.15.2 Flush mounted fire department Siamese inlet connections at or near main building entrance:

- .1 Flush mounted fire department Siamese connection, cast brass body, double 2½" (65 mm) clapper valves, 2" (50 mm) - 2½" (65 mm) inlet ports with brass plugs and chains, 4" (100 mm) or 6" (150 mm) outlet, integral ball drip. Threads per local Fire Department.
- .2 Wall escutcheon plate 15" (375 mm) x 9" (225 mm) marked with 1" (25 mm) high raised letters for primary information and 5/8" (16 mm) for secondary information detailing:
  - .1 Primary Information:
    - .1 "AUTO SPKR STANDPIPE".
    - .2 LEVEL: X TO XX
    - .3 MAX. PRESSURE: XXX PSI (XXXX kPa)
  - .2 Secondary Information:
    - .1 ADDRESSES SERVED

2.15.3 Free standing sidewalk fire department Siamese inlet connections near main building entrance:

- .1 Free standing fire department Siamese inlet connection, cast brass angle body, double 2½" (65 mm) clapper valves, 2" (50 mm) - 2½" (65 mm) inlet ports with brass plugs and chains, 4" (100 mm) or 6" (150 mm) outlet. Threads per local Fire Department.
- .2 Base escutcheon plate 15" (380 mm) x 9" (225 mm) marked with 1" (25 mm) high raised letters "AUTO SPKR STANDPIPE."

2.15.4 Stortz Connection, **4" (100 mm)** outlet.

- .1 Size: 4" (100 mm) or 6" (150 mm) piping.
- .2 Wall escutcheon plate 15" (375 mm) x 9" (225 mm) marked with 1" (25 mm) high raised letters **AUTO SPKR STANDPIPE.**

2.15.5 Pressures must be labeled on plate.

2.15.6 At the low-point near each fire department connection, install a 90-degree elbow with drain connection to allow for system drainage to prevent freezing.

## **2.16 EXTRA STOCK MATERIALS:**

2.16.1 Provide sprinkler cabinet with twelve (12) extra sprinkler heads.

2.16.2 Provide metal storage cabinet in Level 0 Mechanical Room.

2.16.3 Tools: Provide suitable wrenches for each sprinkler type.

## **3 . EXECUTION**

### **3.1 Fire Suppression Sprinkler Systems**

3.1.1 Supply and install fire suppression sprinkler systems throughout building, in accordance with listed codes, bylaws, standards and approvals, including NFPA 13, Ontario Building Code and Ontario Fire Code.

3.1.2 Test sprinkler systems to listed requirements and submit certificate stating that such testing has been carried out and approved.

3.1.3 Provide inspector's test valves and drain pipes at remote points in system to NFPA 13 requirements.

3.1.4 Provide sectional drains in piping greater than 5 US gal (19 L). Drum drips required on all dry system sectional drains.

3.1.5 Supply and install fire suppression sprinkler systems in accordance with piping configuration indicated on engineered drawings. Any

deviations to sprinkler system must be approved by Introba's Fire Protection Engineer of Record.

- 3.1.6 Supply and install fire suppression sprinkler systems in accordance with general piping configuration indicated on drawings. Sprinkler Contractor shall hydraulically calculate sprinkler systems in accordance with the following provisions:
- .1 Calculations shall be responsibility of and signed and sealed by fire protection Sub-Contractor's Registered Professional Engineer. Submit Letters of Assurance to Consultant and Authority Having Jurisdiction in accordance with the Ontario Building Code and Ontario Fire Code.
  - .2 Such calculations shall be based on general piping configuration indicated on drawings.
  - .3 Water supply hydraulic data shall be confirmed in writing by Contractor with water utility or municipal authority prior to submission of shop drawings.
- 3.1.7 Supply and Installation of sprinkler systems on basis of hydraulic calculations shall be responsibility of fire suppression Sub-Contractor and their Registered Professional Engineer.
- 3.1.8 Locate sprinklers in general conformance with locations indicated on sprinkler design drawings. For exact locations, refer to architectural reflected ceiling plans. In absence of reflected ceiling plans, sprinklers shall be installed at centre point, quarter point and/or third point in long dimension of ceiling tiles, and in centre point of short dimension of ceiling tiles, and/or in line with other ceiling elements, light fixtures, diffusers, audio devices and other fittings, in symmetrical and aesthetic pattern acceptable to Architect. Coordinate sprinkler layout with architectural, structural, electrical and mechanical HVAC ceiling elements.
- 3.1.9 Sprinkler bulb protector shall be removed by hand after installation. Do not use tools or any other device(s) to remove the protector that could damage the bulb in any way.
- 3.1.10 Do not install sprinklers that have been dropped, damaged, or show a visible loss of fluid. Never install sprinklers with cracked bulbs.
- 3.1.11 Submit to Consultant completed Contractor's Material and Test Certificate for fire suppression systems on a per zone basis and provide copy in project Mechanical Operation and Maintenance Manuals.
- 3.1.12 Submit to consultant completed backflow preventer test certificate.
- 3.1.13 Submit to consultant completed alarm verification certificate.

### **3.2 Pipe and Fittings**

- 3.2.1 Welding shall be done in shop using welding fittings. Field welding is not permitted.

- 3.2.2 Flanged pattern fittings shall be used for piping 8" (200 mm) diameter and larger, and at valve stations and fire department connections.
- 3.2.3 Provide expansion joints or flexible couplings at building expansion joints, building earthquake joints, building firewalls and other locations as necessary.
- 3.2.4 Grooved end components including vales, fittings and couplings shall be of one Manufacturer and shall be installed in accordance with Manufacturer's instructions.
  - .1 Grooved coupling Manufacturer's factory trained Representative shall provide on-site training for Contractor's field personnel in the use of grooving tools and installation of grooved joint products. Representative shall periodically visit the jobsite and review Contractor is following best recommended practices in grooved product installation. (A Distributor's Representative is not considered qualified to conduct the training or jobsite visit(s).)
- 3.2.5 Proprietary products shall be installed in accordance with Manufacturer's instructions and piping shall be clearly marked at each joint to indicate pipe insertion depth.
- 3.2.6 Tie rods shall only be used in conjunction with fittings possessing integral tie lugs.
- 3.2.7 Tie rods complete with their associated nuts and bolts shall be coated with two coats of asphaltic paint after installation.

### **3.3 Pipe Pitch-Dry Systems**

- 3.3.1 Branch lines, pitch pipe ½" (15 mm) every 10'-0" (3.0m).
- 3.3.2 Mains, pitch pipe ¼" (6 mm) every 10'-0" (3.0m).
- 3.3.3 Provide drum drips at dry system low points (sectional drains).

### **3.4 Flushing of Sprinkler Systems**

- 3.4.1 Flush underground water mains and fire department Siamese connection lines before connection to fire suppression standpipe systems.
- 3.4.2 Flush pipelines until effluent is clear and free debris.
- 3.4.3 Rate of flushing flows shall be as indicated in NFPA 13.
- 3.4.4 Provide proper drainage for flushing operation.

### **3.5 Flow Switches**

- 3.5.1 Provide pipe drain connections from test valves to open discharge at floor drains, service sinks, or other discharge points acceptable to Owner or Consultant.

- 3.5.2 Conduct tests in conjunction with Electrical on each device to ensure indication of “alarm” signal and correct location and labelling on fire alarm system.

**3.6 Supervisory Switches**

- 3.6.1 Install supervisory switches on valves supplying fire suppression sprinkler systems inside the building perimeter.
- 3.6.2 Conduct tests in conjunction with Electrical on each device to ensure indication of “supervisory” signal and correct location and labelling thereof on fire alarm system.

**3.7 Fire Department Siamese Connections**

- 3.7.1 Mount centre line at 18” (457 mm) to 48” (1,220 mm) above adjacent ground, sidewalk or grade surface unless indicated otherwise on drawings. Install escutcheon plates true and level.
- 3.7.2 Seal perimeter of the escutcheon plates to building face with clear, water resistant, silicone caulking in neat manner.

**3.8 Electrical Equipment Protection from Water**

- 3.8.1 Sprinkler piping and sprinklers are to be installed in various areas containing electrical equipment as indicated on drawings.
- 3.8.2 Responsibility for water damage to electrical equipment in these areas from sprinkler system installation whether due to testing or leakage prior to Owner’s acceptance of building shall be responsibility of this Section.
- 3.8.3 Provide and install in this Section of work minimum 20 ga (1.00 mm) sheet metal protective hoods individually located over electrical equipment susceptible to water damage upon release of sprinklers in electrical areas. Such electrical equipment shall include transformers, equipment with ventilation grilles and other switchgear with openings that allow water entry into equipment. Protective hoods shall be sloped to shed water and shall project horizontally beyond equipment perimeter and shall not be integrally mounted on equipment unless prior approval obtained from electrical authorities. Holes through protective hoods that cannot be avoided, shall be sealed with waterproof sealing compound.
- 3.8.4 No piping shall be installed in Electrical Rooms. Only the sprinkler branch and head serving the Electrical Room may be installed in the electrical as per BICSI.

**3.9 Installation of Pre-Action System Detectors**

- 3.9.1 Provision of detection system and connection to pre-action system control panel will be done under electrical Division 26.

3.9.2 120 volt AC supply will be provided to pre-action system control panel under Division 26.

**END OF SECTION**



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## 1. **GENERAL**

### 1.1 **Related Work**

1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

### 1.2 **Reference Standards**

1.2.1 National Fire Protection Association, NFPA 10 Standard for Portable Fire Extinguishers.

1.2.2 Ontario Building Code.

1.2.3 Ontario Fire Code.

### 1.3 **Shop Drawings and Products Data**

1.3.1 Submit shop drawings and product data for fire extinguishers and extinguisher cabinets.

### 1.4 **Maintenance Data**

1.4.1 Provide maintenance data for incorporation into Mechanical Operation and Maintenance Manuals.

## 2. **PRODUCTS**

### 2.1 **Recessed Cabinet with 5lb (2.3 kg) Extinguisher (FE-1)**

2.1.1 Recessed extinguisher cabinet, fire rated.

2.1.2 8" (200 mm) x 17" (425 mm) x 5" (125 mm) cabinet.

2.1.3 Semi-recessed steel cabinet with turn back frame for 4.75" (120 mm) wall or fully recessed steel cabinet with turn back frame for 5.5" (140 mm) wall.

2.1.4 Full length semi-concealed piano hinges for 180° swing.

2.1.5 Flush stainless steel door latch with no exposed fasteners.

2.1.6 18 ga (1.31 mm) steel tub.

2.1.7 16 ga (1.61 mm) steel door and trim with optional  $\frac{3}{16}$ " (4.5 mm) clear tempered glass (-G-T).

2.1.8 Grey Prime coated finish ready for field painting.

2.1.9 5 lb (2.3 kg) ABC Dry Chemical multi-purpose fire extinguisher.

### 2.2 **Surface Mounted Cabinet with 5 lb (2.3 kg) Extinguisher (FE-2)**

2.2.1 Surface mount extinguisher cabinet.

2.2.2 20½" (515 mm) x 8½" (215 mm) x 6" (150 mm) cabinet.

- 2.2.3 Semi-recessed steel cabinet with turn back frame for 4 $\frac{3}{4}$ " (120 mm) wall thickness, or fully recessed steel cabinet with turn back frame for 6 $\frac{3}{4}$ " (170 mm) wall thickness.
- 2.2.4 Full length semi-concealed piano hinges for 180° swing.
- 2.2.5 Flush stainless steel door latch with no exposed fasteners.
- 2.2.6 18 ga (1.31 mm) steel tub.
- 2.2.7 5 lb (2.3) kg ABC Dry Chemical multi-purpose fire extinguisher.

**2.3 Recessed Cabinet with 10 lb (4.5 kg) Extinguisher (FE-3)**

- 2.3.1 Recessed extinguisher cabinet, fire rated.
- 2.3.2 9" (225 mm) wide x 24" (600 mm) high x 6" (150 mm) deep cabinet.
- 2.3.3 Semi-recessed steel cabinet with turn back frame for 4" (100 mm) wall thickness.
- 2.3.4 Full length semi-concealed piano hinges for 180° swing.
- 2.3.5 Flush stainless steel door latch with no exposed fasteners.
- 2.3.6 18 ga (1.31 mm) steel tub.
- 2.3.7 16 ga (1.61 mm) steel door and trim with optional  $\frac{3}{16}$ " (4.5 mm) clear tempered glass (-G-T).
- 2.3.8 Grey prime coated finish ready for field painting.
- 2.3.9 10 lb (4.5 kg) ABC dry chemical multipurpose fire extinguisher.

**2.4 Surface Mounted Cabinet with 10 lb (4.5 kg) Extinguisher (FE-4)**

- 2.4.1 Surface mount extinguisher cabinet.
- 2.4.2 10 $\frac{1}{2}$ " (265 mm) wide x 24" (600 mm) high x 6 $\frac{1}{4}$ " (156 mm) deep cabinet.
- 2.4.3 Surface mount steel cabinet.
- 2.4.4 18 ga (1.31 mm) steel tub.
- 2.4.5 Plexiglas panel, break glass hammer and instruction decal.
- 2.4.6 White baked enamel finish.
- 2.4.7 10 lb (4.5 kg) ABC dry chemical multipurpose fire extinguisher.

**2.5 Clean Agent Fire Extinguishers (FE-CA)**

- 2.5.1 Clean agent portable handheld fire extinguishers.
- 2.5.2 Extinguisher shell factory hydrostatically tested to 60 psi (4,140 kPa) and leak tested at factory.
- 2.5.3 Stainless steel shell and non-magnetic valve, hose and nozzle.
- 2.5.4 Large colour-coded pressure gauge.
- 2.5.5 Easy grip handle with ring pin and retention chain.

- 2.5.6 Factory charged with FE-36 that is colourless, odourless, electrically non-conductive, residue free, low toxicity agent with zero ozone depletion potential.
- 2.5.7 Size FE13 extinguisher with 2A:10BC rating.
- 2.5.8 Surface mounted, white baked enamel steel extinguisher cabinet, complete with Plexiglas panel and attached break glass hammer.

**2.6 Type “K” Fire Extinguishers (FE-K)**

- 2.6.1 Recessed extinguisher cabinet, fire rated.
- 2.6.2 9” (225 mm) wide x 24” (600 mm) high x 6” (150 mm) deep cabinet.
- 2.6.3 Semi-recessed steel cabinet with turn back frame for 4” (100 mm) wall thickness.
- 2.6.4 Full length semi-concealed piano hinges for 180° swing.
- 2.6.5 Flush stainless steel door latch with no exposed fasteners.
- 2.6.6 18 ga (1.31 mm) steel tub.
- 2.6.7 16 ga (1.61 mm) steel door and trim with optional  $\frac{3}{16}$ ” (4.5 mm) clear tempered glass (-G-T).
- 2.6.8 Grey prime coated finish ready for field painting.
- 2.6.9 Surface mount extinguisher cabinet.
- 2.6.10 10  $\frac{1}{2}$ ” (265 mm) wide x 24  $\frac{1}{4}$ ” (600 mm) high x 6  $\frac{1}{4}$ ” (156 mm) deep cabinet.
- 2.6.11 Surface mount steel cabinet.
- 2.6.12 18 ga (1.31 mm) steel tub.
- 2.6.13 Plexiglas panel, break glass hammer and instruction decal.
- 2.6.14 White baked enamel finish.
- 2.6.15 1.59 gal (6 L) Class K wet chemical fire extinguisher, chrome plates.

**2.7 Pressurized Water Fire Extinguishers**

- 2.7.1 2.5 US gal (9.5 L) capacity, pressurized water type, stainless steel construction with **mounting brackets**.

**2.8 Carbon Dioxide Fire Extinguishers (FE-CO)**

- 2.8.1 Hose and horn discharge, self-closing lever or squeeze grip operated, insulated handle, fully charged and complete with mounting brackets and charge indicator.

**2.9 Multi-Purpose Dry Chemical Fire Extinguishers**

- 2.9.1 Pressurized with hose and shutoff nozzle or integral shutoff nozzle and **mounting brackets** suitable for Class A, B and C fires; charge indicator.

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**3 . EXECUTION**

**3.1 Installation**

- 3.1.1 Install fire extinguishers in cabinets at locations as indicated on drawings.
- 3.1.2 Coordinate locations of fire extinguisher cabinets with framing trades in order to facilitate recessed and semi-recessed installations.
- 3.1.3 Mount fire extinguishers and cabinets such that top of extinguisher is 4'-0" (1.2 m) above floor.
- 3.1.4 Install fire extinguisher cabinet doors, glazing panels and fire extinguishers in cabinets prior to project substantial completion review by Consultant.

**3.2 Identification**

- 3.2.1 Identify fire extinguishers in accordance with recommendations of NFPA 10.
- 3.2.2 Attach tag or label to fire extinguishers, indicating month and year of installation, with space for recording subsequent service dates.

**END OF SECTION**

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## 1. **GENERAL**

### 1.1 **General**

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.
- 1.1.2 General Conditions, Supplements, Amendments and this section shall govern plumbing sections (i.e. 22 00 00 to 22 99 99 sections) of work (read in conjunction with the Instructions to Tenderers or Bidders). This section covers items common to 22 00 00 series sections and is intended only to supplement the requirements of Division 1.
- 1.1.3 Plumbing drawings are diagrammatic and approximately to scale. They establish scope of plumbing work and general location and orientation of plumbing facilities. Plumbing facilities shall be installed generally in locations and generally along routings shown, close to building structure with minimum interference with services. Piping shall be concealed within walls, ceilings or other spaces and shall be routed to maximize head room and intended use of space through which they pass, unless specifically noted otherwise.
- 1.1.4 Coordinate with the Electrical Contractor for all required electrical connections to plumbing equipment and accessories. Where alternate or substituted equipment requires an electrical connection, the contractor shall include all costs to provide a complete operating system.
- 1.1.5 Refer to 23 05 00 for complete details for applicable Common Work Results not detailed in this section.

### 1.2 **Related Work**

- 1.2.1 Electrical Division 26
- 1.2.2 Trenching and Backfilling Division 33

### 1.3 **Codes, Standards and Approvals**

- 1.3.1 Installation, workmanship and testing shall conform to the following standards:
  - .1 Ontario Building Code.
  - .2 CSA B149.1, Natural Gas and Propane Installation Code.
  - .3 All products shall be UL/ULC classified in accordance with NSF/ANSI/CAN-61 for potable water service and certified to the no/low lead standard of NSF/ANSI/CAN-372.

### 1.4 **Shop Drawings**

- 1.4.1 Refer to 23 05 00 for complete details of submission requirements.

1.4.2 Shop drawings are required for all materials and equipment including, but not limited to, the following:

- .1 Cleanouts and access panels.
- .2 Floor drains.
- .3 Hot water tanks and heaters.
- .4 Hydrants/hose bibbs.
- .5 Plumbing fixtures.
- .6 Pumps and controls.
- .7 Roof drains.
- .8 Trap primers.
- .9 Valves.
- .10 Water hammer arrestors.
- .11 Compressor units.
- .12 Firestopping.

**1.5 Maintenance Data**

- 1.5.1 Refer to Section 23 05 00 Common Work Results for HVAC.
- 1.5.2 Comprehensive description of operation of systems, including function of each item of equipment within systems.
- 1.5.3 Operating electrical switchgear schedule indicating location of equipment.
- 1.5.4 Lubrication schedule indicating recommended lubricants and grades (grease or oil) for lubricated equipment components.

**1.6 Record Drawings (As Built Drawings)**

- 1.6.1 Section 23 05 00 Common Work Results for HVAC shall apply to Plumbing Systems.
- 1.6.2 In addition, as a minimum, during the construction period, keep on site clean set of drawing marked up, IN COLOUR, to reflect as built state, for examination by Consultant on regular basis. Include elevations, rough-in details and details and detailed locations of hidden services, including locations of maintenance items and their associated identification code (i.e. Values). Underground services and/or concealed piping shall be dimensionally located and noted (use gridlines or structure as the reference).
- 1.6.3 At the time of 'Substantial Completion' submit to Consultant one complete full sized COLOUR photocopy of Record Drawing information produced as per above section.

**1.7 Temporary Usage of Plumbing Equipment**

1.7.1 Plumbing equipment and systems shall not be used without written permission of Consultant and under no circumstances shall be used prior to testing and inspection.

**1.8 Acoustical Treatment**

1.8.1 This project includes special acoustical requirements to ensure low noise levels in noise sensitive areas. The Contractor shall, in particular, give careful consideration to equipment selection and pay close attention to detail during the rough-in stage in order to assure maximum acoustical benefit.

- .1 Conference rooms.
- .2 Library.
- .3 Private offices.
- .4 Quiet rooms.
- .5 Study/testing rooms.

**2 . PRODUCTS**

**2.1 Access Doors**

2.1.1 Refer to Common Work Results for HVAC Section 23 05 00 for access door/access panel requirements.

**2.2 Cleanouts**

- 2.2.1 Cleanouts shall be full size for pipe sizes up to 4" (100 mm) and not less than 4" (100 mm) on larger sizes. Cleanouts installed inside finished areas shall all be of same shape, either round or square.
- 2.2.2 Cleanouts passing through waterproofed floor or slab on grade subject to hydrostatic pressure shall have a clamping collar clamped to floor membrane.
- 2.2.3 Pipe Manufacturers' cleanouts are acceptable for vertical installation at base of soil and waste stacks or rainwater leaders only.
- 2.2.4 Make cleanouts with Barrett type fitting with bolted cover plate and gasket, fitting that has threaded plug, or cleanout ferrule installed in wye or extended wye.
- 2.2.5 Outside area and vehicle area cleanouts shall be heavy duty construction and have fully exposed scoriated cover. Acceptable Product: Zurn Z1400, Jay R Smith 4231 Series, Wade 6000-Z Series.
- 2.2.6 Lino or lino tiled area cleanouts shall have centre portion of cover recessed to receive tile that matches adjoining tile. Acceptable

Product: Zurn DNE 1400-X or ZN 1400-TX, Jay R Smith 4140, Wade 6000-1 Series.

- 2.2.7 Ceramic tile floor area cleanouts shall have fully exposed scoriated cover. Acceptable Product: Zurn DNE 1400 or ZN 1400-T, Jay R Smith 4020, Wade 6000-1 Series.
- 2.2.8 Terrazzo tile floor area cleanouts have centre portion cover to receive terrazzo to match adjoining terrazzo finish. Acceptable Product: Zurn ZN 1400-Z, Jay R Smith 4180, Wade 6000-1 Series.
- 2.2.9 Carpet area cleanouts shall be fully concealed with a small, raised marker. Acceptable Product: Zurn ZN 1400-CM, Jay R Smith 4020-Y, Wade 6000-1 Series.

### **2.3 Hangers and Supports**

- 2.3.1 Refer to Section 22 05 29 for Hangers and Supports for Plumbing Piping and Equipment.

### **2.4 Pipe Sleeves and Escutcheons**

- 2.4.1 Provide and locate pipe and duct sleeves.
- 2.4.2 Provide detailed information on openings required in pre-cast members for mechanical work. Cast holes larger than 4" (100 mm) diameter and field cut holes smaller than 3½" (90 mm) diameter.
- 2.4.3 Provide separate sleeves for piping passing through walls, floors, roof and ceilings. Sleeves shall be 20 ga (1.00 mm) galvanized iron and standard weight steel piping sleeves in concrete beams, foundation walls and footings. Plastic sleeves may be used in concrete wall form work where permitted by Authorities having Jurisdiction.
- 2.4.4 Sleeves shall be sized large enough to allow for movement due to expansion and to provide for continuous pipe insulation where not passing through fire rated assemblies.
- 2.4.5 Sleeves passing through basement walls or potentially wet floors shall be set with integral "puddle flanges".
- 2.4.6 Seal penetrations through aboveground exterior walls, and underground exterior walls and slabs including slabs on grade, where no hydrostatic pressure exists, with flexible, non-hardening, weatherproof caulking compound. Seal around exterior circumference of sleeves and annular space between pipes and sleeves.
- 2.4.7 Provide Link Seal type wall gasket to seal exposed sides of opening between pipe and sleeve on foundation walls with caulking fill. Provide water proofing mastic seal on concealed side of opening.
  - .1 Acceptable Sealing Products: Garlock Link-Seal, Metraflex MetraSeal.



- 2.4.8 For finished floor areas, provide pipe sleeves 1" (25 mm) above floor with annular fin.
- 2.4.9 Install chrome-plated escutcheons with set screws where insulated or uninsulated piping passes through finished floor, ceiling and wall surfaces. Copper piping shall not be in contact with ferrous metals. Use cast-iron or galvanized sheet metal escutcheons for equipment rooms.
- 2.4.10 Coordinate installation of concrete curbs around duct openings in mechanical room floors with General Contractor.
- 2.4.11 Provide plastic grommets, equivalent to Pipe Tytes or Greenlee 712-M, for pipes passing through metal stud partitions.

## **2.5 Pipe Bedding**

- 2.5.1 All buried piping inside the building below floors and slabs, except for footing drains, shall be supported on a bed of well compacted sand (i.e. 95% Modified Proctor Density). Bedding shall extend 6" (150 mm) below pipe and support pipe barrel, not joints and/or couplings. Before backfilling, complete line shall be inspected and approved by Authorities Having Jurisdiction.

## **3 . EXECUTION**

### **3.1 Pressure Piping Installation**

#### **3.1.1 General**

- .1 Install piping straight, parallel and close to walls and ceilings, with fall of not less than 1:50 for gravity piping and with slope to drain cocks, fixtures or equipment for pressure piping, unless otherwise indicated on drawings. Use standard fittings for direction changes. Provide drain cocks as required.
- .2 Install groups of piping parallel to each other, spaced to permit application of insulation, identification and service areas, on trapeze hangers.
- .3 Where pipe size differs from connection size to equipment, install reducing fitting close to equipment. Reducing bushings are not permitted.
- .4 Brass and copper pipe and tubing shall be free from surface damage. Replace damaged pipe or tubing.
- .5 Ream ends of pipe and tubes before installation.
- .6 Install copper pipe to not contact with dissimilar metal and not be crimped or collapsed. Joints on cast or ductile iron pressure service piping shall be made electrically conductive.

- .7 Install flanges or unions and shut-off valves to permit removal of equipment without disturbing piping systems.
- .8 Clean ends of pipes or tubing and recesses of fittings to be joined. Assemble joints without binding.
- .9 Install piping to connections at fixtures, equipment, outlets and other appurtenances requiring service. Trap and vent waste connections to fixtures. Grade all vents to drain back to waste piping.
- .10 Plug or cap pipe and fittings to keep out debris during construction.
- .11 Joint material shall be compatible with type of pipe used.
- .12 Non-corrosive lubricant or Teflon tape shall be applied on male thread of threaded joints.
- .13 Flush and clean out piping systems after testing.
- 3.1.2 Equipment Drainage:
  - .1 Install drain valves at low points.
  - .2 Extend equipment drain piping to discharge into floor or hub drain.
- 3.1.3 Expansion and Contraction and Building Seismic Joints:
  - .1 Support piping to prevent stress or strain.
  - .2 Install pressure piping with loops and offsets to permit expansion and contraction without damaging pressure piping system.
  - .3 Install pressure piping with expansion joints where space does not permit loops and offsets.
- 3.1.4 Buried Piping:
  - .1 Lay pipe on compacted bedding of clean, coarse sand, free from clay, snow or ice, organic matter or stones.
  - .2 Do not lay pipe in water or when conditions are unsuitable.

### **3.2 Plumbing System Acoustical Requirements**

- 3.2.1 Provide minimum ½" (15 mm) pipe size for suite fixtures, including supplies to faucets.
- 3.2.2 Ensure no rigid contact between pipes and supporting framing and gypsum wall board.
- 3.2.3 Do not secure piping to partition which forms part of adjacent suite.
- 3.2.4 Provide flexible connections for all fixtures.
- 3.2.5 Domestic pipes shall be wrapped in the area of the attachments with minimum ¼" (6.0 mm) thick Rubatex or Armaflex sleeving and secure over insulation using oversized clamps. If piping is insulated, this requirement is waived if clamps mount over insulation. Hard

plastic pipe sleeves are not acceptable. An alternate is to provide resilient pipe mounting system such as Acoustoplumb or HoldRite.

- 3.2.6 Tee take-offs serving back to back fixtures are not permitted. Divide supply lines at riser and feed each bathroom individually.
- 3.2.7 Supply, waste and vent pipe penetrations of gypsum wall board shall be  $\frac{1}{8}$ " (3.0 mm) to  $\frac{1}{4}$ " (6.0 mm) oversized, pipe centred in hole, gap caulked with silicone sealant and covered with escutcheon. This requirement does not eliminate need for firestopping. Refer to Section 23 05 05 Firestopping for firestop requirements.
- 3.2.8 Do not allow pipe work to contact gypsum wall board, framing, conduit, electrical or ductwork fans connected to room services. Exercise special care in furred down bathroom ceiling spaces.
- 3.2.9 Water supply lines penetrating floors must not contact structure.
- 3.2.10 Waste stacks and rainwater leaders shall not touch structure and shall be resiliently supported at floor penetration with neoprene pad isolators sized for minimum  $\frac{3}{8}$ " (9.5 mm) static deflection. Neoprene pad isolators shall be equal to Mason "Super W". Ensure piping does not touch framing or gypsum wall board.
- 3.2.11 Lavatory and bath wastes in back to back situations should be carried separately to waste stack; direct connections from back to back fixtures not acceptable.
- 3.2.12 Mount bathtubs on Mason "Super W" neoprene pad isolators sized for  $\frac{1}{8}$ " (3.0 mm) static deflection under full load conditions (i.e., tub full of water). For one person tub, use five pads with 30 durometer rating. Manufacturer shall ensure filled tub will not exceed pad rating. If continuous support is required, provide isolators between support and structure. Ensure supply and drain piping can accommodate changes in deflection between full and empty conditions. Provide seal around tub lip to accommodate isolator deflection.

### **3.3 Access Doors**

- 3.3.1 Install access doors at concealed cleanouts, traps, unions, expansion joints, valves, control valves, air vents, water hammer arrestors, special equipment, trap primers, vacuum breakers and other equipment for which periodic access will be required.
- 3.3.2 Locate access doors so concealed items are accessible for adjustment, operation, maintenance and replacement.
- 3.3.3 Do not locate access doors in feature walls or ceilings without prior approval of Consultant. Locate in service areas and storage rooms wherever possible.

### **3.4 Cleanouts**

- 3.4.1 Install cleanouts at the following locations:

- .1 Building drain leaving building on upstream side of exterior wall.
  - .2 Changes of direction of more than 90° in drainage piping.
  - .3 Nominally horizontal branch or building drain at intervals of not more than 25'-0" (7.5 m) for pipe sizes 2½" (65 mm) and less, 50'-0" (15 m) for 3" (80 mm) and 4" (100 mm) pipe sizes, and 100'-0" (30 m) for pipe sizes larger than 4" (100 mm).
  - .4 Fixture drain of a sink, kitchen piping or grease waste piping at intervals not exceeding 25'-0" (7.5 m).
  - .5 Base of soil or waste stacks and rainwater leaders.
  - .6 As called for by Ontario Building Code – Part 7 Plumbing.
- 3.4.2 Locate wall cleanouts 3" (80 mm) minimum above top of base board or minimum 8" (200 mm) above finished floor level where no baseboard.
- 3.4.3 Coordinate cleanout location with millwork and other obstructions; place in accessible location with sufficient clearance for rodding and cleaning.
- 3.4.4 Extend cleanouts to finished floor or wall unless exposed in basement room, pipe tunnel or accessible crawlspace.
- 3.4.5 Extend cleanouts in wet floor areas above floor in walls, or provide with gasketted, waterproofed tops.
- 3.4.6 Bring cleanouts on outside drains to grade and anchor in a concrete collar.
- 3.4.7 Locate cleanouts serving fixtures in Healthcare Facilities, Mortuaries, Laboratories and similar occupancies, where contamination by bodily fluids is likely, a minimum of 6" (150 mm) above flood level trim of fixture.

### **3.5 Hangers and Supports**

- 3.5.1 Refer to section 22 05 29 for Hangers and Supports for Plumbing Piping and Equipment.

### **3.6 Pipe Sleeves and Escutcheons**

- 3.6.1 Install chrome-plated escutcheon plate on exposed piping passing through walls, floors and ceilings in finished areas.
- 3.6.2 Sleeves shall be concentric with pipe and, except at fire separations, shall be sized to allow for the continuity of insulation.
- 3.6.3 Extend sleeves 2" (50 mm) above floor slabs in wet areas. Wet areas include equipment rooms, janitor's rooms, kitchen areas, utility rooms, bath areas and washrooms.
- 3.6.4 Extend sleeves through outside walls to 1" (25 mm) beyond the exterior face and caulk with flexible caulking compound.

- 3.6.5 Remove removable plastic sleeves are used prior to pipe penetration and sleeve the resulting hole.
- 3.6.6 Extra high vertical risers for cold water and hot water systems with many horizontal branch takeoffs passing through sleeves set in rigid structure adjacent to main risers, set sleeves to accommodate long term structural movement to avoid imposing stress on these systems.
- 3.6.7 Refer to Section 23 05 05 Firestopping for firestop requirements.

**3.7 Core Drilling and Cutting**

- 3.7.1 Arrange and pay for cost of core drilling and cutting for plumbing systems.
- 3.7.2 Verify location of existing service runs and structural reinforcement within existing concrete floors and walls prior to core drilling and cutting. Coring and cutting of structural building components shall only take place upon specific written approval of Structural Engineer. Provide repairs to existing services damaged as result of core drilling.
- 3.7.3 Penetrations up to 6" (150 mm) nominal pipe size in precast concrete may be cored on site by plumber. Locate larger penetrations and arrange to have pre-cored with pre-cast Manufacturer prior to shipping to construction site.

**3.8 Piping Expansion**

- 3.8.1 Install piping systems, including all take-offs, so that the piping and connected equipment will not be distorted by expansion, contraction or settling.
- 3.8.2 Install anchors where necessary to control expansion. Install expansion joints or loops on hot water piping where required.

**3.9 Testing and Inspection**

- 3.9.1 Refer to Section 22 05 93 – Testing, Adjusting and Balancing for Plumbing.
- 3.9.2 Furnish labour, materials, instruments, etc. necessary for required tests. Work shall be inspected by local plumbing inspector and review by Consultant.
- 3.9.3 Correct leaks by remaking joints. Retest systems until no leaks are observed.
- 3.9.4 Do not cover any plumbing system before being inspected and approved by Plumbing Inspector.
- 3.9.5 If plumbing system or part thereof is covered before being inspected or approved, Contractor will uncover system upon the direction of the Plumbing Inspector or Consultant.

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**3.10 Project Photographs**

- 3.10.1 Provide digital photographs of all systems prior to covering.
- 3.10.2 Provide digital photographs in “jpeg” format to Consultant complete with text description of each photograph, including date, system type, materials used, and location/direction for sections of underground piping prior to backfilling. Submit photographs via email and/or disc as requested by Consultant. Individual email sizes not to exceed 7MB in size.
- 3.10.3 Provide additional digital photographs of work as requested by Consultant to assist in resolution of RFIs, prior to covering work.

**3.11 Substantial Completion Requirements**

- 3.11.1 The following items must be completed, with documentation, prior to the date of Substantial Completion:
  - .1 All pipe expansion compensators and flexible connections checked by Supplier with an inspection report submitted to the Commissioning Agent and this Consultant.
  - .2 Seismic restraints reviewed and inspected by the Suppliers/Contractors’ Ontario Registered Professional Engineer, with a report submitted to the Commissioning Agent and this Consultant.
  - .3 All plumbing fixtures have been tested, adjusted, cleaned and in proper operation.
  - .4 All plumbing access doors and panels are in place and not painted closed.
  - .5 Potable water systems have been cleaned, flushed, chlorinated, and copies of final chlorination and water quality tests have been submitted to the Commissioning Agent and this Consultant.
  - .6 All backflow prevention stations and devices have been tested, with test reports submitted to the Commissioning Agent and this Consultant.
  - .7 All domestic hot water recirculation systems have been balanced and maximum wait time at fixtures verified, with written balancing report submitted to the Commissioning Agent and this Consultant.
  - .8 Final plumbing Inspectors sign-off to be submitted to this Consultant.
  - .9 Final gas inspection sign-off to be submitted to this Consultant.
  - .10 Final As-built Record drawings have been submitted for review to this Consultant.

**END OF SECTION**

**1. GENERAL**

**1.1 Related Work**

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

**1.2 Scope of Work**

- 1.2.1 Refer to Section 23 05 13 Common Motor Requirements for HVAC Equipment. Comply with requirements of Section as related to general requirements, products and execution.
- 1.2.2 In addition to equipment and systems listed in Section 23 05 13, provide motors complying with requirements of Section 23 05 13 plumbing equipment including the following:
- .1 Domestic cold water booster pumps.
  - .2 Domestic hot water booster and/or recirculation pumps.

**END OF SECTION**

**1. GENERAL**

**1.1 Related Work**

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

**1.2 Scope of Work**

- 1.2.1 Refer to Section 23 05 20 Thermometers and Pressure Gauges for HVAC Piping. Comply with requirements of Section as related to general requirements, products and execution.
- 1.2.2 In addition to piping, equipment and systems listed in Section 23 05 20, provide thermometers and pressure gauges complying with requirements of Section 23 05 20, on plumbing piping systems and equipment including the following:
- .1 Domestic cold water.
  - .2 Domestic hot water and recirculation.
  - .3 Tanks, pumps, compressors, vacuum units and all other equipment.
- 1.2.3 Provide thermometers in brass or stainless steel wells at heat exchangers, water heaters, and other equipment intended to change temperature of fluid.
- 1.2.4 Provide pressure gauges complete with isolation ball valves on both sides of pressure reducing valves, backflow prevention stations, pumps, compressors and other equipment intended to change pressure of fluid. Provide snubbers for pressure gauges located adjacent to pumps or compressors.

**END OF SECTION**



**1. GENERAL**

**1.1 Related Work**

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.
- 1.1.2 Refer to Section 22 05 48 Vibration Isolation for Plumbing Piping and Equipment

**1.2 Scope of Work**

- 1.2.1 Refer to Section 23 05 29 Hangers and Supports for HVAC Piping and Equipment. Comply with requirements of Section as related to general requirements, products and execution.
- 1.2.2 In addition to piping, equipment and systems listed in Section 23 05 29 provide hangers and supports complying with requirements of Section 23 05 29 on plumbing piping and equipment including:
  - .1 Domestic cold water.
  - .2 Domestic hot water and recirculation.
  - .3 Sanitary waste and venting.
  - .4 Storm drainage.
  - .5 Tanks, pumps, compressors, vacuum units and all other equipment.

**END OF SECTION**

**1 . GENERAL**

**1.1 Related Work**

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.
- 1.1.2 Refer to Section 22 07 19 Plumbing Piping Insulation.
- 1.1.3 Refer to Section 22 05 34 Hot Water Heat Tracing for Temperature Maintenance.

**1.2 Scope of Work**

- 1.2.1 Refer to Section 23 05 33 Heat Tracing for HVAC Piping. Comply with all requirements of Section as related to general requirements, products and execution.
- 1.2.2 In addition to piping and systems listed in Section 23 05 33 provide heat tracing for freezing protection complying with requirements of Section 23 05 33 on plumbing piping systems in exterior or unheated areas including the following:
  - .1 Domestic cold water.
  - .2 Domestic hot water and recirculation.
  - .3 Storm drainage piping and underside of drain bodies.

**2 . PRODUCTS**

**2.1 Pipe Heat Tracing**

- 2.1.1 Provide complete, CSA approved system of heat tracing on piping exposed outdoors where indicated.
- 2.1.2 Entire design and installation of system shall comply with Canadian Electrical Code and requirements of local inspection authority.
- 2.1.3 Provide necessary materials to provide complete system.
- 2.1.4 Use Raychem Chemelex Auto Trace self-regulating, shielded, jacketed cable type XL-TRACE (use XTV for hot water piping systems) or equal.
- 2.1.5 Acceptable Products: Raychem, Chromalox, Nuheat.

**3 . EXECUTION**

**3.1 Installation**

- 3.1.1 Install heat trace system in accordance with Manufacturer's instructions/recommendations and these specifications.

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- 3.1.2 Prior to installing heating cables, ensure pipe systems are complete and have passed tests.
  - 3.1.3 Cables to be secured to pipes using Raychem Type G554 glass cloth tape at 12" (300 mm) intervals.
  - 3.1.4 Follow Manufacturer's recommendations for installation of cable around valves and flanges.
  - 3.1.5 After pipes are traced, test prior to installation of pipe insulation.
  - 3.1.6 Provide suitable identification for those pipe systems provided heat tracing. At intervals of 20'-0" (6.0 m), provide on outside surface of insulation adhesive backed nameplate "Caution - Heat Tracing."

**END OF SECTION**

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## 1. GENERAL

### 1.1 General

1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

### 1.2 Related Work

1.2.1 Also refer to Section 22 07 19 Plumbing Piping Insulation.

1.2.2 Also refer to Section 22 05 33 Heat Tracing for Plumbing Piping.

### 1.3 Description of Work

1.3.1 Furnish and install complete CSA Certified and FM Approved system of heaters and components, listed specifically for maintaining domestic hot water temperatures at selected temperatures.

## 2. PRODUCTS

### 2.1 Heaters

2.1.1 Self-regulating heater shall consist of two 16 AWG nickel-coated radiation-cross-linked conductive polymer core, covered by radiation-cross-linked, polyolefin di-electric jacket surrounded by polymer-coated aluminum wrap, and enclosed in tinned copper braid of 14 AWG equivalent wire size. Braid shall be covered with (nominal) 40 mil polymer outer jacket, colour coded for easy identification. 105°F (40°C) to 122°F (50°C) (yellow) 105°F (40°C) to 140°F (60°C) (red) selected temperature range.

2.1.2 Cable shall have minimum cut-through resistance of 100lb per IEEE 515.1 and CSA 130-03 Resistance to Cutting Tests. Cable shall have minimum impact resistance of 10 ft-lbs per IEEE 515.1 and CSA 130-03 Impact Tests. Cable shall have minimum abrasion resistance of 2500 cycles per IEEE 515.1 Abrasion Test. Cable shall withstand crush resistance of 225 lbs per IEEE 515.1 Deformation Test and withstand crush resistance of 345 lbs per CSA 130-03 Crush Resistance Test.

2.1.3 Heater shall operate on line voltage of 208V and have option of operating on 208V or 240V with HWAT-ECO Controller.

2.1.4 Heating cable connection kits shall be CSA Certified and FM Approved for use as part of system to maintain hot water temperature. Component enclosures shall be rated NEMA 4X to prevent water ingress and corrosion. Installation shall not require

Installing Contractor to cut into heating cable core to expose bus wires. Connection systems requiring Installing Contractor strip bus wires or which use crimp or terminal blocks, shall not be acceptable. Connection kits except for power connection shall be installed under thermal insulation. End seal shall use silicone gel.

- 2.1.5 Provide complete installed system including at least one agency-approved electronic controller. Controller shall not be line sensing over-limit design. Controller shall be capable of setting different pipe temperatures based on ambient and voltage with 24 hour, 7 day/week programmable options, energy savings, BMS interface capabilities and flexible wiring configurations to operate individually or control up to eight additional controllers.
- 2.1.6 System shall maintain temperatures between 105°F (40°C) and 122°F (50°C) or 105°F (40°C) and 140°F (60°C) at 208V or 240V. Temperature shall be maintained by utilizing electronic controller with straight runs of heating cable on pipe.
- 2.1.7 Acceptable Products: Raychem HWAT 125°F (51.7°C) HWAT-Y2 (yellow) 140°F (60°C) HWAT-R2 (red), Hevi-Duty, Nelson, Thermon, Nuheat.
- 2.1.8 Fibreglass tape.
- 2.1.9 Acceptable Products: Raychem GT-66, Hevi-Duty, Nelson, Thermon, Nuheat.

### 3. **EXECUTION**

#### 3.1 **Installation**

- 3.1.1 Install self-regulating heaters and components on domestic hot water supply piping mains and risers and indicated on plans after piping has been pressure tested, before thermal insulation is applied. Secure heater to piping with fibreglass tape.
- 3.1.2 Apply “electric traced” signs to outside of thermal insulation jacketing. Comply with minimum label spacing and size requirements from Section 23 05 53 Identification for HVAC Piping and Equipment.

#### 3.2 **Pipe Insulation**

- 3.2.1 Provide minimum piping insulation in accordance with the following Pipe Insulation Thickness Table:

Copper Pipe Size (NPS)	Insulation Thickness
½	½" (15 mm)
¾	1" (25 mm)
1	1" (25 mm)

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1 ¼	1½" (40 mm)
1 ½	1½" (40 mm)
2	2" (50 mm)
2 ½	2½" (65 mm)
3	3" (80 mm)

- 3.2.2 On pipe 1¼" (32 mm) and smaller, provide insulation oversized ¼" (6.0 mm) for properly installing insulation over heating cables. On pipes 3" (80 mm) and larger, thickness of insulation may be equal to pipe diameter with one heating cable or one-third of pipe diameter with two runs of heating cable.
- 3.2.3 Install system in accordance with drawings and Manufacturer's instructions. Installer is responsible to provide functional system installed in accordance with applicable local, provincial and National requirements. Protect each circuit with 30 mA ground-fault protection device.

### 3.3 Tests

- 3.3.1 After installation and before and after installing thermal insulation, test heater cables using 2500 VDC megger. Heater circuits shall be continuous and megger readings shall be minimum 1000 megaohm regardless of heater length. Repair or replace circuits yielding unacceptable readings.

**END OF SECTION**

**1. GENERAL**

**1.1 Related Work**

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

**1.2 Scope of Work**

- 1.2.1 Refer to Section 23 05 48 Vibration Isolation for HVAC Piping and Equipment. Comply with requirements of Section as related to general requirements, products and execution.
- 1.2.2 In addition to piping, equipment and systems listed in Section 23 05 48 provide vibration isolation complying with requirements of Section 23 05 48 on plumbing piping and equipment including the following:
- .1 Domestic cold water.
  - .2 Domestic hot water and recirculation.
  - .3 Sanitary waste and venting.
  - .4 Storm drainage.
  - .5 Tanks, pumps, compressors, vacuum units and all other equipment.

**END OF SECTION**

## 1. GENERAL

### 1.1 Related Work

1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

### 1.2 Scope of Work

1.2.1 Refer to Section 23 05 53 Identification for HVAC Piping and Equipment. Comply with requirements of Section as related to general requirements, products and execution.

1.2.2 In addition to piping, equipment and systems listed in Section 23 05 53, provide identification on plumbing piping, valves and equipment, including the following:

- .1 Domestic cold water.
- .2 Domestic hot water and recirculation.
- .3 Sanitary waste and venting.
- .4 Storm drainage.
- .5 Tanks, pumps, compressors, vacuum units and all other equipment.
- .6 Trap primer access points.

1.2.3 Identification of medical gas systems shall comply with requirements of applicable CSA Standard where requirements of standard exceed these specifications.

### 1.3 Pipe Identification Colour Schedule

Service	Identification Lettering	Background Colour	Letters Colour
Acid Waste	Acid	yellow	black
Boiler Blow Off Piping	-	yellow	black
Boiler Blowdown	-	yellow	black
Boiler Feed Water	B.F.W.	yellow	black
Chilled Water Return	CH.W.R.	green	white
Chilled Water Supply	CH.W.S	green	white
Cold Water Service	C.W.	green	white
Fire Combined Standpipes	SPR/S.P.	red	white
Compressed Air	COMP.A.	blue	white
Condensate - Medium Pressure	M.P.Cond.	yellow	black
Condensate - Low Pressure	L.P.Cond.	yellow	black
Condensate - Pumped	Pump.Cond.	yellow	black



<b>Service</b>	<b>Identification Lettering</b>	<b>Background Colour</b>	<b>Letters Colour</b>
Condenser Water Return	C.W.R	green	white
Condenser Water Supply	C.W.S.	green	white
Cooling Tower Sump Water Supply	C.T.W.S.	green	white
Cooling Tower Sump Water Return	C.T.W.R.	green	white
Distilled Water	Dist.W.	green	white
Domestic Cold Water	D.C.W.	green	white
Domestic H.W. Recirc.	D.H.W.R.	green	white
Domestic H.W. Supply	D.H.W.S.	green	white
Non-Potable Water (irrigation etc.)	NPW	purple	white
Exhaust Piping	-	yellow	black
Fire lines W.S.	W.S.	red	white
Fuel oil 2,3,4,5,6	F.O.#	yellow	orange
Glycol Heating Return	GLR - do not drain	yellow	black
Glycol Heating Supply	GLS - do not drain	yellow	black
Heat Pump Water return	H.P.W.R.	yellow	black
Heat Pump Water supply	H.P.W.S.	yellow	black
Heat Recovery (cool)	HRC - do not drain	yellow	black
Heat Recovery (warm)	HRW - do not drain	yellow	black
Hot Water Return	H.W.R.	yellow	black
Hot Water Supply	H.W.S.	yellow	black
Natural Gas	Gas	yellow	orange
Propane	LP GAS	yellow	orange
Safety Valve Blowdown	-	yellow	black
Fire Sprinkler lines	SPR	red	white
Fire Sprinkler lines (Dry)	SPR (DRY)	Red	white
Steam	kPa	yellow	black
Sanitary Drain	SAN	None	None
Plbg. Vent	PVent	None	None
Storm Drain	Storm	None	None

**END OF SECTION**

**1. GENERAL**

**1.1 Related Work**

1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

1.1.2 Refer to Section 22 08 00 Commissioning of Plumbing.

**1.2 Scope of Work**

1.2.1 Refer to Section 23 05 93 Testing, Adjusting and Balancing for HVAC. Comply with requirements of Section as related to general requirements, products and execution.

1.2.2 In addition to the piping, equipment and systems listed in Section 23 05 93 provide testing adjusting and balancing complying with requirements of Section 23 05 93 for plumbing piping, equipment and systems including the following:

- .1 Domestic cold water.
- .2 Domestic hot water and recirculation.
- .3 Domestic tempered water and recirculation.
- .4 Sanitary waste and venting.
- .5 Storm drainage.
- .6 Tanks, pumps, compressors, vacuum units and all other equipment.
- .7 Trap primers.

1.2.3 Balancing of domestic hot water and tempered water recirculation systems by recognized balancing agency and submission of balancing report is mandatory.

1.2.4 Pressure test plumbing piping systems in accordance with specific requirements of specification sections for those systems.

1.2.5 Medical gas systems shall be tested and certified by certified independent testing agency selected by Owner and retained by Owner.

**END OF SECTION**

**1. GENERAL**

**1.1 Related Work**

1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

1.1.2 Refer to Section 22 07 19 Plumbing Piping Insulation.

**1.2 Scope of Work**

1.2.1 Refer to Section 23 07 16 HVAC Equipment Insulation. Comply with requirements of Section as related to general requirements, products and execution.

1.2.2 In addition to piping, equipment and systems listed in Section 23 07 16, provide equipment insulation on plumbing equipment and systems including the following:

- .1 Domestic cold water storage tanks.
- .2 Domestic hot water storage tanks and heat exchangers.

**END OF SECTION**

**1. GENERAL**

**1.1 Related Work**

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.
- 1.1.2 Be responsible for ensuring sufficient space is provided to allow proper installation of insulation materials.
- 1.1.3 Refer to Section 22 07 16 Plumbing Equipment Insulation.

**1.2 Scope of Work**

- 1.2.1 Refer to Section 23 07 19 HVAC Piping Insulation. Comply with requirements of Section as related to general requirements, products and execution.
- 1.2.2 In addition to piping and systems listed in Section 23 07 19 provide piping insulation on plumbing piping systems including the following:
  - .1 Domestic cold water.
  - .2 Domestic hot water and recirculation.
  - .3 Domestic tempered water and recirculation.
  - .4 Storm drainage piping and underside of drain bodies.
  - .5 Sanitary waste and P-traps, grey and black water systems in exterior and unheated areas.
  - .6 Offset waste piping, P-traps and supplies under wheelchair accessible lavatories and sinks.
  - .7 Provide foil faced flexible insulation on components requiring adjustment or servicing including booster pumps, meter sets, pressure reducing valves, valve bodies, strainers, etc.
  - .8 Sanitary vent stacks for last 10'-0" (3.0 m) prior to penetrating roof.

**END OF SECTION**

**1. GENERAL**

**1.1 Related Work**

1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

**1.2 Scope of Work**

1.2.1 Refer to Section 23 08 00 Commissioning of HVAC. Comply with requirements of Section as related to general requirements, products and execution.

1.2.2 In addition to piping, equipment and systems listed in Section 23 08 00 provide commissioning complying with requirements of Section 23 08 00 plumbing piping, equipment and systems including the following:

- .1 Domestic cold water.
- .2 Domestic hot water and recirculation.
- .3 Sanitary waste and venting.
- .4 Storm drainage.
- .5 Compressed air.
- .6 Tanks, pumps, compressors, vacuum units and all other equipment.

**END OF SECTION**

## 1. **GENERAL**

### 1.1 **Related Work**

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

### 1.2 **Scope of Work**

- 1.2.1 Domestic water systems include domestic cold water, domestic hot water, domestic tempered water and domestic water re-circulation systems.
- 1.2.2 Domestic water piping shall be provided as depicted on drawings to all plumbing fixtures, appliances and equipment that require domestic water service.
- 1.2.3 New domestic water piping shall be connected to existing domestic water piping as indicated on drawings.
- 1.2.4 New domestic water piping shall be connected to exterior cold water building service as indicated on drawings.
- 1.2.5 Refer to "Common Work Results for Fire Suppression," Section 21 05 06 where domestic water supply and supply to fire suppression systems are combined in one common supply line.
- 1.2.6 Mechanical makeup water piping systems and force main or pressure waste water piping systems shall be constructed of materials, installed and tested as specified in this section.
- 1.2.7 Non-potable water systems shall be provided to the standards and requirements of this section.

### 1.3 **Codes, Standards and Approvals**

- 1.3.1 All products including fabricated assemblies/spools that will come in contact with domestic (potable) water shall be tested and certified to NSF/ANSI/CAN 61 and 372 for domestic cold and commercial hot water ratings (as applicable). Before any work commences, provide evidence of agency certification to these standards through official certification documents and/or online certification Listings including tested and Approved water contact temperature(s). Any products found to be non-compliant with these requirements shall be replaced at the contractor's expense.

### 1.4 **Cross Connection and Backflow Control**

- 1.4.1 Double check valve assemblies and reduced pressure principle backflow prevention devices shall have approval from the Foundation for Cross Connection Control.

- 1.4.2 Vacuum breakers shall conform to the requirements of CSA B64.5.
- 1.4.3 Following installation, test report completed by certified tester shall be submitted to Owner, indicating satisfactory operation of each device.
- 1.4.4 Tests shall be conducted 30 to 60 days prior to date of Substantial Completion.
- 1.4.5 Provide one repair kit for every cross-connection control device installed.

**1.5 Freeze Protection**

- 1.5.1 Provide freeze-proof hose bibbs where required due to ambient temperatures.

**2. PRODUCTS**

**2.1 General Standards:**

- 2.1.1 Piping and fittings shall be in accordance with current edition or applicable revisions of applicable codes or governing regulations. Pipe and pipe fittings must be of the same manufacturer for PVC, ABS, PEX and CPVC systems. All products shall be UL/ULC classified in accordance with NSF/ANSI/CAN-61 and NSF/ANSI-372 for both cold and hot potable water service. Materials in contact with PVC or CPVC pipe and fittings shall comply with Manufacturers compatibility documentation.
- 2.1.2 Mechanical grooved pipe couplings, fittings, butterfly, ball and check valves, expansion joints, mechanical-Ts, pressure reducing valves, strainers, domestic water balancing and other products as manufactured and/or supplied by Victaulic Company, may be used for piping systems and mechanical equipment connections (in lieu of welded, flanged and threaded methods) (and also may be used as unions, seismic joints, flexible connections, expansion compensators and vibration reducers) in systems specified. Operating conditions shall be in the 32°F (0°C) to 250°F (121°C) temperature range according to the gasket or valve seat selected and working pressures as shown in the coupling Manufacturer's current product specifications, as detailed under specific systems specifications (subject to local code approval).

**2.2 Pipe and Fittings**

Size	Pipe	Fittings
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Domestic and Non-Potable Water Piping Below Grade (Inside and Outside Building)		
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Size	Pipe	Fittings
To 3" (80 mm) 4" (100 mm) and Up	Type "K" soft copper Ductile iron	Flared tube Hub and spigot with mechanical clamp and rod on long radius bends or push on rubber gasket joints to CSA B131.10
Up to 2½" (65 mm)	Class 150 or Series 200 PVC	Solvent Joints/Schedule 40 fittings
3" (80 mm) and Up	Class 150 or Series 200 PVC	Hub and spigot with retainer glands and harness restraint devices at each thrust point. All rods and fasteners below grade shall be 306 stainless steel.
Domestic and Non-Potable Water Piping Above Grade		
All sizes	Certified Type "L" or Type "K" hard copper	Wrought bronze or cast brass with Silvacrite 100 lead free solder. Roll grooved copper may be used in lieu of sweated joints; roll grooves must be formed using "RR" rolls; grooved couplings to be installation ready complete with pre- lubricated center leg gaskets and housings with angle bolt pads to provide rigid joint. Gasket shall be grade – EHP. Victaulic 600 series Viega ProPress fittings.
	Cross-Linked Polyethylene (PEX). Restricted use – not to be routed in topping slabs.	Conform to CAN3-B137.5 and ASTM F-876 and F-877, Uponor Pre- sleeved AquaPEX tubing for in-slab service, fittings to ASTM F-1960. Uponor Aquapex, PureLink/AquaLink system.



Size	Pipe	Fittings
½" (15 mm) - 2" (50 mm)	Schedule 10 Stainless Steel	Pipe shall be IPS sized, conforming to ASTM-A-312, Type 304/304L or 316/316L. Tube is not acceptable. Stainless steel fittings ½" (15 mm) - 2" (50 mm) shall be precision cold drawn austenitic stainless steel housing complete with pipe stop and Vic-Press end connections, rated to 500 psi (3,450 kPa), with HNBR gasket, rated for - 20°F (-29°C) - 210°F (98°C), Vic-Press Schedule 10S Fittings and Valves. Viega ProPress fittings.
2" (50 mm) - 12" (300 mm)	Schedule 10 Stainless Steel	Pipe shall be IPS sized, conforming to ASTM A-312, Type 304/034L. Where Schedule 10 Stainless steel pipe is used 2" (50 mm) and above, all roll grooves must be formed using "RX" rolls . Couplings shall be specifically designed to provide a rigid joint for stainless steel. Joints shall be rated to minimum 300 psi (2,070 kPa) on Schedule 10S stainless steel pipe. Victaulic Style 807 rigid coupling for 2" (50 mm) – 6" (150 mm). Victaulic Style 889 rigid coupling for 8" (200 mm) – 12" (300 mm). For flange adapters, Victaulic Style 841 for sizes 2" (50 mm) – 4" (100 mm) and Style 445SS for sizes 6" (150 mm) – 12" (300 mm). Viega ProPress. Where pipe system flexibility or expansion compensation is required, contact Victaulic.

Size	Pipe	Fittings
4" (100 mm) and up	Grooved end cement lined ductile iron pipe grooved in accordance with AWWA Standard C606	Fittings for domestic cold water service shall be cement lined ductile iron, ASTM A-536, grade 65-45-12, conforming to requirements for AWWA C110 for center to end dimensions, AWWA C153 or AWWA 21.10/AWWA C110 for wall thickness and AWWA C606 rigid radius grooving dimensions for end preparation. Couplings shall be cast of ductile iron conforming to ASTM A-536 Supplied with Grade "M" FlushSeal® gasket for cold potable water service. Victaulic AWWA fittings and Style 31, 307 couplings and 341 flange adapters.

## 2.3 **Grooved Mechanical Pipe Couplings, Fittings and Valves**

- 2.3.1 Victaulic Piping Systems. Where the name Victaulic is used, it refers to Victaulic the Manufacturer.
- 2.3.2 The use of grooved end pipe, fittings, valves and couplings is acceptable for potable water in sizes 2" (50 mm) and larger.
- 2.3.3 When using the grooved piping concept, provide grooved end valves for isolation, balance, flow control and check service suitable for pipe type and end connection.
- 2.3.4 Gaskets:
  - .1 Gaskets in couplings for Copper and Stainless Steel piping to be Grade "P" Fluoroelastomer Blend rated for +0°F (-18°C) to +180°F (+82°C) for potable water service..
- 2.3.5 For Grooved Joints: Ensure that grooved pipes are in compliance with the current groove specifications and recommendations. Ensure that the "A" dimension (i.e. the area from the pipe end to the front edge of the groove) is clean and free from indentations, scores, seams, projections or roll marks for proper gasket sealing. Gasket style and elastomeric material (grade) verified as suitable for the intended service as specified. Ensure that correct tool and rolls are used for pipe being grooved. A pipe tape should be used to verify proper grooved dimensions.

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- .1 Grooved coupling Manufacturer's factory trained Representative shall provide on-site training for Contractor's field personnel in the use of grooving tools and installation of grooved joint products. Representative shall periodically visit the jobsite and review Contractor is following best recommended practices in grooved production installation. (Distributor's Representative is not considered qualified to conduct the training or jobsite visit(s).)
- 2.3.6 For copper systems, provide Installation-Ready couplings complete with pre-lubricated grade "P" Fluoroelastomer Blend center leg gaskets. Housings shall have angle bolt pads to provide rigid joints. Victaulic Style 607 coupling.
- 2.3.7 Provided copper system shall be manufactured to copper-tube dimensions. (Flaring of tube or fitting ends to accommodate alternate sized couplings is not permitted.)
- 2.3.8 For combined domestic/fire water line inside building, provide Victaulic 717 PPS Coated Check Valve and 7B2 Monitored BFV, joined with a Style 807 or 889 coupling complete with Grade "P" Fluoroelastomer Blend Gasket or Style 307 coupling where joining to AWWA pipe complete with FlushSeal® Halogenated Butyl gasket for potable water. See details for transition to incoming supply lines.
- 2.3.9 When transitioning from grooved end ductile iron pipe to grooved end copper pipe, provide style 647 di-electric water way.
- 2.3.10 On Domestic Ductile Iron Systems, provide Victaulic Series 861 MasterSeal™ for shutoff and Series 717 PPS for check and 732 PPS coated or Series 968-F for straining.
- 2.4 Viega Press Fittings**
- 2.4.1 Installation shall be to manufacturer's installation requirements using only manufacturer's press tool appropriate to the pipe and application.
- 2.4.2 Installer shall hold and maintain proper proof of training by qualified Viega representative and have available if requested.
- 2.5 Metal Protection**
- 2.5.1 All ferrous metal work buried underground shall be of stainless steel construction. Retainer rod, washers and nuts on underground water/pressure mains shall be 316 stainless steel, hangers shall be 316 stainless steel where used for piping supported below grade.
- 2.6 Valves**
- 2.6.1 Gate, globe, ball, butterfly valves shall be provided with stem extension to allow for proper insulation thickness. Stem extension

to stay stationary to ensure vapor barrier seal is not broken when valve is exercised.

2.6.2 Gate (for shut-off and isolation):

- .1 2" (50 mm) and smaller, bronze body, solid wedge disc, bronze or stainless steel trim, non-rising stem, 125 psi (860 kPa) rating.
  - .1 Acceptable Products:
    - .1 Solder Joint Type: Kitz 808, Red and White/Toyo 268AB LF.
    - .2 Threaded Joint Type: Kitz 807, Red and White/Toyo 268AB LF.
  - .2 2½" (65 mm) and larger, flanged ends cast-iron body, solid wedge disc, bronze or stainless steel trim, rising stem, outside screw and yoke.
    - .1 Acceptable Products: Jenkins 404, Kitz 72, Red and White/Toyo 421A/MAS W-10.

2.6.3 Ball (in lieu of gate valves or as specified):

- .1 2" (50 mm) and smaller, brass two piece body, blow-out proof stem, PTFE seats, brass chrome plate ball, lever handle operator, 150 psi (1,034 kPa) rating. 2½" (65 mm) and larger, American 4000 Flanged.
  - .1 Acceptable Products:
    - .1 Solder Joint Type: Red and White/Toyo 5049AB, Jenkins LF202J, Kitz 59, MAS B-4-LF .
    - .2 Threaded Joint Type: Red and White/Toyo 5044AB, Jenkins LF201J, Kitz 58, Victaulic 78BL, MAS B-3-LF.
    - .3 Pex Pipe clamp connection: Red and White 5017AB, 5015AB.
  - .2 2" (50 mm) and smaller, Stainless steel three-piece, swing-out design, PTFE seats, stainless steel ball, locking handle operator, 400 psi (2,758 kPa) rating.
    - .1 Acceptable Product:
      - .1 Vic-Press Series P569.
  - .3 1½" (40 mm) to 6" (150 mm), Stainless Steel two piece, end-entry valve, RTFE Seat, Stainless steel ball with Fluoroelastomer seals.
    - .1 Acceptable Product:
      - .1 Grooved Joint: Victaulic Series 726S.
      - .2 Flanged Butterfly (in lieu of gate valves or as specified):
  - .4 2½" (65 mm) and larger, 200 psi (1,380 kPa) rating, wafer style, threaded lug style cast-iron body, EPDM seat liner,

bronze disc, 416 stainless steel stem, 10 position lever lock handle operator on 6" (150 mm) diameter and smaller, handwheel worm gear operator on 8" (200 mm) diameter and larger, for installation between Class 125/150 flanges.

- .1 Acceptable Products:
  - .1 Wafer Style: Apollo WD141, Center Line Series200W (EPDM), Metraflex, MAS-D Series, Kitz DJ, Toyo 200L.
  - .2 Lug Style: Apollo LD141, Center Line Series 200L (EPDM), Metraflex, MAS-D Series, Kitz DJ, Toyo 200L.
  - .3 With "Victaulic" copper grooved end pipe system, use Victaulic style #608 cast brass body grooved valve with an EPDM encapsulated disk, 300 psi (2,070 kPa) rating.

2.6.4 Grooved Butterfly (in lieu of gate valves or as specified):

- .1 2" (50 mm) and larger, 300 psi (2,065 kPa) rating, grooved end, suitable for bi-directional and dead-end service to full rated pressure. Grooved end stainless steel body and disc. Disc shall be connected to the stem without the use of fasteners or pins and be offset from the disc centerline to provide a full 360° continuous contact with the seating surface when closed. Seat shall be pressure responsive, Grade P Fluoroelastomer.
  - .1 Acceptable Products
    - .1 For ductile iron grooved end pipe system, Victaulic series 861.
    - .2 For stainless steel grooved end pipe system, Victaulic Series 861.
  - .2 For copper grooved end pipe system, 2 1/2" (65 mm) and larger, 300 psi (2,065 kPa). Cast brass body complete with Aluminum bronze disc, with pressure responsive grade "P" Fluoroelastomer seat. Stem shall be offset from the disc centerline to provide complete 360-degree circumferential seating. Bubble tight, dead-end or bi-directional service.
    - .1 Acceptable products:
      - .1 Victaulic series 608N.

2.6.5 Globe (for throttling, bypass and make-up applications):

- .1 2" (50 mm) and smaller, bronze body, bronze or stainless steel trim, 125 psi (860 kPa) rating.
  - .1 Acceptable Products:
    - .1 Solder Joint Type with Bronze Bevel Type Disc: Kitz 12, Red and White/Toyo 212.

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- .2 Threaded Joint Type with Composition Type Disc:  
Kitz 03, Red and White/Toyo 220.
      - .2 2½" (65 mm) and larger, flanged ends, cast-iron body, bronze or cast-iron bevel-type disc, bronze or stainless steel trim, rising stem, outside screw and yoke, 125 psi (860 kPa) pressure rating.
        - .1 Acceptable Products: Jenkins 2342J, Kitz 76, Red and White/Toyo 400A.
  - 2.6.6 Check (for horizontal installation):
    - .1 2" (50 mm) and smaller, threaded joint type, bronze body, bronze or stainless steel swing disc holder with Teflon disc, 125 psi (860 kPa) rating.
      - .1 Acceptable Products: Kitz 19, Red and White/Toyo 236 AB LF.
    - .2 2½" (65 mm) and larger, grooved, stainless steel body, stainless steel disc, 300 psi (2065 kPa) pressure rating.
      - .1 Acceptable Products: Victaulic Series 816.
  - 2.6.7 Balance (for domestic hot water recirculation):
    - .1 2" (50 mm) and smaller, thermostatic balancing type, for maximum temperature of 250°F (120°C), maximum pressure of 200 psi (1,380 kPa), fixed non-adjustable or adjustable temperature setpoint, low lead construction throughout, temperature accuracy of +/-3°F (1.7°C).
      - .1 Acceptable Products: ThermOmega Tech CircuitSolver, Caleffi ThermoSetter™ 1164A series, TA Series 7TZ Therm Zero, Victaulic Series 7WT.
    - .2 1¼" (32 mm) and smaller, globe lock shield, for maximum system temperature, bronze body and trip, Teflon, polytetrafluoroethylene (PTFE), disc, female by male union connection, 100 psi (690 kPa) rating.
      - .1 Acceptable Products: Red and White/Toyo 9527/9529 AB LF, Tour and Anderson STAD Zero, Victaulic TA series 790 circuit balancing valve.
    - .3 1½" (40 mm) and larger, plug type, wrench adjustable stop, for maximum system temperature, semi-steel body, resilient plug seals, EPT or RS 55, maximum 250°F (120°C) operating temperature, 125 psi (860 kPa), threaded end connections for up to 2" (50 mm), flanged end connections on 2½" (65 mm) and larger.
      - .1 Acceptable Products: DeZurik 435 with 487 adjustable stop, Newman-Hattersley 170M or 171M, Oventop, Red-White 9574P .
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2.6.8 Vacuum Relief (for hot water tanks installation):

- .1 Up to ½" (15 mm), 125 psi (860 kPa) rating.
  - .1 Acceptable Products: ½" (15 mm) Watts 36A, Cash Acme VR-801.
- .2 ¾" (20 mm) and larger, 125 psi (860 kPa) rating.
  - .1 Acceptable Products: ¾" (20 mm) Watts 36A, Cash Acme VR-801.

2.6.9 Pressure Reducing:

- .1 Potable Water System Pressure Reducing Valve:
  - .1 Provide pilot operated globe type pressure reducing valve with bronze strainer assembly to limit static water pressure to 80 psi (550 kPa) at any plumbing fixture on incoming water line to Plumbing Code requirements. Valve body and cover shall be ductile iron to ASTM A536, electro-statically applied fusion bonded epoxy coating. Strainer shall be Y pattern, ductile iron body and stainless steel screen. Provide low flow bypass where indicated. Basis of Design: Victaulic Series 972 PRV and Victaulic Series 968-F Strainer, Bermad.
  - .2 Domestic Hot Water Applications: Pressure reducing valve shall be rated to 225°F (107°C) minimum at required pressure.
- .2 Acceptable Products:
  - .1 ¼" (6.0 mm) to ⅜" (9.5 mm), 125 psi (860 kPa) rating: Watts 215, Singer.
  - .2 ½" (15 mm) to 2" (50 mm), 125 psi (860 kPa) rating: Victaulic Series 935-H, Watts 223LF, Braukmann, Conbraco, Cash Acme, Singer, Beeco, Zurn ZW 209.
  - .3 2½" (65 mm) and larger, 125 psi (860 kPa) rating: Victaulic Series 972, BCA 317 PR, Clayton 90 or 90B, Singer 106PR, Beeco, Zurn ZW 209, Bermad.
  - .4 All sizes: Cash Acme EB-25 Pressure Regulator.

2.6.10 Pressure Reducing Valve with Integral Low Flow Bypass:

- .1 1½" (40 mm) and larger, 125 psi (860 kPa) rating: Acceptable Products: Clayton, Singer, Wilkins, Beeco, Bermad.

2.6.11 Drain Valves and Hose Bibbs:

- .1 Hose Bibbs: Lockshield globe type with bronze body and trim suitable for maximum system operating pressure. Acceptable Products: Dahl 2316.

- .2 Drain Valves: Ball type with brass body, cap and chain and chrome-plated brass ball. Acceptable Products: Kitz 58CC, Dahl 50430 Series.
- .3 Stop and Drain Valves: R-W/Toyo W5046LF or Dahl 521 Series.

2.6.12 Solenoid:

- .1 Slow closing solenoid valve, forged brass body, Buna "N" disc, stainless steel parts, enclosure to suit environmental conditions, UL and CAS approved, 120 V. Acceptable Products: ASCO

2.6.13 Thermostatic Mixing:

- .1 On both upstream hot and cold supplies, in accessible location, provide positive swing check valves and strainers. This requirement in addition to check valve device common to mixing valve. Where required, provide access panel to check valves and strainers. Mixing valve to be equal to Watts LFUSG-B or Caleffi 5213 Series, Powers Hydroguard LFE480.
- .2 On both upstream hot and cold supplies, in accessible location, provide positive swing check valves and strainers. This requirement in addition to check valve device common to mixing valve. Where required, provide access panel to check valves and strainers. Mixing valve to be equal to Moen 104451 adjustable thermostatic mixing valve or Caleffi 5213 Series, Powers Hydroguard Series LFLM496 Adjustable.
- .3 On both upstream hot and cold supplies, in accessible location, provide positive swing check valves and strainers. This requirement in addition to check valve device common to mixing valve. Where required, provide access panel to check valves and strainers. Cabinet type mixing valve to be equal to Moen 15440 or Cash Acme Heatguard 145 Series thermostatic mixing valve complete with valving in stainless steel cabinet.
  - .1 Acceptable Product: Powers Hydroguard LFLM490 Series.

**2.7 Vacuum Breakers**

2.7.1 Pressure Type:

- .1 CSA approved, mechanically independent, spring loaded poppet type check valve with a downstream spring loaded air inlet valve, with upstream and downstream isolation valves and test cocks. Acceptable Products: Cla-Val 38-VB/AR, Conbraco 4V-500, Febco 765, Watts 800M4FR, Wilkins 720A.



2.7.2 Atmospheric Type:

- .1 CSA approved, bronze body, chrome plate finish where exposed. Acceptable Products: Conbraco 38-100, Febco 710/715A, Watts 288A, 288AC, Wilkins 35, Cash Acme V-101 Series.

2.7.3 Vacuum breakers size to match.

**2.8 Backflow Preventers**

2.8.1 Double check valve assembly (DCVA), factory assembled station to CSA B64.5. Acceptable Products: Watts Series 757, CXm F-72, Cla-Val D, D2, Conbraco 40-100, Febco 805, Wilkins 950, MBD-10.

2.8.2 Reduced pressure principle backflow prevention device (RPBP), with inlet and outlet shut-off valves, double check valve assembly, and differential relief outlet and repair/maintenance kit to CSA B64.10-M1984. Acceptable Products: Watts Series 909, CLA-Val RP, Conbraco 40-200, Febco 860, 867, 835YD, 825, Neptune 575, Wilkins 975, Beeco FRP Series.

**2.9 Strainers**

2.9.1 Provide 4 to 1 ratio of basket open area to connecting pipe cross-sectional area, 'Y' pattern, 304 stainless steel screen.

2.9.2 ¼" (6.0 mm) to 2" (50 mm), threaded ends, bronze body, 150 psi (1,034 kPa) rating.

- .1 Acceptable Products: Red and White/Toyo 380, Crane 988-½, Armstrong, Sarco (Canada), Kitz 15.

2.9.3 2½" (65 mm) and larger, grooved or flanged ends, ductile or cast-iron body, 150 psi (1,034 kPa) rating.

- .1 Acceptable Products: Victaulic Style 968-F, Red and White/Toyo 381, Crane 989-½, Armstrong, Sarco (Canada), Kitz 80, Mueller 758, MAS W-40.

**2.10 Water Hammer Arrestors**

2.10.1 Bellows or piston manufactured style with stainless steel casing and welded stainless steel besting bellow if of the bellows style. Site fabricated air chambers are unacceptable. Acceptable Products: Zurn Z-1700 Series bellows style, Jay R. Smith 5000 Series, Amtrol-Mini-Trol, Watts SS-Series, Precision Plumbing Products Inc. 316 piston type, Wade Bellows or Piston Type Shockstops.

**2.11 Thermometers and Pressure Gauges**

2.11.1 Refer to Section 22 05 20 Thermometers and Pressure Gauges for Plumbing.

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**2.12 Temperature and Pressure Relief Valves**

2.12.1 Design: ASME rated for energy input to system and pressure rating of equipment.

2.12.2 Acceptable Products: Watts, Cash Acme, Apollo.

**2.13 Pipe Joints**

2.13.1 Solders and fluxes having lead content and self-cleaning acid type fluxes shall not be used.

2.13.2 Copper to steel or iron and flanged adaptors shall be brass, not copper.

2.13.3 All unions or similar interconnections between dissimilar metals shall be di-electric couplings.

.1 Copper silicon casting conforming to UNS C87850 with grooved and or/threaded ends. UL classified in accordance with NSF/ANSI/CAN-61 for potable water service and shall meet the low-lead requirements of NSF/ANSI/CAN-372.

.1 Standard of Acceptance: Victaulic Series 647.

2.13.4 Grooved Joints Lubricants: Lubricate gaskets with products supplied by the coupling manufacturer in accordance with published installation instructions. The lubricant shall be specifically for the gasket elastomer and system media.

**2.14 Air Vents**

2.14.1 Design: Automatic float type, 150 psi (1,034 kPa) maximum operating pressure.

2.14.2 Acceptable Products: Armstrong 11-AV, Maid-o-Mist 71, Taco 426, Amtrol, Metraflex Style MV-15, Caleffi 5020 MINICAL, Victaulic Bermad Model C30, C50-P or A71.

**2.15 Hydrants and/or Hose Bibbs: Refer to Schedule on drawings**

2.15.1 Acceptable Products: Zurn, Watts, Jay R Smith, Mifab, Wade.

**2.16 Trap Seal Primers**

2.16.1 Provide flow actuated type priming device piped to nearest fixture so device will introduce regulated amount of water into trap whenever fixture is used. Acceptable Products: Watts A200-T, Zurn, Watts, J R Smith 2699, Wade 2400 Series.

2.16.2 Provide pressure actuated type priming device piped when nearest fixture is remote to the floor drain requiring trap priming. Acceptable Products: Precision Plumbing Products Model P-1, Watts Series LFTP300.

2.16.3 Electronic type trap primers can only be used as an alternate product subject to prior acceptance by the consultant and confirmation that the contractor has coordinated with and allowed for electrical connections required. These are to be allowed for in parkades and remote floor drains where the nearest flushing fixture is further away than manufacturer's recommendation.

## **2.17 Water Softeners**

2.17.1 Duplex water softening equipment to remove hardness to not more than 5 parts per million (0.3 grains per US gal) of hardness as determined by ASTM standard soap test when operated at 80 USgpm (5.0 L/s) peak flow, 110 USgpm (7.0 L/s) continuous flow. System shall be designed to provide approximately 55,000 USgal (208,000 L) net of softened water between regenerations based upon hardness of 100 parts per million  $\text{CaCo}^3$  at intermittent flow rate of 150 USgpm (9.5 L/s).

2.17.2 Softener equipment shall be approved design by Manufacturer regularly engaged in production of water treatment equipment. Equipment shall be complete from supply connection of unsoftened water to discharge connection of softened water. Installation shall be fully supervised by experienced factory trained Representative.

2.17.3 Equipment shall consist of two pressure type softener tanks operating with fully automatic, self-contained, hydraulically operated lift turn valve, and brine tankage system.

### **2.17.4 Softener Tanks:**

- .1 36" (900 mm) diameter by 60" (1,500 mm) shell height with domed ends and supported with steel strap legs.
- .2 Manufactured of steel welded to ASME code specifications, galvanized inside and out, for working pressure of 150 psi (1,034 kPa) and hydrostatically tested at pressure of 50% in excess of working pressure.
- .3 Equipped with one 11" (280 mm) by 15" (325 mm) maintenance opening located in top head of tank and one 4" (100 mm) by 6" (150 mm) maintenance opening located in tank side near bottom.

### **2.17.5 Brine Tank:**

- .1 36" (900 mm) diameter by 48" (1,200 mm) high with cover.
- .2 Manufactured of steel, welded and galvanized inside and out.
- .3 Equipped with elevated salt plate for collection of brine and suitable chamber housing automatic air eliminator.

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- 2.17.6 Brine system automatically opens to introduce brine into softeners, close to prevent entry of air and refill brine tank with proper amount of water.
  - 2.17.7 Upper distributor baffle distributes incoming hard water uniformly, without permitting any jet action to disturb resin surface, and to take off backwash flow.
  - 2.17.8 Hydraulic automatically operated diaphragm valves control regeneration steps of backwash, brine draw and slow rinse, purge fast rinse and service. Diaphragm valves shall incorporate self-adjusting flow regulators to properly control flow rate during regeneration regardless of pressure fluctuations and shall open and close slowly to minimize water hammer and noise.
  - 2.17.9 Regeneration controlled by electronic sensor with manual over-ride which compensates for variation of water usage and hardness and is unaffected by water temperature changes. Alternator shall allow only one unit to be regenerated while other unit is in service. Indicating lights shall show status of each softener. Totalizing meter shall continuously measure amount of soft water produced.
  - 2.17.10 Provide each softener complete with 20 ft<sup>2</sup> (1.85 m<sup>2</sup>) of high capacity resinous type material having minimum exchange capacity of 300,000 grains when regenerated with 15 lb (6.8 kg) of salt per ft<sup>3</sup>.
  - 2.17.11 Furnish complete test kit to Owner for conducting soap test.
  - 2.17.12 Power connection provided by Electrical Division.
  - 2.17.13 Acceptable Products: Culligan Hi-Flo 50 Model HB-600.

**2.18 Indirect Hydronic Domestic Hot Water Heater and Storage Tank**

- 2.18.1 Tank to be ASME rated to 125 psi (860 kPa) and be lined with Polyshield polymer-lined (or equal approved glass lined tank). Tank to come complete with:
  - .1 ASME/CSA rated temperature and pressure relief valve.
  - .2 22" (550 mm) minimum access panel.
  - .3 Thermal insulation to ASHRAE 90.1-2010 Standards.
  - .4 Lifting lugs.
  - .5 Drain valve.
  - .6 De-stratification pump (Intra-tank circulator).
  - .7 Temperature and pressure gauges.
- 2.18.2 Heat exchange to be an ASME stamped double walled copper U-tube with non-ferrous baffles, rods and water-side tube sheets.
- 2.18.3 The unit shall come complete with the following controls and interlocks which shall be BACnet MSTP:

- .1 Upper and lower immersion thermostats.
- .2 Immersion temperature limiting device (high limit control).
- .3 Terminal for remote on/off control.

2.18.4 The unit is to be fully compliant with ASHRAE 90.1-2010.

2.18.5 Factory start-up of the unit will be required.

2.18.6 The warranty for the unit is to be five (5) years.

2.18.7 Acceptable Products: PVI, AO Smith, Viessmann, Bradford White, Niles.

## **2.19 Water Heater and Tank (Electric)**

2.19.1 Glass-lined, electric hot water heater and tank, **ASME construction**, CSA listed, rated for 150 psi (1,034 kPa) working pressure.

2.19.2 Plated copper elements, fully automatic controls, manually adjustable thermostat, 120 V control circuit powered by fused transformer.

2.19.3 Extra density, vermin proof, glass fibre insulation with heavy gauge steel jacket finished with baked enamel finish over bonderized undercoat.

2.19.4 Magnesium anode protection, heavy duty magnetic contactors and fuse protection against excessive current flows.

2.19.5 Refer to Schedule on drawings.

2.19.6 Acceptable Products: AO Smith, Ruud, Rheem, State, PVI, Bradford-White.

## **2.20 Hot Water Storage Tank**

2.20.1 ASME construction, steel tank, glass lined, magnesium anode protection, painted exterior, for 125 psi (860 kPa) working pressure.

2.20.2 Extra density, vermin proof, glass fibre insulation with heavy gauge steel jacket finished with baked enamel finish over bonderized undercoat.

2.20.3 Refer to Schedule on drawings.

2.20.4 Complete with legs for vertical or horizontal installation (refer to drawings).

2.20.5 Acceptable Products: AO Smith, A&R Tank Ltd., NST (Niles Steel Tank), Bradford-White.

2.20.6 Provide PVI Brand AquaPLEX Engineered Duplex Alloy for Domestic Hot Water Storage Tank. No anode or lining required for this specific material and brand. This vessel is also acceptable for use with immersion type heating elements as well as the following:

- .1 PVI Power VT and Tricon Condensing Water Heaters.

- .2 PVI TURBOPOWER 99 Condensing Water Heater.
- .3 PVI TURBOPOWER Gas, Oil, Gas/Oil Water Heaters.
- .4 PVI DURAWATT Electric Water Heater.
- .5 PVI Quickdraw Steam, Solar, and Boiler Water Heaters.

## **2.21 Expansion Tank for Domestic Hot Water System**

- 2.21.1 Welded carbon steel expansion tank, ASME construction, stainless steel connection, heavy duty butyl diaphragm, rigid polypropylene liner and integral floor stand, in accordance with NSF/ANSI/CAN-61 for potable water service and shall meet the low-lead requirements of NSF/ANSI/CAN-372.
- 2.21.2 Refer to Schedule on drawing.
- 2.21.3 Acceptable Products: Amtrol ST-60V-C Therm-x-trol, State, Sparco, Flexcon, Wessels.

## **2.22 Thermostatic Water Controllers**

- 2.22.1 Provide factory tested and assembled high/low flow thermostatic mixing valves complete with check valve, pressure reducing valve, volume control, shutoff valve and stem type thermometer on outlet; strainer stop check on inlet, mounted in lockable cabinet of 16 ga (1.61 mm) prime coated steel. Capacity, model and locations as scheduled.
- 2.22.2 Field assembled systems will be accepted only where Manufacturer's Representative provides setup services after assembly and certifies in writing that valve has been properly adjusted and assembled. Manufacturers shall provide a seven year warranty against all failures on the thermostatic elements.
- 2.22.3 For local thermostatic water controller with integral check stops, wall mounting bracket, rough chrome finish, removable cartridge with strainer and thermal motor. Provide one spare cartridge for each valve size on individual units.
- 2.22.4 Inlet hot temperature to valves will be 140°F (60°C) to 160°F (70°C). Outlet temperature shall be set to 105°F (40°C).
- 2.22.5 Acceptable Products: Lawler, Leonard, Symmons, Armstrong Digital Water Temperature Control, Cash Acme, Caleffi, Powers, Guardian.

## **2.23 Recirculation Pumps**

- 2.23.1 Pump between Heater and Tank:
  - .1 Bronze body, bronze impeller.
  - .2 Spring loaded coupler between motor and pump shaft, drip proof.

- .3 Bronze sleeve type bearing, resilient-mount.
- .4 Refer to Schedule on drawings.
- .5 Aquastat on tank to suit 115V rating.
- .6 Acceptable Products: Bell & Gossett, Armstrong, Taco, Grundfos, Wilo.

2.23.2 Building Recirculation Pumps:

- .1 Bronze body, bronze impeller.
- .2 Spring loaded coupler between motor and pump shaft, drip proof.
- .3 Bronze sleeve type bearing, resilient-mount.
- .4 Refer to Schedule on drawings.
- .5 Acceptable Products: Bell & Gossett, Armstrong, Taco, Grundfos, Wilo.

**2.24 Pressure Booster System**

- 2.24.1 Provide packaged [**duplex - sized for 40/60 split**] pressure boosting system factory assembled, tested and adjusted and shipped to job site as integral unit.
- 2.24.2 Lead pump operates continuously; lag pump operates on system demand. When lead pump fails to operate, lag pump starts automatically.
- 2.24.3 Lead pump operates continuously; second and third pumps operate on system demand; system shall alternate second and third pumps automatically. When lead pump fails to operate, start next pump in sequence automatically.
- 2.24.4 Provide time delay relay to prevent lag pump short cycling on fluctuating demands.
- 2.24.5 Provide sufficient flow through pump to prevent overheating during low flow periods.
- 2.24.6 Provide low pressure control to stop pump operation if incoming water pressure drops to atmospheric.
- 2.24.7 Provide each pump with switch to permit manual or automatic operation.
- 2.24.8 Provide combination pressure reducing/check valve to maintain constant system pressure.
- 2.24.9 Additional Equipment:
  - .1 Manual transfer switch for lead-lag control.
  - .2 Pressure switch to shut-off pumps on adequate city pressure.
  - .3 Drawdown/pressure tank.

- 2.24.10 Provide time clock for automatic day-night changeover. Day cycle, pumps to operate continuously with pressure maintained by pressure reducing valves. Night cycle, pumps to operate intermittently with pressure switch located in pressure tank operating pump for pre-determined, adjustable time period.
- 2.24.11 Refer to Schedule on drawings.
- 2.24.12 Acceptable Products: Plad, Taco, Armstrong, Bell & Gossett (Xylem), Wilo, Grundfos.

## **2.25 Water Meter**

- 2.25.1 Arrange and pay for supply and installation of water meter.
- 2.25.2 Water meter shall be **supplied by Contractor** and shall be to **City/Municipal** Standards.
- 2.25.3 Hermetically sealed direct reading centre sweep register, one-piece cast bronze main case, rotating disc measuring chamber with flow control adjustment, magnetically driven, rated for 150 psi (1,034 kPa) service, reading in ft<sup>3</sup> (m<sup>3</sup>) and flanged ends conforming to AWWA C700, AWWA C701 or AWWA C702. Acceptable Products: Neptune Trident 8, Rockwell, Hersey.
- 2.25.4 Provide self-generating remote meter reader to suit municipal requirements. Provide conduit from water meter location to remote reader location.
- 2.25.5 Acceptable Products:
  - .1 Up to 2" (50 mm): Schlumber Neptune T-10 Meter with ProRead ARB.
  - .2 Greater than 2" (50 mm): Neptune Tru/Flo Compound Meter with ProRead ARB, Neptune High Performance Turbine Meter.

## **2.26 Ultraviolet Water Disinfection System**

- 2.26.1 System shall include sterilizer, remote mounted control panel, biological filter, elapsed time meter and temperature alarm.
- 2.26.2 Manufacturer's agent shall provide start-up and commissioning of system and shall provide operating and maintenance instructions to Owner. Provide installation, operating and maintenance instructions for insertion into Operating and Maintenance Manuals.
- 2.26.3 Manufacturer's Representative shall verify capacity of UV dosage by sampling for UV transmittance at 254 nanometre wavelength in water using single beam ultraviolet filtered photometer.
- 2.26.4 Provide water sterilization using 2-lamp UV system. Germicidal lamps constructed of UV-transmitting quartz shall provide UV dosing level of 30,000 microwatt-sec/cm<sup>2</sup>. Electrical



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Characteristics: 120 volt/60hz/100 watts. Minimum rated operating life 9000 h.

- 2.26.5 Contract UV chamber of 316 stainless steel and rated for 125 psi (860 kPa) operating pressure. Seals shall be compatible with potable water system.
- 2.26.6 Provide separate biological cartridge type filter upstream of UV sterilizer to remove suspended particulate.
- 2.26.7 Unit pressure drop to be negligible.
- 2.26.8 Automatic lamp power control. UV sensor transmitting 4-20 mA signal for continual monitoring of fluence rate, remote control panel, BAS compatible.

### 3. **EXECUTION**

#### 3.1 **Supply Piping (General)**

- 3.1.1 Upon completion, flush water piping systems with water before installing fixtures to remove any foreign material in piping. Clean plumbing fixtures and equipment and leave in good operating condition.
- 3.1.2 Provide connections as required, including shutoff valves with unions or flanges to equipment installed by other trades.
- 3.1.3 Ream pipes and tubes. Clean scale and dirt, inside and outside, before assembly. Remove foreign material from piping.
- 3.1.4 Clamp cast-iron water pressure pipe at fittings with  $\frac{3}{4}$ " (20 mm) 316 stainless steel threaded rods and fasteners complete with required pipe retainer glands, adapters and harnesses to secure pipe sections and fittings together; **OR provide proper anchors, thrust blocks and supports throughout.**
- 3.1.5 Reduce horizontal piping with eccentric reducer fittings installed to provide drainage and eliminate air pockets.
- 3.1.6 Wherever dissimilar metals are joined or supported, provide non-conducting type connections or hangers to prevent galvanic corrosion. Plastic or rubber mechanisms are acceptable for hangers and supports. Brass adapters and valves are acceptable for pipe connections.
- 3.1.7 Install piping to allow for expansion and contraction without stressing pipe or connected equipment.
- 3.1.8 Where grooved piping systems are utilized, contractor to coordinate with product supplier to provide piping system design services to accommodate thermal movement and/or differential settlement of the piping system, included but not limited to, risers and horizontal piping systems. The service includes a detailed schematic design

locating anchors, anchor loads, guides, expansion joints and any other required Victaulic components to accommodate movement. A calculation report showing thermal movement and accommodation shall also be provided. A design stamped by a qualified professional engineer where the project is being constructed is required.

- 3.1.9 Provide clearance for insulation and access to valves, air vents, drains and unions.
- 3.1.10 For Pex or Pex-Al Pex potable water piping, use only the pipe manufacturers matched connection and coupling accessories. Provide supplier training and sample inspection by supplier's representative for initial installation and mock-ups.
- 3.1.11 For grooved joints, pipe ends shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove for proper gasket seating. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified.
  - .1 Supplier factory trained Representative shall provide on-site training for Contractor's field personnel in the use of grooving tools and installation of grooved joint products. Representative shall periodically visit the jobsite and review Contractor is following best recommended practices in grooved product installation.
- 3.1.12 When joining grooved ductile to grooved copper a di-electric waterway is necessary. The groove by groove di-electric waterway shall be used.
- 3.1.13 No in-position welding of stainless steel pipe is permitted.

### **3.2 Concealed Supply Piping**

- 3.2.1 Install concealed water supply piping to plumbing fixtures, trim items, equipment, hose bibbs, etc. using cast brass 90° drop ear elbow or drop ear tees, as the piping design dictates.
- 3.2.2 Provide blocking within the concealed space and the elbows and tees shall be secured to the blocking using brass screws to provide a rigid installation.
- 3.2.3 Do not install pipe in any part of wall where temperature is less than 42°F (5.5°C) under winter design conditions.
- 3.2.4 Under no circumstances shall domestic cold water piping be routed in topping or floor slab.

### **3.3 Plumbing System Acoustical Requirements**

- 3.3.1 Minimum pipe size for suite fixtures, including supplies to faucets, shall be ½" (15 mm).

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- 3.3.2 Ensure no rigid contact between pipes and supporting framing and gypsum wall board.
  - 3.3.3 Do not secure piping to partition which forms part of adjacent suite.
  - 3.3.4 Wrap pipes with minimum ¼" (6.0 mm) thick Rubatex or Armaflex sleeving and secure over insulation using oversized clamps. If piping is insulated, this requirement is waved if clamps mount over insulation. Hard plastic pipe sleeves are not acceptable. An alternate is to provide resilient pipe mounting system such as Acoustoplumb or HoldRite
  - 3.3.5 Tee take-offs serving back to back fixtures are not permitted. Divide supply lines at riser and feed each bathroom individually.
  - 3.3.6 Carry lavatory and bath wastes in back to back situations separately to waste stack; direct connections from back to back fixtures not acceptable.
  - 3.3.7 Oversize supply, waste and vent pipe penetrations of gypsum wall board by ⅛" (3.0 mm) to ¼" (6.0 mm), pipe centred in hole, gap caulked with silicone sealant and covered with escutcheon. This requirement does not eliminate need for firestopping. Refer to Section 23 05 05 Firestopping for firestop requirements.
  - 3.3.8 Do not allow pipe work to contact gypsum wall board, framing, conduit, electrical or ductwork fans connected to room services. Exercise special care in furred down bathroom ceiling spaces.
  - 3.3.9 Ensure water supply lines penetrating floors do not contact structure.
  - 3.3.10 Ensure sleeves through slab are sized to allow for proper clearances to allow firestop and insulation installation.
  - 3.3.11 Waste stacks and rainwater leaders shall not touch structure. Provide resilient support at floor penetration with neoprene pad isolators sized for minimum ⅜" (9.5 mm) static deflection. Neoprene pad isolators shall be equal to Mason "Super W". Ensure piping does not touch framing or gypsum wall board.
  - 3.3.12 Mount bathtubs on Mason "Super W" neoprene pad isolators sized for ⅛" (3.0 mm) static deflection under full load conditions (i.e. tub full of water). For one person tub, use five pads with 30 durometer rating. Manufacturer shall ensure filled tub will not exceed pad rating. If continuous support is required, provide isolators between support and structure. Ensure supply and drain piping can accommodate changes in deflection between full and empty conditions. Provide seal around tub lip to accommodate isolator deflection.

### **3.4 Valve Installation**

#### **3.4.1 General:**

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- .1 Where possible, disassemble solder end joint valves before soldering. Cycle, 2 pcs solder valves prior to soldering. Solder in fully open position with wet rag to prevent seat damage.
  - .2 Where disassembly and the subsequent reassembly are impossible, give special regard to solder jointing. Ensure valve parts are not melted or deformed during soldering.
- 3.4.2 Shut-Off Valves:
- .1 Install shut-off or isolation valves at the following locations:
    - .1 Where water service enters building.
    - .2 At base of each building riser.
    - .3 At each main branch supply point. Provide valve on each outlet leg from tee or cross.
    - .4 At each single plumbing fixture. Satisfied by provision of fixture stop where called up.
    - .5 At each piece of equipment.
    - .6 At points indicated on drawings.
    - .7 Where required by plumbing code.
- 3.4.3 Balancing Valves:
- .1 Install balancing valves in hot water recirculating branch lines and branch connections to return mains as indicated on drawings.
- 3.4.4 Pressure Reducing Valves:
- .1 Pressure reducing valve stations shall consist of the following:
    - .1 High-flow or main pressure reducing valve shall be sized based at 8 ft/s flow rate and shall be provided with strainer, reducer if required and shut-off valve on inlet side and reducer if required and shut-off valve on outlet side.
    - .2 Low-flow pressure reducing valve shall be integrated with main pressure reducing valve, or shall be provided in a secondary bypass with strainer and shut-off valve on inlet side and shut-off valve on outlet side.
    - .3 Bypass around both pressure reducing valves with normally closed globe valve, which shall be same pipe size as incoming or outflowing building service, and pressure gauge and gauge cock on each side of globe valve. Bypass only PRV; do not bypass water meter or backflow prevention device.

- .2 Set main pressure reducing valve at 60 psi (415 kPa) outlet pressure.
- .3 Set small flow pressure reducing valve at 5 psi (35 kPa) higher outlet pressure than main pressure reducing valve.
- 3.4.5 Drain Valves:
  - .1 Provide drain valves at low points in system.
  - .2 Install drain valves,  $\frac{3}{4}$ " (20 mm) minimum, or line size where piping is smaller than  $\frac{3}{4}$ " (20 mm).
  - .3 Install hose-end adaptor, cap and chain on discharge side of each drain valve or pipe to drain where indicated.
- 3.4.6 Mixing:
  - .1 On up-stream hot and cold supplies, in accessible location, provide positive swing check valves and strainers. This requirement in addition to check valve device that is integral to mixing valve or downstream in mixed supply. Provide access panel to check valves and strainers.

### **3.5 Vacuum Breaker Installation**

- 3.5.1 Install at each fixture or item of equipment where contamination of domestic water system can occur and with CSA B64.10 requirements.
- 3.5.2 Vacuum breaker installation shall be in accordance with manual "Cross Connection Control Manual" published by Pacific Northwest Section of American Water Works Association.
- 3.5.3 Atmospheric type vacuum breakers shall be installed at least 12" (300 mm) above flood level rim of fixture.
- 3.5.4 Vacuum breakers serving fume hoods shall be installed outside fume hood.
- 3.5.5 Provide drainpan with water deflection enclosure on concealed pressure type vacuum breakers with drain line to appropriate drain.
- 3.5.6 Complete testing of vacuum breakers prior to final acceptance of plumbing systems. Certificate shall be submitted, signed and witnessed that testing was satisfactory.

### **3.6 Backflow Prevention Station Installation**

- 3.6.1 Install at each fixture or item of equipment where contamination of the water system can occur and in accordance with CSA B64.10 requirements.
- 3.6.2 Pipe differential relief outlet to drain.
- 3.6.3 Backflow prevention station shall be in accordance with manual "Cross Connection Control" published in the BC Section of American Water Works Association.

- 3.6.4 Complete testing of reduced pressure principle backflow prevention devices shall be carried out under this section of work prior to final acceptance of plumbing systems. Certificate shall be submitted signed and witnessed that testing was satisfactory.

**3.7 Strainer Installation**

- 3.7.1 Install strainer blow-off connections.
- 3.7.2 Blow-off connections shall be full drain size and shall include:
- .1 Up to 2" (50 mm) - nipple and cap (hot services).
  - .2 2½" (65 mm) and larger - nipple, globe valve and nipple (hot services).
  - .3 All sizes (cold services) - plug blow-off connection only.

**3.8 Flanges and Unions**

- 3.8.1 Provide on connections to pumps, reducing valves, control valves, fixtures, and equipment.
- 3.8.2 Connections up to and including 2" (50 mm) size shall be bronze union, 150 psi (1,034 kPa) rating with ground seat. All larger connections shall be flanged.
- 3.8.3 Unions not required in installations using grooved mechanical joint couplings. (Couplings shall serve as unions and disconnect points.)

**3.9 Pressure Gauges**

- 3.9.1 Install pressure gauge at all pump suction and discharge points at inlet and outlet of all major equipment having more than a 4 psi (25 kPa) pressure drop and at each pressure reducing station inlet and outlet.

**3.10 Water Hammer Arrestors**

- 3.10.1 Size in accordance with the Plumbing and Drainage Institute PD1-WH-201 sizing procedures.
- 3.10.2 Install on branch lines to flush valves, solenoid valves, self-closing faucets, quick closing valves on refrigeration, kitchen, laundry and other equipment incorporating solenoid valves.
- 3.10.3 Install at the tops of all domestic water vertical risers, and as shown on the drawings.

**3.11 Thermometers**

- 3.11.1 Install at domestic hot water storage tank inlet and outlet, and at heat exchanger inlet and outlets.

- 3.11.2 Locate for ease of readability with sensing elements directly in contact with flowing medium and immediately adjacent to sensing elements.
- 3.11.3 When installed to sense the water temperature in a pipe, install its sensing element in a non-ferrous, separable well filled with a heat conduction paste. Install the separable well in a form which minimizes the restriction to water flow, if necessary, in a section of oversized pipe.

### **3.12 Pipe Joints**

- 3.12.1 Install di-electric type couplings or fittings where copper or stainless steel piping and accessories connect to plumbing equipment such as steel storage tanks, pressure reducing stations and ductile iron pipe.
- 3.12.2 Where water service enters building, terminate at edge of building with Smith Blair standard sleeve coupling having stainless steel nuts and bolts. Bridge excavation with ductile iron pipe.
- 3.12.3 Tie rods shall only be used in conjunction with fittings possessing integral tie lugs.
- 3.12.4 Tie rods complete with their associated nuts and bolts shall be coated with two coats of asphaltic paint after installation.
- 3.12.5 Where plastic PEX piping systems are being used, the complete pipe joining "System" shall be entirely provided by the pipe Manufacturer (Uponor AquaPEX, PureLink/AquaLink).
- 3.12.6 All roll grooves on Stainless Steel Schedule 10 pipe must be formed using "RX" rolls.
- 3.12.7 All roll grooves on Copper tube must be formed using "RR" rolls.
- 3.12.8 Ensure minimum coupling pressure rating is 300 psi (2,065 kPa).
- 3.12.9 Viega press fittings shall be completed according to manufacturer's installation instructions using only manufacturer's press tool appropriate to the pipe and application.

### **3.13 Air Vents**

- 3.13.1 Install at high points in domestic hot water recirculation system.
- 3.13.2 Install on tees. Do not install on horizontal piping or radiused elbows.
- 3.13.3 Install ½" (15 mm) minimum isolating gate valve ahead of each air vent.
- 3.13.4 Pipe air vent discharge connections separately to nearest building drain using ¼" (6.0 mm) hard drawn copper.

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**3.14 Hydrants and/or Hose Bibbs**

- 3.14.1 Provide operating keys to Owner for hose bibbs without attached handle.
- 3.14.2 Provide isolating shut-off valve upstream of hose bibbs.
- 3.14.3 Set exterior ground type hose bibb boxes flush and anchor in 18" (450 mm) square x 8" (200 mm) thick concrete collar set at 1" (25 mm) above surrounding grade.
- 3.14.4 Connect drain ports on floor mount type hose bibbs indirectly to drainage system where such drainage ports are located within confines of building.
- 3.14.5 Seal around perimeter of hose bibbs with silicone caulk. Where waterproof membrane is present, provide hose bibb with membrane clamp.

**3.15 Trap Seal Primer Valves**

- 3.15.1 Provide floor drain trap primers in water closet rooms and other areas connected to sanitary sewer in accordance with Provincial Plumbing Code and as designated on drawings. Pipe material shall be Type L copper, NSF-61 approved, polypropylene tubing or aquapex for buried and in-slab pipe connections.
- 3.15.2 Locate where readily accessible by maintenance staff.
- 3.15.3 Provide shutoff upstream to allow service without affecting other fixtures.
- 3.15.4 Provide minimum of 12"x12" (300 mm x 300 mm) access door at each trap primer location to access shutoff and primer.
- 3.15.5 Where electronic trap primers are used, the contractor shall include and allow for the complete installation and coordination with the electrical trade.

**3.16 Hot Water Tanks and Heaters**

- 3.16.1 Provide temperature and pressure relief valves. Install so that probe properly senses temperature. Pipe relief port full outlet size to drain. Position discharge at drain to prevent splash-over.
- 3.16.2 Provide vacuum relief valve and check valve on cold water supply.
- 3.16.3 Provide isolating valves at tank and heater water connections.
- 3.16.4 Provide corrosion resistant watertight pan under any hot water storage tank and/or hot water heater/storage tank in compliance with Ontario Building code
- 3.16.5 Provide Type B vents on gas fired units.
- 3.16.6 Provide Type A vents on positive discharge units.



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**3.17 Recirculation Pumps**

3.17.1 Pump between Heater and Tank:

- .1 Install in accordance with Manufacturer's instruction.
- .2 Provide check valve on recirculation pump discharge and isolation valves up-stream of pump inlet and down-stream of check valve.
- .3 Provide electrical controls connection for the recirculation pump between heater and tank.

3.17.2 Building Recirculation Pump:

- .1 Coordinate with Electrical Division for provision of manual switch with wiring to pump.
- .2 Provide check valve on recirculation pump discharge and isolation valves upstream of pump inlet and downstream of check valve.
- .3 Coordinate with Controls division for connection to DDC system or a dedicated programmable clock.

**3.18 Water Booster Pump System**

- 3.18.1 Install in accordance with Manufacturer's instruction.
- 3.18.2 Provide electrical controls and connection between control panel and pumps.
- 3.18.3 Coordinate with Electrical Division for provision of power to control panel.
- 3.18.4 Provide pressure reducing valve on pump discharge.
- 3.18.5 Provide isolation valves and grooved couplings or flanges at inlet and discharge headers.

**3.19 Water Meters**

- 3.19.1 Approved meter rooms must provide vehicular access allow 10'-0" (3.0 m) vertical clearance from the City roadway to water meter station.
- 3.19.2 Install at location depicted on drawings, under no circumstances shall any other valves, backflow prevention, or any other fixture be placed upstream of the water meter.
- 3.19.3 Provide strainer on inlet to water meter between inlet valve and water meter.
- 3.19.4 Provide isolation valves on inlet to and outlet from water meter with valved bypass around the water meter connected to water system upstream of inlet valve and downstream of outlet valve. See Detail for UBC supplied by Utilities.
- 3.19.5 Wiring and conduit to remote reader by this section of work.

- 3.19.6 Provide test report from independent test agency to verify that meter and reader have been installed and set to read within acceptable limit of accuracy as set out in AWWA standards.

**3.20 Testing and Inspection**

- 3.20.1 Testing shall consist of hydraulic pressure testing at 200 psi (1,380 kPa) for 8 hours.
- 3.20.2 Comply with all requirements of Section 22 05 93 Testing, Adjusting and Balancing for Plumbing.

**3.21 Flushing and Chlorination of Water Lines**

- 3.21.1 Thoroughly flush water piping until free from scale, sediment and debris as soon as possible after system filled with water.
- 3.21.2 On completion of laying and testing, all water piping shall be pre-flushed, chlorinated and flushed again in accordance with AWWA C-651.
- 3.21.3 Retain firm, qualified to supervise and inspect chlorination and flushing procedures and perform chemical biological tests as required.
- 3.21.4 Mains shall be chlorinated to chlorine residual of not less than 10 ppm after standing for 24 hours. Hypochlorite and water are recommended as disinfectant. AWWA C-651 recommends amount of chlorine required.
- 3.21.5 Submit to Consultant certificate from testing firm that chlorination and flushing has been successfully completed.

**END OF SECTION**

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## 1. GENERAL

### 1.1 Related Work

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

### 1.2 Scope of Work

- 1.2.1 Interior sanitary waste and vent piping shall be provided as indicated on drawings from plumbing fixtures to the
- .1 Exterior sanitary building service as indicated on drawings.
- 1.2.2 Interior storm drainage piping and rainwater leaders shall be provided as indicated on drawings from roof drains, area drains, planter drains and catch basins to the
- .1 Exterior storm building service as indicated on drawings.

## 2. PRODUCTS

### 2.1 Interior Drain Waste and Vent Pipe and Fittings

#### 2.1.1 Buried Pipe and Fittings:

- .1 Cast-iron pipe and fittings with mechanical joint stainless steel couplings to CAN/CSA-B70.
- .2 Acrylonitrile-Butadiene-Styrene (ABS) Drain Waste and Vent Pipe Fittings conforming to CAN/CSA-B181.1 or,
- .3 Polyvinyl Chloride (PVC) Drain Waste and Vent Pipe and Pipe Fittings conforming to CAN/CSA-B181.2. Materials in contact with PVC pipe and fittings shall comply with Manufacturers compatibility documentation.
- .4 IPEX System 15 SDR-15 Polyvinyl Chloride (PVC) Drain Waste and Vent Pipe and Pipe Fittings conforming to CAN/CSA-B181.02 for underground and parkade drainage where hydrocarbons may be present. Materials in contact with PVC pipe and fittings shall comply with Manufacturers compatibility documentation.

#### 2.1.2 Above Ground Pipe and Fittings:

- .1 Cast-iron pipe and fittings with mechanical joint stainless steel couplings to CAN/CSA-B70.
- .2 DWV copper drainage pipe with cast brass or wrought copper drainage pattern fittings with 50/50 Sn/Pb recessed Solder joints.

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- .3 IPEX System XFR, complete with approved firestopping accessories. Refer to Section 23 05 05 Firestopping. Materials in contact with PVC pipe and fittings shall comply with Manufacturers compatibility documentation.
  - .4 IPEX System 15 complete with approved firestopping accessories. Refer to Section 23 05 05 Firestopping. System 15 is not allowed in high rise applications, in return air plenums or vertical service spaces. Materials in contact with PVC pipe and fittings shall comply with Manufacturers compatibility documentation.
  - .5 Manufacturer of cast iron piping shall be certified to current standards of ISO-9001, ISO-14001, OHSAS-18001 Standards, and must be made in North America, with recycled content stated on submission materials.
    - .1 Acceptable Manufacturers: Bibby Ste-Croix, Tyler Pipe, AB+I.
  - .6 No HUB couplings shall be certified to the current standard of CSA B602 and 3rd party listed to the current standard of CAN/ULC-S102.2.
    - .1 Acceptable Products: Bibby St-Croix, Anaco, Tyler.
- 2.1.3 Pressurized Sanitary Storm (Force Main) Piping and Fittings
- .1 Copper Type K or L hard tempered with solder joint fittings (above grade only).
  - .2 IPEX Xirtec PVC Schedule 80 pipe and pipe fittings, or equivalent, complete with solvent joint fittings. Pipe and fittings shall meet minimum flame and smoke spread ratings for the building type and construction. Materials in contact with PVC pipe and fittings shall comply with Manufacturers compatibility documentation.
  - .3 IPEX Xirtec CPVC Schedule 80 pipe and fittings, or equivalent, complete with solvent joint fittings for applications in high buildings and plenums which require a minimum flame spread rating of 25 and smoke developed classification of 50. Materials in contact with CPVC pipe and fittings shall comply with Manufacturers compatibility documentation.
- 2.1.4 Additional Requirements:
- .1 Cast iron DWV system shall be connected with couplings that are certified to CSA-B-602 and third party listed to current CAN/ULC-S102.2 for flame and smoke spread ratings. Heavy-Duty, Shielded, Stainless Steel Couplings composed of a fully corrugated shield, a clamp assembly with a 3/8 inch gear screw tightened to 80 inch pounds,

neoprene gaskets and listed to comply with CSA-B60 and Third party listed to current standard of CAN/ULC-S102.2.

- .1 Manufacturers: Anaco/Husky HD 2000 (Bibby Ste-Croix) or equal.
- .2 Pressure waste piping from pumping stations and other equipment shall be pressure piping and fittings as specified for domestic water.
- .3 Plastic (PVC) piping where used underground shall adapt to approved pipe material prior to penetrating the building slab. Materials in contact with PVC pipe and fittings shall comply with Manufacturers compatibility documentation.
- .4 Copper to cast-iron joints shall be male brass adaptors to tapped fittings.
- .5 Nipples shall be cast-iron or heavy brass.

## **2.2 Chemical Resistant Sewer Piping including Vent Piping**

2.2.1 Cast Iron Pipe: ASTM A 518/A 518M Corrosion Resistant High Silicon Iron Castings, hubless, service weight

- .1 Fittings: High silicon cast iron to same standard as piping.
- .2 Joints: CISPI 310, neoprene gaskets and stainless steel clamp and shield assemblies.

2.2.2 Glass Pipe: ASTM C1053

- .1 Fittings: ASTM C1053.
- .2 Joints: Stainless steel compression couplings with tetra-fluoroethylene seal ring.

2.2.3 FRPP and PVD Pipe: Polypropylene, flame retardant

- .1 Fire retardant polypropylene (FRPP) shall comply with, and be labeled to CSA standard CAN3-B181.3-M86, Polyolefin Laboratory Drainage Systems. FRPP shall be manufactured from resins meeting ASTM D4101 and conform to ASTM D2447 for dimensional tolerances.
- .2 PVDF pipe and fittings shall comply and be labeled to, plumbing standard ULC/ORD-C996.1-ASTM D3311 and ASTM D3222 and shall be manufactured from Kynar type 460 and 740 resins meeting a flame spread of less than 25, and a smoke developed rating of less than 50, under CAN/ULC-S102.2.
- .3 Fittings: Polypropylene.
- .4 Joints: Electrical resistance fusion or thermally fused with mandrel and plate.

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**2.3 Drains**

- 2.3.1 Floor drains connected to the sanitary system shall include trap primer connections from local water supply points at sinks, lavatories and as shown on the drawings.
- 2.3.2 Provide drains as specified in Hose Bibb and Drain Schedule with lacquered cast-iron body (except as noted otherwise) and clamping collar.
- 2.3.3 Provide drains by single Manufacturer throughout.
- 2.3.4 Drains shall be 4" (100 mm) unless noted otherwise. Provide heavy duty H-20 bearing strength drain grates at all locations where vehicles and heavy traffic areas are located (including but not limited to entry vestibules, loading docks and aprons, maintenance garage bays, auto shop bays, metal shop bays, garbage rooms) and as indicated on the drawings.
- 2.3.5 Roof drains shall include domes, screens, drainage grids, etc. Plastic component parts are not acceptable.
- 2.3.6 Acceptable Products: Jay R. Smith, Zurn, Mifab, Wade, Watts.

**2.4 Submersible Sump Pumps**

- 2.4.1 Type: CSA approved, completely submersible, vertical, centrifugal. Pumps with sheet metal or plastic parts on impellers or casing will not be accepted.
- 2.4.2 Casing: Hermetically sealed of cast-iron or bronze.
- 2.4.3 Impeller: Non-clog of cast-iron or bronze. Sanitary pumps to pass 2" (50 mm) sphere. Storm pumps to pass 1" (25 mm) sphere.
- 2.4.4 Shaft: Stainless steel on ball bearings.
- 2.4.5 Seals: Ceramic and carbon; oil lubricated.
- 2.4.6 Motor: CSA approved for submersible operation complete with built-in automatic reset thermal overload protection
- 2.4.7 Controls
  - .1 Simplex System: Pressure switch inside control unit with oil isolated diaphragm.
  - .2 Duplex System: Provide CSA approved automatic alternator control panel and float switches (four) to alternate pump operation on average load and cut in second pump on rising level or pump failure. Panel shall be totally pre-wired complete with contacts, circuit breakers, pump run lights, HOA starters, selector switches, electronic alternator circuit devices, manual override circuit and transformers.
  - .3 Alarms: Separate float switch complete with contacts in panel for remote alarm installation. Provide high level alarm light and beeper with reset.

- .4 Provide BTL certified BACnet/IP for alarm and monitoring through BAS.
- 2.4.8 Electrical: Pumps and alarm shall be fitted with suitable length waterproof flexible cord with junction box for mounting in sump.
- 2.4.9 Slide Rail System
  - .1 Provide factory slide rail system with discharge shutoff valves outside sump operable through extended valve box assembly.
  - .2 Provide standard rail guides with pump and support brackets and check valve guide.
  - .3 Lift out check valve and sealing flange shall lift out with pump.
  - .4 Discharge and support elbow shall be mounted on sump base for rail and pump support.
  - .5 Sump cover and hatch shall be suitable for H-20 traffic loading with latch open cover for pump removal.
- 2.4.10 Acceptable Products: Myers, Zoeller, Barnes, Plad, Grundfos.
  - .1 Self-lubricating bearings.
  - .2 3" (80 mm) discharge.

## **2.5 Pressure Waste Valves**

- 2.5.1 Plug type: full port valve, flanged ends, screwed ends are acceptable for valves smaller than 2" (50 mm).
  - .1 Up to 2" (50 mm) size - Keystone round port Ballcentric valve with flanged ends, Homestead #1512 Ballcentric with flanged ends.
  - .2 2" (50 mm) and larger - Keystone round port Ballcentric valve with flanged ends, Homestead #1522 Ballcentric with flanged ends.
- 2.5.2 Check Valves:
  - .1 3" (80 mm) size and smaller: APCO rubber flapper, Terminal City outside lever and weight, ITT Flygt HDL Model 5087.
  - .2 4" (100 mm) size and larger: APCO series 6000 cushioned swing check valve complete with oil operated dash point, Terminal City outside lever and weight, ITT Flygt HDL Model 5087.

## **2.6 Stormceptor Unit**

- 2.6.1 Stormceptor Model STC-300 oil and grit separator complete with Jellyfish filter.
- 2.6.2 Designed, to remove minimum 80% and constructed average annual post-development TSS and remove maximum 40% of

average annual post-development TP based on average annual loadings from all storms less than or equal to 2 year/24 hour storm.

- 2.6.3 Unit to be LEED compliant to satisfy LEED Site Stormwater Management Credit SS6.2 and shall be certified by Ministry of Environment that meets MOE Protocol for definition of OGS.
- 2.6.4 Unit complete with bolt down manhole lid cover and ladder rungs for access.
- 2.6.5 26000 L storm water based on fifteen (15) minute rainfall intensity.
- 2.6.6 Remove minimum 80% TSS and minimum 40% TP based on the following runoff coefficient.

## 2.7 Oil Interceptor

- 2.7.1 The oil interceptor shall be concrete body oil interceptor, equipped with baffles, adjustable oil draw-off, steel H-20 load-rated manhole cover and frame and concrete manhole extensions with ladder rungs to suit buried depth up to grade.
- 2.7.2 Unit shall be equipped with flow control devices at inlet to unit installed as recommended by Manufacturer.
- 2.7.3 Valve controlling oil waste draw-off from interceptor shall be rising stem, threaded ends, double discs, threaded bonnet, 150 psi (1,034 kPa) gate valve suitable for use with oil.
- 2.7.4 Acceptable Products:
  - .1 4" (100 mm) inlet – Langley Concrete Type II Coalescing Plate Oil Interceptor with 16 mm Spacing.
  - .2 6" (150 mm) inlet – Langley Concrete Type II Coalescing Plate Oil Interceptor with 8 mm Spacing.
  - .3 8" (200 mm) inlet – Langley Concrete 4212 Coalescing Plate Oil Interceptor with 8 mm Spacing.
- 2.7.5 Terminate no-corrode riser above valve at OPW #104-AN 300 mm cast-iron manhole and set assembly in concrete collar flush with finish grade. Manhole cover plate shall be marked "WASTE OIL VALVE."

## 2.8 Catch Basins

- 2.8.1 Barrell and base: ASTM C478M, ASTM C478; precast concrete sections laid on cast-in-place reinforced concrete foundation pad, **[36" (900 mm)]** diameter with precast concrete top.
- 2.8.2 Inlet assembly: Two piece heavy duty cast steel or cast iron frame and grate with ground or machined grate and frame bearing surfaces.
  - .1 Curb gutter style: Rectangular grate and storm back, capacity 247 cu ft/s (7 cu m/s).



- .2 Standard: Round frame and grate with capacity 194 cu ft/s (5.5 cu m/s).
- .3 Manhole frame: Grate top, capacity 141 cu ft/s (4.0 cu m/s).
- 2.8.3 Minimum 4' (1,200 mm) cover over outlet and minimum 2' (600 mm) sump below outlet.
- 2.8.4 Acceptable products: AE Precast, Langley Precast, Fraserway Precast, Diamond Precast.

## 2.9 **Manholes Sumps**

- 2.9.1 Formed bottom manholes: ASTM C478M, ASTM C478; reinforced precast concrete sections laid on cast-in-place reinforced concrete foundation pad as specified in section 03 30 00
  - .1 Size 48" (1,200 mm) diameter.
  - .2 Cover: Standard cast iron with minimum sized pick hole and frame. Use heavy duty cover and frame in vehicular traffic areas.
  - .3 Steps: ¾" (20 mm) diameter galvanised steel on 16" (400 mm) centres.
- 2.9.2 Acceptable products: AE Precast, Langley Precast, Fraserway Precast, Diamond Precast.

## 3 . **EXECUTION**

### 3.1 **Floor Drains**

- 3.1.1 Install floor drains at low points to provide proper drainage.
- 3.1.2 Water piping from trap primer to floor drain shall be PEX tubing where cast into concrete and protected in a polyethylene sleeve where buried below slab. Provide Type L copper where exposed within building.

### 3.2 **Roof Drains**

- 3.2.1 Install roof drains at low points on roof to provide proper drainage. Coordinate with roofing Contractor.
- 3.2.2 Install in accordance with RCABC standards to maintain integrity of roof guarantee.
- 3.2.3 Install integral expansion joints where roof drains are installed directly above rainwater leaders.
- 3.2.4 Provide watertight seal in the gap between the flashing, pipe and lead cap on roof overflow drains to ensure water does not leak into the building interior during an overflow scenario.

- 3.2.5 Verify style of roof drain with roofing details prior to submitting shop drawings.

### **3.3 Sewage Pumps**

- 3.3.1 Control wiring between control panel and control devices shall be supplied by this Division. Control work shall be done in accordance with Electrical Specification, the Canadian Electrical Code and the Technical Safety BC requirements. Install electrical control wiring in metallic conduit.
- 3.3.2 Install pumps to Manufacturers' installation instructions.
- 3.3.3 Mount level regulators at elevations indicated.
- 3.3.4 Mount control panel within line of sight and within 32' (10 m) of sump chamber access cover.
- 3.3.5 Test control circuit operation after installation of pumps by filling pumping chamber at least twice.
- 3.3.6 Correct deficiencies in control circuit.
- 3.3.7 Provide intrinsically safe barriers for sump pumps located within parking garages, vehicle service or parking bays and in other areas which can receive fuels.
- 3.3.8 Provide heat tracing and minimum 1" (25 mm) thick pipe insulation for all sump pump discharge pipes where they run through an unheated space.

### **3.4 Safes, Flashing and Vent Terminals**

- 3.4.1 Terminate vent terminals minimum of 1" (25 mm) above water level at which roof drainage overflows through roof overflow scuppers or drains.
- 3.4.2 Cleanouts passing through walls or floors subject to hydrostatic pressure and waterproofed by means other than membrane shall be provided with clamping collars and flashings, tied directly to the cleanout clamping collar.
- 3.4.3 Supply flashings to cleanouts and drains. Securely fix flashing clamps and extend 12" (300 mm) beyond edge of cast-iron fittings.
- 3.4.4 Supply and install waterproofing membrane under built-up showers and mop sinks on floor not slab-on-grade. Safes shall extend across floors and up walls and curb to minimum height of 6" (150 mm) and shall be turned into floor drain flange, unless specifically noted otherwise. Seams shall be completed sealed. Treat both sides of safe with two coats of water waterproof sealant compatible with membrane.
- 3.4.5 Vent flashing minimum 18" (450 mm) x 18" (450 mm) base dimension shall terminate flush with top of 12" (300 mm) high vent

pipe and gap between flashing and pipe shall be closed with aluminum cap 3" (80 mm) high. Main flashing shall not be turned over pipe. Vent installation detail to be compliant with RCABC Standard Construction Detail 10.3.5.

- 3.4.6 Securely fix all roof drains and tie into roof membrane using membrane clamping collars. Installation to comply with RCABC Standard Construction Detail 10.3.6.

### **3.5 Piping**

- 3.5.1 Do not install ABS, PVC or other plastic piping upstream of kitchen grease interceptors, where high temperature waste is directed.
- 3.5.2 Do not install piping with glued joints at temperatures below those recommended by solvent Manufacturer.
- 3.5.3 Refer to Section 23 05 05 Firestopping for firestop requirements.
- 3.5.4 Joints to be connected with couplings as per Section 2.1.3.
- 3.5.5 Support horizontal runs and brace at intervals and points as recommended by the Manufacturer and/or local Authority Having Jurisdiction.
- 3.5.6 Support vertical stacks and assemblies and brace as recommended by the Manufacturer and/or local Authority Having Jurisdiction.

### **3.6 Testing and Inspection**

- 3.6.1 Tests on sanitary and storm systems shall consist of hydraulic pressure testing of 5 ft water column (30 kPa) minimum and 25 ft water column (75 kPa) maximum for 8 hours. Check for proper grade and obstruction with ball test.
- 3.6.2 Tests on sump pump discharge shall consist of hydraulic pressure testing of 50 psi (1,379 kPa) minimum for 8 hours.
- 3.6.3 Tests on sumps or tanks that receive sanitary sewage shall consist of filling sump with water to rim and have no drop in water level over 24 hours.
- 3.6.4 Air test in accordance with Plumbing Code may be used during freezing conditions.

### **3.7 Catch Basins, Sumps and Manholes**

- 3.7.1 For buried interceptors (all types), include interconnecting pipe installation when provided as part of the assembly by the supplier, and provide concrete pad(s) and hold down straps as indicated on manufacturers literature and installation instructions for buried interceptors.

**END OF SECTION**

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## 1. **GENERAL**

### 1.1 **Related Work**

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

### 1.2 **Codes and Standards**

- 1.2.1 All products shall be UL/ULC classified in accordance with NSF/ANSI/CAN-61 for potable water service and certified to the no/low lead standard of NSF/ANSI/CAN-372.
- 1.2.2 Fixtures shall display CSA approval where CSA standard is available.
- 1.2.3 Plumbing fittings shall be to CAN/CSA B125, Plumbing Fittings.
- 1.2.4 Plumbing fixtures shall be to CAN/CSA B45, 'General Requirements for Plumbing Fixtures'.
- 1.2.5 Vitreous china plumbing fixtures shall be to CAN/CSA B45.1, 'Ceramic Plumbing Fixtures'.
- 1.2.6 Enamelled cast-iron plumbing fixtures shall be to CAN/CSA B45.2, 'Enamelled Cast-iron Plumbing Fixtures'.
- 1.2.7 Porcelain enamelled steel plumbing fixtures shall be to CAN/CSA B45.3, 'Porcelain Enamelled Steel Plumbing Fixtures'.
- 1.2.8 Stainless steel plumbing fixtures shall be to CAN/CSA B45.4, 'Stainless Steel Plumbing Fixtures'.
- 1.2.9 Plastic plumbing fixtures shall be to CAN/CSA B45.5, 'Plastic Plumbing Fixtures'.

### 1.3 **Colour**

- 1.3.1 Vitreous china fixtures shall be white unless otherwise noted.
- 1.3.2 Stainless steel fixtures shall be satin and/or mirror finish or combination thereof.
- 1.3.3 Exposed plumbing brass and metal work shall be heavy triple chromium plated.

### 1.4 **Quality**

- 1.4.1 Similar plumbing fixtures shall be by one manufacturer.
- .1 Standard of Acceptance: American Standard, Kohler, Caroma, Zurn Toto, Moen-Commercial.
- 1.4.2 Plumbing fixture supply brass shall be of one Manufacturer, unless otherwise specified.

- .1 Standard of Acceptance: American Standard, Kohler, Caroma, Zurn, Toto, Moen-Commercial, Delta-Commercial, Sloan.
- 1.4.3 Fixtures shall be free from flaws or blemishes. Surfaces shall be clear, smooth and bright and have dimensional stability.
- 1.4.4 Plumbing fixtures and trim shall be new, unless otherwise noted.
- 1.4.5 Visible or exposed parts, trim, supplies traps, tubing, nipples, escutcheons, check valves on diverter supply lines and valves to sanitary and/or kitchen fixtures shall be chrome-plated finish, unless otherwise noted.
- 1.4.6 Fittings shall have heavy duty stems.
- 1.4.7 Roof drains, floor drains: Standard of Acceptance: J.R. Smith, Zurn, Wade, Watts.

2 . **PRODUCTS: REFER TO SCHEDULE ON DRAWINGS**

3 . **EXECUTION**

3.1 **Fixture Installation**

- 3.1.1 Connect fixtures complete with specified trim supplied, drains, accessory piping, vented traps, stops or valves, reducers, escutcheons and fittings for proper installation of fixtures and supply fittings.
- 3.1.2 Provide necessary hangers, supports, brackets, reinforcements, steel back-up plates and floor flanges to set fixtures level and square. Mount fixtures so 200 lb (90 kg) mass will not loosen or distort mounting.
- 3.1.3 Provide minimum 18 ga (1.27 mm) circular stainless steel shrouds for concealing services dropping to island or bench fixtures from ceiling spaces complete with ceiling and counter flanges. Diameter shall be to accommodate services; however, shrouds shall be same diameter in one room or area.
- 3.1.4 Provide chrome-plated quarter turn mini ball valves for lavatories, sinks and tank type water closets.
- 3.1.5 ABS P-traps and waste arms are not permitted.
- 3.1.6 Water Closets:
  - .1 Floor mounted water closets shall be connected to waste utilizing brass or cast-iron floor flanges with lead stub or mechanical joint connections and wax seals.
  - .2 Polished chrome flexible pipe supplied with metal compression rings are acceptable for tank type water closets. Supply shall incorporate ½" (15 mm) inlet x ¾" (9.5

mm) compression outlet angle stop complete with 12" (300 mm) long flexible riser to fixture. PEX or other plastic supplies are not acceptable.

- .3 Provide 4" (100 mm) drain pipe connections and branch drains from all water closets. Use staggered wye connections at toilet branch drain connections; avoid flat double wye connections.
- .4 Provide extended spud pieces on handicapped water closets to accommodate closed toilet seat being raised.

3.1.7 Lavatories and Sinks:

- .1 Polished chrome flexible pipe supplied with metal compression rings are acceptable. Supply shall incorporate ½" (15 mm) inlet x ¾" (9.5 mm) compression outlet angle stop complete with 20" (500 mm) long flexible riser to fixture.
- .2 Control handles for two handle mixing faucets shall be positioned with cold control on right and hot control on left. Activation by rotating cold control handle clockwise and hot control handle counter clockwise.
- .3 Faucets shall be complete with nuts and tailpieces.
- .4 Provide gaskets and/or sealing washers to prevent entry of water into fixture trim, faucet holes or punchings in millwork.
- .5 Gooseneck spouts shall have clearance of 8" (200 mm) from nozzle tip to countertop, unless otherwise specified.
- .6 Plastic control handles and spouts are unacceptable.
- .7 Lavatory and sink P-traps shall be complete with either a cleanout or slip joint connection.

3.1.8 Urinals:

- .1 Piping, fittings and P-traps from urinals shall not be copper; vents above urinal rim may be copper.
- .2 Urinals shall have individual wastes.

**3.2 Fixture Trim Holes or Punchings**

- 3.2.1 Fixture punchings for faucets or other trim shall match holes necessary for specified trim.
- 3.2.2 Provide fixture and templates to applicable trades for holes and cut outs required in millwork.

**3.3 Walls and Floors**

- 3.3.1 Fixtures mounted on glazed tile surfaces shall have ground faces to finished surface.
- 3.3.2 Plumbing fixtures in contact with walls and floors, shall be sealed with Dow Corning anti-mildew 786 building sealant, made watertight and beaded smooth.

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**3.4 Water Hammer Arrestors**

- 3.4.1 Provide water hammer arrestors or shock absorbers on fixtures with flush valves and/or quick closing valves or solenoid valves.

**3.5 Handicap Fixtures**

3.5.1 Water Closets:

- .1 Install wall hung water closets designed for handicap use with top of seat 17" (425 mm) to 19" (475 mm) above finished floor.
- .2 Install offset on handicap water closet flush valve connection to eliminate interference with grab bar mounting.
- .3 Install flush valve so handle is facing transfer or non-grab bar side of water closet.
- .4 Install flush valve so that hands free flush is coordinated to flush with the seat cover up.

3.5.2 Lavatories and Sinks:

- .1 Provide offset P-traps.
- .2 Supplies shall accommodate offset P-trap.
- .3 P-traps and waste arms shall be insulated with manufactured insulation kit or ½" (15 mm) of fibreglass insulation and finished with polyvinyl chloride jacket.
- .4 Acceptable Manufactured Products: Truebro 'Handi Lav-Guard,' Brocar Products Inc. 'Trap Wrap,' Sexauer 'Handi Lav-Guard' Plumberex 'Handy Shield'.

**END OF SECTION**

## 1. **GENERAL**

### 1.1 **Related Work**

1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

### 1.2 **Scope of Work**

1.2.1 Some items in this section relate to connecting to equipment supplied by Owner or other trades.

1.2.2 Responsibility for this equipment once delivered to site is included in this Section.

1.2.3 Unless otherwise noted, provide and install trim under this section of work for equipment supplied by Owner or other trades.

1.2.4 Provide escutcheons for wall and floor penetrations.

## 2. **PRODUCTS**

### 2.1 **Stoves, Range or Countertop**

2.1.1 Connect  $\frac{3}{4}$ " (20 mm) natural gas through shut-off valves, unions and pressure regulators.

### 2.2 **Dish Washer**

2.2.1 Connect  $\frac{1}{2}$ " (15 mm) hot water from adjacent kitchen sink complete with shut-off valve.

2.2.2 Connect waste to adjacent kitchen sink or garburator.

### 2.3 **Clothes Washers**

2.3.1 Connect hot and cold water complete with water hammer arrestors and automatic washer supply valves.

2.3.2 Acceptable Products: Waltec 29W521 Auto-Wash-Trol

### 2.4 **Fridges with Ice Machines**

2.4.1 Connect  $\frac{1}{2}$ " (15 mm) cold water through shut-off valve, union and coiled loop of copper tubing to permit pulling of fridge.

## 3. **EXECUTION**

### 3.1 **Valves**

3.1.1 Locate valves in accessible location.



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**END OF SECTION**

1. **GENERAL**

1.1 **Related Work**

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

2. **PRODUCTS – NOT USED**

3. **EXECUTION**

- 3.1.1 Supply and install piping components - pipe fittings, valves, strainers, vacuum breakers, backflow preventers, unions and insulation - as indicated, specified or as recommended by equipment Manufacturer.
- 3.1.2 Arrange rough-in and piping connections to equipment, as recommended by equipment Manufacturer.
- 3.1.3 Chrome plate uninsulated piping and piping components exposed to view, unless otherwise indicated. Provide chrome plate escutcheons at wall and floor penetrations.
- 3.1.4 Connect equipment requiring plumbing connections.
- 3.1.5 Piping servicing kettles, ranges, etc., shall be neatly racked together with heating pipes and shall be minimum of 12" (300 mm) above floor.
- 3.1.6 Refer to kitchen Consultant's food facilities and plumbing drawings for details of equipment item numbers and rough-in locations.
- 3.1.7 Provide and install components under this section of work for kitchen equipment requiring plumbing connections that are supplied under other sections of work.
- 3.1.8 Gas pressure regulator settings indicated are for elevations up to 2,000' (610 m) above sea level. BTU input range shall be derated for the elevation above sea level if above 2,000' (610 m).

**END OF SECTION**

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1. **GENERAL**

1.1 **Related Work**

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

2. **PRODUCTS**

2.1 **Compressed Air Pipe**

- 2.1.1 Above ground pipe and fittings inside building:

- .1 Schedule 5 steel pipe to ASTM A-135 Grade A (1008/1010 carbon steel) with interior zinc based coating and exterior 99.99% pure zinc galvanized coating with conversion coating and clear organic topcoat used in conjunction with Victaulic Pressfit fitting system. Acceptable Products: Allied Tube and Conduit's Air-Flo 300 steel pipe.
- .2 Schedule 5S stainless steel pipe to ASTM A-312, Type 304/304L, full finish annealed and certified for use with the Vic-Press 304™ piping system.
- .3 Schedule 40 galvanized steel inside and outside, ASTM A53 and CSA B63-1966 (R1971).
- .4 Type "K" or "L" hard drawn seamless copper tubing to ASTM B88.
- .5 125 psi (860 kPa) rating.
- .6 Conformity with ANSI B31 standards for steel, cast-iron, brass.
- .7 Do not use thread protection couplings, close nipples, running ripples or street elbows.

2.2 **Fittings**

- 2.2.1 Steel Pipe:

- .1 Coupling type fittings: Victaulic Pressfit with Grade T Nitrile O-ring.
- .2 Screwed of galvanized steel.
  - .1 2" (50 mm) and larger, 150 psi (1,034 kPa) to ASTM A-338-61.
  - .2 ¾" (19 mm) to 1-¾" (45 mm) to ASTM A-47-77.
  - .3 Plugs 300 psi (2,070 kPa) solid steel or forged to ASTM-105-77 Grade II.
- .3 Grooved end for galvanized steel pipe:

- 
- .1 Cast ductile iron to ASTM A-536-84.
  - .2 Wrought steel to ASTM A-234 WPB.
  - .3 Factory-fabricated steel ASTM A53.
  - .4 Ends per CSA B242-80.
  - .5 Victaulic.
  - .4 Welded:
    - .1 Forged steel (same weight as connecting pipe), butt type.
    - .2 Long radius elbows and reducing fittings.
    - .3 Welded Tees or Sweepolets: Branch connections except those less than half diameter of main.
    - .4 Threadolets or Weldolets: Branch connection less than half diameter of main.
    - .5 Caps: Standard weight seamless carbon steel to ASTM A181.7, Grade I and ANSI B16.5.
  - 2.2.2 Stainless Steel Pipe:
    - .1 Precision, cold drawn, austenitic stainless steel with elastomer O-ring seals.
    - .2 Victaulic Vic-Press 304™.
  - 2.2.3 Copper Pipe:
    - .1 Wrought copper fittings to ANSI B16.22 and 95.5 SN/Pb solder under 1" (25 mm), Silfos 1" (25 mm) and over. Grooved Victaulic fittings 2" (50 mm) and over.
  - 2.2.4 Grooved Joint Couplings:
    - .1 Steel Pipe: Victaulic Style 107N (rigid) and Style 177 (flexible); installation-ready, for direct stab installation without field assembly.
    - .2 Copper Tubing: Victaulic Style 607H; installation-ready, for direct stab installation without field disassembly. Flaring the adjoining tube or fitting ends to accommodate alternate sized couplings is not permitted.
    - .3 Provide with gaskets suitable for compressed air services.
  - 2.2.5 Unions
    - .1 Steel Pipe: Malleable iron, ground joint and brass to iron seat, 150 psi (1,034 kPa).
    - .2 Copper Pipe: Di-electric couplings or waterway fittings.
    - .3 Unions not required in installations using grooved mechanical joint couplings (couplings shall serve as unions and disconnect points).
  - 2.2.6 Flanges:
-

- .1 Steel Pipe: Raised face, steel weld-neck, lap or back-welded slip-on-type (flanges compatible with mating flange). Carbon steel bolts and nuts ASTM A307. Bolts full diameter of bolt holes, bolts in each hole.
- .2 Copper Pipe: Copper to iron flanges shall be brass.
- .3 Flange Adapter: Flat face, ductile iron housings with elastomer pressure responsive gasket, for direct connection to ANSI Class 125 or 150 flanged components. Victaulic Style 741.

## 2.3 Valves

- 2.3.1 Globe: 200 psi (1,380 kPa), wog.
  - .1 2" (50 mm) and smaller - Crane 14-½P, Jenkins 2032, Lunkenheimer 73-P5.
- 2.3.2 Valves shall be washed in hot solution of sodium carbonate or tri-sodium phosphate (10 lb (4.5 kg) per 26 USgal (100 L) of water).

## 2.4 Air Compressor

- 2.4.1 Provide two stage, duplex, air cooled, horizontal, reciprocating type, stationary air compressors, mounted on welded steel base, with provision for V-belt adjustment.
- 2.4.2 Compressor Regulation: Automatic dual control with time delay relay. Pressure switch shall operate to cut out at gauge pressure of 120 psi (827 kPa) with minimum differential gauge pressure of 100 psi (690 kPa) for start-stop operation and gauge pressure of 110 psi (760 kPa) for constant speed.
- 2.4.3 Control: operate base load machine at constant speed with automatic standby by other machine. Set for automatic start-stop. Provide lead lag change over.
- 2.4.4 Intercooler shall be air cooled with fan.
- 2.4.5 Provide each unit with safety valves, pressure gauge, moisture separator, moisture drain valve and automatic condensate trap.
- 2.4.6 Provide Aftercooler:
  - .1 Suitable for operation under gauge pressure of 135 psi (930 kPa) working pressure, complete with removable tube nests and tube plates, water inlet piping with automatic water valve.
  - .2 Suitable for cooling discharge air to within 51°F (11°C) of ambient air temperature, with compressors operating at specified capacity.
- 2.4.7 Provide replaceable cartridge type filter and silencer for each compressor.

- 2.4.8 Refer to schedule on drawings for capacities.
- 2.4.9 Acceptable Products: DeVilbiss Air Cooled, Atlas Copco Air Cooled, Ingersoll Air Cooled, Brunner Air Cooled, Broomwade Air Cooled, Kaeser.
- 2.4.10 Provide anti-vibration mounts. Transmissibility 5%.

## **2.5 Air Dryer**

- 2.5.1 Provide refrigerated compressed air dryer of self-contained hermetically sealed mechanical refrigeration type complete with water cooled heat exchanger, refrigeration compressor, automatic controls moisture removal trap, all internal wiring and piping and full refrigerant charge, ready for connections to power, water and drains. Refrigeration unit shall operate at 60% of time at all but maximum load conditions.
- 2.5.2 Valved bypass shall be installed around air dryer. Inlet and outlet connections shall be factory insulated.
- 2.5.3 Dryer Capacity: To match compressor at a gauge pressure of 690 100 psi (690 kPa), maximum gauge pressure of 125 psi (860 kPa) atmospheric dew point, -30°F (-34°C) entering air 95°F (35°C) 60% RH.

## **2.6 Air Receiver**

- 2.6.1 Provide 24" (600 mm) diameter by 72" (1,800 mm) horizontal tank built to CSA B51 and Provincial Regulations for working gauge pressure of 125 psi (860 kPa).
- 2.6.2 Inlet and outlet connections shall be ¾" (19 mm) diameter.
- 2.6.3 Fittings shall include adjustable pressure regulator, safety valve, gauge pressure range of 0 to 150 psi (1,034 kPa), 3" (75 mm) dial to CGSB 91-GP-1 Type A, Grade A, drain cock and automatic condensate trap.
- 2.6.4 Provide Provincial inspector's certificate, NB label or ASME label.
- 2.6.5 Tanks shall be shop primed.

## **2.7 Compressed Air Outlets**

- 2.7.1 Compressed Air Outlet CA-1: Wall mounted quick disconnect fitting with shut-off upstream of outlet.
- 2.7.2 Compressed Air Outlet CA-2: Air tool control complete with strainer, regulator, gauge, oiler and quick disconnect fitting. Provide shut-off upstream of outlet.
- 2.7.3 Compressed Air Outlet CA-3: Ceiling drop connection to 78" (2,000 mm) above floor complete with rigid piping take-off from top side of main and return bend to 20" (500 mm) below main. Adapt a lower

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end of return bend to ½" (12 mm) industrial flexible compressed air hose with quick disconnect outlet with shut-off upstream of outlet.

**2.8 Lubricator**

- 2.8.1 In-line lubricators shall be 1" (25 mm) diameter.
- 2.8.2 Standard of Acceptance: DeVilbiss L-9660E.

**3 . EXECUTION**

**3.1 General**

- 3.1.1 Ream pipe ends.
- 3.1.2 Grade piping toward compressor and/or provide in-line water separators.
- 3.1.3 Exercise care with flux application to copper pipe joints to minimize excess inside completed joints.
- 3.1.4 Make screwed joints with full cut standard tapes pipe threads. Provide pipe dope or Teflon tape to male threads.
- 3.1.5 Grooved joints shall be installed in accordance with the Manufacturer's latest published installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Gaskets shall be of an elastomer grade suitable for the intended service, and shall be molded and produced by the coupling Manufacturer. Grooved coupling Manufacturer's factory trained Representative shall provide on-site training for Contractor's field personnel in the use of grooving tools and installation of grooved joint products. Representative shall periodically visit the jobsite and review Contractor is following best recommended practices in grooved product installation. (Distributor's Representative is not considered qualified to conduct training or jobsite visit(s)).
- 3.1.6 Install Vic-Press 304™ in accordance with Victaulic recommendations. Pipe shall be certified for use with the Vic-Press 304™ system, square cut 0.03" (0.06 mm), properly deburred, and cleaned. Pipe ends shall be marked with a gauge supplied by Victaulic. Use a Victaulic 'PFT' series tool with the proper sized jaw for pressing.
- 3.1.7 After pipe installation but before outlet valve installation blow line clear with dry air or nitrogen.

**3.2 Valves**

- 3.2.1 Valves shall be disassembled prior to soldering.
- 3.2.2 Install shut-off or isolation valves at the following locations:

- 
- .1      Base of each building air riser.
  - .2      Main branch supply point, provide valve on each outlet leg from tee or cross.
  - .3      Upstream of each air outlet and/or each equipment connection.
  - .4      Points as indicated on drawings.

**3.3      Tests and Inspection**

- 3.3.1      Tests on compressed air systems shall consist of air-pneumatic pressure tests of 200 psi (1,380 kPa) for 8 hours. Soap shall be used on all joint being tested pneumatically.

**END OF SECTION**



## **1. GENERAL**

### **1.1 Conformance**

- 1.1.1 General Conditions, Supplements and Amendments shall govern this Division (read in conjunction with Instruction to Tenderers / Bidders). This section covers items common to all sections of Mechanical work and is intended to supplement requirements of Division 01. Refer also to Sections 21 05 06 and 22 05 00.

### **1.2 Work Included**

- 1.2.1 Provide complete, fully tested and operational mechanical systems to meet requirements described herein, in complete accordance with applicable codes and ordinances.
- 1.2.2 "Provide" shall mean "Supply and Install" products and services specified.
- 1.2.3 Provide materials, equipment and plant, of specified performance and quality, with current models with published, certified ratings for which replacement parts are readily available.
- 1.2.4 Provide project management and on-site supervision to undertake administration, meet schedules, ensure performances, and coordination, and establish orderly completion and delivery of fully commissioned installation.
- 1.2.5 Follow Manufacturer's recommendations for installation, safety, access for inspection, maintenance and repairs. Provide access to motors, belts, filters and lubricating points. Install equipment to permit maintenance and disassembly with minimum disturbance to connecting piping or duct systems.
- 1.2.6 Most stringent requirements of this and other mechanical sections shall govern.
- 1.2.7 Work shall be in accordance with the Drawings and Specifications and their intent, complete with necessary components, including those not normally shown or specified, but required for complete installation.
- 1.2.8 Provide seismic restraints for required equipment, piping and ductwork.
- 1.2.9 Connect mechanical services to equipment furnished by Owner or other Sections, including start-up and test.

### **1.3 Standard of Acceptance**

- 1.3.1 Means that item named and specified by Manufacturer and/or catalogue number forms part of specification and sets standard regarding performance, quality of material and workmanship and

when used in conjunction with referenced standard, shall be deemed to supplement standard.

- 1.3.2 Acceptable product Manufacturers are listed within section where they are specified or in equipment schedules.
- 1.3.3 Where two or more items of equipment and/or material, of the same type, are required, provide products of single Manufacturer.
- 1.3.4 Visible Manufacturer's nameplate shall indicate Manufacturer's name, model number, serial number, capacity data, electrical characteristics and approval stamps.
- 1.3.5 Provide new materials and equipment not less than quality specified and of current models with published ratings and available replacement parts. Equipment shall have ULC, CSA or ASME nameplates as required by Authorities having jurisdiction.
- 1.3.6 Use same brand of Manufacturer throughout, unless otherwise specified, for each specification application of equipment or material.
- 1.3.7 Replace materials less than specified quality and relocate work incorrectly installed as determined by Consultant.

#### **1.4 Addition of Acceptable Manufacturers**

- 1.4.1 Equipment/material considered to satisfy specification, but of Manufacturer other than those named in section specifying equipment/material may be submitted in writing to Consultant for consideration not later than five working days prior to close of tender or bid depository Sub-Trade tender, whichever is earlier.
- 1.4.2 Addition of Manufacturer's names to specifications shall be by addendum only.
- 1.4.3 Provide complete technical and performance equivalency comparison to specified equipment to show that proposed equipment is equal to, or better than the specified equipment. At a minimum, provide a checklist or side by side comparison with the following information:
  - .1 Physical dimensions and installed weight.
  - .2 Electrical characteristics.
  - .3 Performance data.
  - .4 Acoustical data.
  - .5 Service space requirements.
  - .6 Components specifications breakdown (Fins material, tube material, casing material, operating components specifications, etc.)
  - .7 Maintenance requirements.

- .8 Use the technical specifications of the equipment in this specification as a checklist to show compliance/non-compliance.

## **1.5 Tender Inquiries**

- 1.5.1 Contractor queries during tender period shall be made in writing to Consultant. Contractor queries will be collected and suitable addenda issued for clarification. No verbal information will be issued by Consultant's office during tender. Tender queries may be emailed, mailed, or couriered to Consultant's office. No telephone questions will be answered.

## **1.6 Equipment List/Sub-Trades**

- 1.6.1 Unless requested otherwise, submit within seven days of contract award a list naming Sub-Contractors and Manufacturers of equipment to be used.
- 1.6.2 Equipment list shall be full list of materials intended for installation.

## **1.7 Detailed Price Breakdown**

- 1.7.1 Provide to Consultant within 30 days of award of Contract, separate materials and labour breakdown. Progress payments shall not be processed until breakdown is received as follows:
  - .1 Project start-up costs (shop drawings, permits, etc.).
  - .2 Insulation and firestopping.
  - .3 Vibration isolation.
  - .4 Seismic bracing.
  - .5 Plumbing.
  - .6 Commissioning.
  - .7 Fire protection.
  - .8 Hot water heating.
  - .9 Sheet metal.
  - .10 Controls.
  - .11 Verification of control systems.
  - .12 Balancing of air and water systems.
  - .13 Equipment and systems testing.
  - .14 Maintenance Manuals and Record Drawings.
- 1.7.2 Contractor to provide materials and labour breakdown for each point listed on Consultant's change notice. Contractor also to receive same from affected Sub-Trades and submit their breakdown. Additional information to be provided as per Consultant's request.

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**1.8 Responsibilities**

- 1.8.1 Responsibility as to Division providing equipment or materials rests solely with General Contractor. Extras shall not be considered based on difference in interpretation of specifications as to which trade provides certain equipment or materials.
- 1.8.2 Visit site before tendering. Examine local and existing conditions on which work is dependent. No consideration will be granted for any misunderstanding of work to be done resulting from failure to visit site.
- 1.8.3 Ensure equipment does not transmit noise and/or vibration to other parts of building, as a result of poor installation practice.
- 1.8.4 Where Contract Documents do not contain sufficient information for proper selection of equipment for bidding, notify Consultant during tendering period.
- 1.8.5 Examine Consultants' (architectural, code, landscape, structural, civil, electrical, food services) drawings plus Code Consultant's report and work of other trades to ensure work can be carried out. Conflicts or additional work not covered by drawings and specifications shall be brought to attention of Consultant before start of work.
- 1.8.6 During freezing weather, protect materials such that no harm can be done to installations already in place and/or to materials and equipment on project.
- 1.8.7 On completion of work, tools and surplus waste materials shall be removed and work left clean and operating correctly.
- 1.8.8 Advise Consultant of specified equipment, material or installation which violates laws, ordinances or regulations.

**1.9 Coordination and Supervision**

- 1.9.1 Employ FULL-TIME superintendent until total completion and defects and deficiencies are rectified. An amount of **\$6,000.00** will be included in addition to deficiency holdback at substantial completion to ensure full-time superintendent remains on site until work is certified totally performed.
- 1.9.2 Check drawings of trades to verify space and headroom limitations for work to be installed. Coordinate work with trades and make changes to facilitate satisfactory installation.
- 1.9.3 Drawings are diagrammatic and approximately to scale unless detailed otherwise. They are not intended to show structural details or architectural features. Contract Documents establish scope, material and installation quality and are not detailed installation instructions.

- 1.9.4 Install distribution systems and equipment generally in locations and routes shown, close to building structure avoiding interference with other services or free space.
- 1.9.5 Work out interference problems on site with other trades and coordinate work before fabricating or installing any material or equipment. Where necessary, produce interference drawings. Ensure materials and equipment fit into allotted spaces and equipment can be properly serviced and replaced. Extras for improper coordination and removal of equipment to permit remedial work shall not be considered.
- 1.9.6 When open web structural joists are used, obtain structural shop drawings to ensure adequate space is available for installation of pipes and ductwork.
- 1.9.7 Coordinate with other divisions including, but not limited to the following:
  - .1 Electrical requirements for mechanical equipment and devices requiring electrical power and connection to fire alarm/annunciator panels for mechanical equipment.
  - .2 Mechanical services connection locations with kitchen, laundry and irrigation equipment.
- 1.9.8 Mechanical Contractor shall provide following services:
  - .1 Coordinate mechanical work.
  - .2 Follow up on material and equipment deliveries, review shop drawings and produce interference drawings.
  - .3 Ensure Sub-Trades are installing work properly.
  - .4 Ensure interconnecting phases with Mechanical are covered.
  - .5 Review cost breakdown, progress claims and cost submissions for mechanical work.
  - .6 Resolve and direct responsibility for warranty.
  - .7 Provide digital photographs of progress as specified.

#### **1.10 Inspection of Work**

- 1.10.1 Consultant Representative shall review work prior to being concealed. Piping below ground must be reviewed prior to covering.
- 1.10.2 Work shall be approved by authorities having jurisdiction.
- 1.10.3 Openings shall be sealed, in particular in fire rated walls and floors. Sealing shall be inspected prior to covering.

#### **1.11 Permits**

- 1.11.1 Obtain required permits and pay fees and comply with Provincial, Municipal and other legal regulations and bylaws applicable to work.

- 1.11.2 Arrange for inspection of work by authorities having jurisdiction. On completion of work, furnish final unconditional certificates of approval by inspecting authorities.
- 1.11.3 Contractors and Sub-Contractors responsible for installation of smoke control and sprinkler systems shall be made available to demonstrate sequence of operation and interconnection with other life safety/fire protection systems at coordinated site inspection with Authority Having Jurisdiction for occupancy permit.

#### **1.12 Codes, Regulations and Standards**

- 1.12.1 Mechanical work shall conform to the following codes, regulations and standards, and other codes in effect at time of award of Contract, and any others having jurisdiction. The applicable version of each code and standard shall apply unless otherwise specified in the contract documents:
  - .1 Bylaws.
    - .1 Local Building Bylaws.
  - .2 Canadian Council on Animal Care.
    - .1 Guide to the Care and Use of Experimental animals.
  - .3 Canadian Gas Association.
    - .1 National Standard of Canada CAN/CGA-B149.1 (latest edition). - Natural Gas Installation Code.
    - .2 National Standard of Canada CAN/CGA-B149.2-M95. - Propane Installation Code.
  - .4 SMACNA Publications
    - .1 HVAC Duct Construction Standards.
    - .2 Fire, Smoke and Radiation Damper Installation Guide.
    - .3 Guidelines for Seismic Restraints of Mechanical Systems.
- 1.12.2 Where specifications specifically indicate requirements more onerous than indicated codes, these requirements shall be incorporated.

#### **1.13 Warranty**

- 1.13.1 Equipment and systems shall be warrantied for one year. Provide written certifications to Owner. Provide extended warranty certificates on equipment as applicable and specified.
- 1.13.2 Use of equipment or systems during construction shall not alter warranty period or represent acceptance of work or equipment.
- 1.13.3 Warranty coverage shall include labour and material to correct defective equipment, workmanship, material and building damage caused by failure of same.

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1.13.4 Warranties shall be effective from date of Substantial Completion.

**1.14 Workmanship**

1.14.1 Workmanship shall be in accordance with established practice and standards accepted and recognized by Consultant and Contractor.

1.14.2 Tradesmen engaged in installation of work covered within Mechanical shall be qualified in accordance with requirement of Tradesmen Qualification Act and pertinent licensing requirement required by Ministry of Municipal Affairs.

**1.15 Performance Verification of Installed Equipment**

1.15.1 Installed mechanical equipment may be subject to performance verification as specified herein if required by Consultant.

1.15.2 When performance verification requested, equipment shall be tested to determine compliance with specified performance requirements.

1.15.3 Consultant will determine by who shall carry out testing. When requested, Contractor shall arrange for services of independent testing agency.

1.15.4 Testing procedures shall be reviewed by Consultant.

1.15.5 Maintain building comfort condition when equipment removed from service or testing purposes.

1.15.6 Promptly provide Consultant with test reports.

1.15.7 Should test results reveal that originally installed equipment meets specified performance requirements, Owner will pay costs resulting from performance verification procedure.

1.15.8 Should test results reveal equipment does not meet specified performance, equipment will be rejected and the following shall apply:

- .1 Remove rejected equipment. Replace with equipment which meets requirements of Contract Documents, including specified performance requirements.
- .2 Replacement equipment may be subject to performance verification as well, using same testing procedures on originally installed equipment.
- .3 Contractor shall pay costs resulting from performance verification procedure.

**1.16 Drawings and Measurements**

1.16.1 Drawings are diagrammatic and are intended to indicate scope and general arrangement of work and are not detailed installation drawings. Do not scale drawings. Obtain accurate dimensions from Architectural and Structural drawings.

1.16.2 Consult Architectural drawings and details for exact locations of fixtures and equipment. Obtain this information from Consultant where definite locations are not indicated.

1.16.3 Take field measurements where equipment and material dimensions are dependent upon building dimensions.

**1.17 Interference Drawings**

1.17.1 Provide interference check Revit model to indicate coordination with other trades on site has been carried out, conflicts identified and resolutions found.

**1.18 Shop Drawings**

1.18.1 Submit shop drawings in the format and quantity specified in the general conditions for all equipment indicated and proposed for as ACCEPTABLE PRODUCT in the section where they are specified or in the equipment schedules. A comprehensive listing of mechanical equipment and materials complete with the expected submission dates shall be submitted to Consultant within 30 days of contract award. Consultant reserves right to modify list.

1.18.2 Shop drawings shall be submitted in electronic (PDF) form as discussed with Consultant in accordance with Guidelines on Shop Drawings including the following information:

- .1 Cover sheet.
- .2 Physical and dimensional data.
- .3 Service space requirements.
- .4 Electrical requirement data.
- .5 Performance data.
- .6 Manufacturers' specifications.
- .7 Installation instructions.
- .8 Starting instructions.
- .9 Maintenance instructions.
- .10 Operating instructions.

1.18.3 Fan and pump submissions shall include performance curves (charts are not acceptable).

1.18.4 Include radiated, discharge and inlet sound power levels for major pieces of mechanical equipment.

1.18.5 Do not include non-applicable information. Non-applicable information shall be removed entirely or crossed out from shop drawing.

1.18.6 Cover sheet shall include the following information:

- .1 Title, number of pages, Contractor, Supplier, Manufacturer, date of submission.



- .2 Place for Consultant's review stamp 4" (100 mm) x 3" (80 mm).
  - .3 Related parties involved in Contractor's pre-submission review (Mechanical and General Contractors).
  - .4 Related parties involved in Consultant's review.
  - .5 Area allocated for comments.
- 1.18.7 Maintain one complete copy of reviewed shop drawings on site in indexed 3-ring binder.
- 1.18.8 Shop drawings not prepared as described above shall not be reviewed by Consultant.
- 1.18.9 Do not order equipment or materials until shop drawings have been accepted by Consultant.
- 1.18.10 Related mechanical equipment and materials shall be submitted together (e.g. coils, heat exchangers, glycol pump, furnaces complete with cooling coil and condensing unit). Shop drawings not properly submitted with related equipment shall be held until related shop drawings submitted.
- 1.18.11 Submit in Imperial (SI Metric) units to match those specified.
- 1.18.12 Consultant's review of shop drawings shall not relieve Contractor from compliance with specified requirements. Installed materials and equipment shall meet specified requirements whether or not shop drawings are reviewed by Consultant.
- 1.18.13 Shop drawing review by Consultant shall provide the following certification: "Reviewed for general design and compliance with the contract documents. Dimensions and suitability for site condition are the responsibility of the Contractor. Coordinate electrical requirements with the Electrical Contractor. This review of drawing shall not relieve the Contractor from complying with the conditions of the contract documents."

#### **1.19 Duct and Pipe Mounted Control Equipment**

- 1.19.1 The following automatic control equipment will be supplied by Controls Contractor but installed by appropriate trade sections of Mechanical Contract:
- .1 Automatic control valves.
  - .2 Temperature control wells.
  - .3 Pressure tapings.
  - .4 Flow switches.
  - .5 Automatic control dampers.
  - .6 Static pressure sensors.
  - .7 Water check meters.
  - .8 Gas check meters.

- .9 BTU meters.

**1.20 Spare Parts**

1.20.1 Provide spare parts as follows:

- .1 One set of packing for each pump.
- .2 One casing joint gasket for each size pump.
- .3 One head gasket for each heat exchanger.
- .4 One glass for each gauge glass installed.
- .5 One set of V-belts for each piece of machinery.
- .6 One filter cartridge for each filter installed (pre- and final filters).

**1.21 Project Close-Out Requirements**

1.21.1 The project closeout requirements are specifically listed in each section of this specification. Refer to detailed specifications in each section for further, detailed requirements.

**1.22 Semi Final Inspection**

1.22.1 Perform the following before semi-final field review:

- .1 HVAC systems capable of operation with automatic controls in operation with alarms functional.
- .2 Tests on systems and equipment completed and certificates of approval obtained from Authorities.
- .3 Rough balance of **air** and **water** systems completed.
- .4 Firestopping completed. Refer to Section 23 05 05 Firestopping for firestop requirements.
- .5 Valve tagging completed and equipment, ductwork and piping identified. Escutcheons installed.
- .6 Equipment lubricated in accordance with Manufacturer's data.
- .7 Extended warranty form mailed to Manufacturer and copy provided to Owner.
- .8 Systems chemically cleaned and flushed, strainers cleaned and water treatment initiated. Equipment drains installed. Manufacturer's report on acceptability of treatment obtained.
- .9 Submit sample of Operating and Maintenance Manuals. [Arrange for Operation and Maintenance Instruction Seminar and submit schedule for approval.]
- .10 Ensure access doors suitably located and equipment accessible.
- .11 Written report submitted by Manufacturer's Representative on noise and vibration control devices including flexible

- connections. **Equipment alignment carried out by qualified millwright and certified report submitted.**
- .12 Seismic sway bracing and restraint systems installed.
  - .13 Check operation of plumbing systems and fixtures. Ensure fixtures are solidly supported.
  - .14 Fan plenums cleaned and permanent filters installed.
  - .15 Ensure electrical connections to mechanical equipment are complete and motor rotation correct.
  - .16 For packaged, self-contained HVAC equipment, Manufacturer's checkout list completed. Copies forwarded to Consultant and included in Maintenance Manuals.
  - .17 Turn all digital photography files over to Consultant with dates of photos and locations taken from.
  - .18 Verify that documentation for LEED® credits is complete.

### **1.23 Substantial Completion Requirements**

1.23.1 Consultant shall issue checklist for completion by Contractor before Substantial Completion Field Review. Provide written declaration that work is complete. The following items shall be complete before Substantial Completion Field Review:

- .1 Piping expansion compensators and flexible connections checked by Supplier – inspection report filed with Commissioning Agent.
- .2 Seismic restraints inspected by Suppliers' Professional Engineer and report has been filed with Commissioning Agent. Schedule S Letter of Assurance from Seismic Engineer submitted.
- .3 All access doors and panels are in place and not painted closed.
- .4 HVAC piping systems have been cleaned, flushed and all final strainer baskets are in place. Provide copy of test reports.
- .5 Steam piping has been cleaned, flushed and inspected for operational readiness.
- .6 Steam and pressure piping system As-builts submitted and complete with registration forms filled out for submission to Provincial Boiler and Pressure Vessel Authorities.
- .7 Boiler(s) started and efficiency checks performed by factory trained personnel, with start-up checklists and test sheets submitted and filed with the Commissioning Agent.
- .8 Chiller start-up sheets and performance check has been done by Suppliers' representative, reports file with Commissioning Agent.
- .9 Atrium smoke exhaust system has been tested and verified.

- .10 Exit Stair vestibule pressurization fans have been tested and verified.
  - .11 Ductwork has been cleaned, provide letter of verification to Commissioning Agent and this Consultant.
  - .12 Draft balancing reports have been submitted to this consultant.
  - .13 Commissioning Checklists for operational readiness and safety checks have been submitted to this Consultant.
  - .14 Controls pre-operational readiness checklists (end to end checks and sequences of operation) have been verified and submitted to this Consultant.
  - .15 All control devices have been calibrated and checked for proper operation. Submit report through Commissioning Agent.
  - .16 Final draft Mechanical Maintenance Manuals have been submitted for review to this Consultant.
  - .17 Draft Record drawings (marked up whiteprints or ACAD files) have been submitted to this Consultant for review.
  - .18 The most recent Site Review (inspection) Report has been re-submitted to this Consultant with all outstanding items either crossed off and initialled as "Done", and outstanding items noted with "Time to Complete" or "by others" with a clear statement of who the "others" are and that they have been alerted to perform the rectification of the deficient work.
  - .19 Confirmation that training sessions have been arranged and set up for the Owners' operating personnel for Controls and Systems Operation.
  - .20 Final certification of all medical gas systems has been performed and Certification Package from testing Agency has been forwarded to the Consultant.
  - .21 Refer to requirements in Section 21 05 06 and Section 22 05 00 for plumbing and fire protection systems.
- 1.23.2 Complete the Substantial Completion Checklist as attached as Appendix "A" of this section.
- 1.23.3 Complete Residential Unit Completion Checklist as attached as Appendix "B" of this Section for each residential unit and submit prior to requesting Substantial Completion.

#### **1.24 Deficiency Holdbacks and Deficiency Inspections**

- 1.24.1 Work under this Division, which is still outstanding when substantial completion is certified, will be considered deficient and a sum equal to minimum twice the estimated cost of completing that work will be held back.

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## 2. PRODUCTS

### 2.1 Operating and Maintenance Manuals

- 2.1.1 Acceptable Agencies: MDT, KD Engineering Ltd., Western Mechanical Services, Inland Technical Services.
- 2.1.2 Provide services of acceptable agency to prepare proper documentation and instruction to Owner in operation and preventative maintenance of mechanical equipment and systems. Complete and turn over documentation two months before Substantial Completion. Provide proposed table of contents and first draft of General Systems Description to the consultant for review prior to preparing full O&M Binders.
- 2.1.3 Provide three 8.5" (215 mm) x 11" (275 mm) catalogue binders with hot stamped lettering front and spine. One copy of final manuals to remain with Consultant during warranty period.
- 2.1.4 Provide electronic format for Maintenance Manuals as well as hard copy, to contain all of the same content as the hard copy. The electronic format shall be arranged in a searchable, segmented format using PDF format with both Table of Contents linking and Bookmark formatting. Scanned material will not be accepted. Where possible and as available, include Maintenance and Operation videos from equipment Suppliers and Manufacturers that demonstrate Maintenance procedures.
- 2.1.5 Each binder shall be indexed with custom made tab dividers (9 point oriole Bristol divider paper stock) with sequentially numbered colour index tabs of laminated Mylar plastic as available from Tab colours shall be orange for 1.0, 1.1, 1.2, 1.2 ... series tabs, green for 2.0, 2.1, 2.2... series tabs, yellow for 3.0, 3.1, 3.2... series tabs, red for 4.0, 4.1... series tabs. The following indexing system shall be used:
  - .1 Tab 1.0 - Mechanical Systems: title page with clear plastic protection cover.
  - .2 Tab 1.1 - List of Mechanical Drawings: provide list of mechanical drawings.
  - .3 Tab 1.2 - Description of Systems: provide description of each system with summer or winter operating variances and controller operating setpoints.
  - .4 Tab 1.3 - Operating Division: provide operating description of each major component and how components interface with other components, operation of controls including operational sequences for summer or winter, troubleshooting sequences and safeguards to check if equipment goes offline.
  - .5 Tab 1.4 - Maintenance and Lubrication Division: provide preventative maintenance and lubrication schedule for each major component including weekly, monthly, semi-annual an

maintenance schedule requirements or pneumatic, electronic and DDC systems.

- .6 Tab 1.5 - List of Equipment Suppliers and Contractors: provide list of equipment suppliers and Contractors, including addresses and telephone numbers. Furnish list of spare parts for each piece of equipment such as bearings, seals v-belts, filters, etc.
  - .7 Tab 2.0, 2.1, etc. - Certification: provide copies of WHMIS safety data sheets. Include copy of test data, cleaning and chemical treatment program, analysis of system water taken at time system was put into operation, hydrostatic or air tests performed, equipment alignment certificates, copy of valve tag and pipe colour identification schedules and inspection approval certificates for plumbing and natural gas systems.
  - .8 Tab 3.0, 3.1, etc. - Shop Drawings and Maintenance Bulletins: provide materials received in compliance with Shop Drawings.
  - .9 Tab 4.0 - Balance Reports: provide copies of balance reports.
- 2.1.6 Submit documents to Consultant for review before turning over to Owner.
- 2.1.7 Obtain shop drawing information for Mechanical equipment and include in appropriate section.

## **2.2 Record Drawings and Digital Photographs**

- 2.2.1 Digital photographs of project shall be taken before covering or concealing underground piping and/or service in walls, concealed ceilings, furring or shafts. Photographs shall be emailed to the Consultant at **bhavin.degadwala@introba.com** with the Consultant's job number and project name clearly indicated on the email. Identify each photo with the date and location the photograph was taken from within the same email.
- 2.2.2 Prior to each FIELD REVIEW, the Contractor shall ensure one set of white prints clearly marked (for Consultant inspection) indicating any changes and deviations from Contract Documents, including any work by change orders and job instructions plus:
- .1 Alterations to ductwork, piping, mechanical equipment and associated work.
  - .2 Inverts of services at key points within building, entering and leaving building and at property line. Dimension to services in relation structure and building, entering and leaving building grid lines for buried services, manholes, catch basins and outside shutoff valves.
  - .3 Locations of concealed piping, conduit and equipment such as fire dampers, cleanouts, service valves and access doors.

- 2.2.3 If the marked up white prints are not available for inspection, 5% of the progress payment is automatically deducted.
- 2.2.4 Before substantial completion, turn marked up white prints (Record Drawings) over to consultant for Record Drawings. Include a cash allowance of **\$100.00** per sheet for the consultant to transfer marked up site changes to **REVIT** files, and for providing two sets of record drawings and electronic **REVIT** to the Owner. The contractor may provide the **REVIT** record drawings at their own cost under this cash allowance in lieu of having the consultant provide the **REVIT** services but only with the written acceptance from the consultant.

### 2.3 Access Doors

- 2.3.1 Acceptance Products: Zurn, Wade, Acudor, Can-Aqua, Milcor, Maxam, Van-Met.
- 2.3.2 Supply flush mounted access doors, for installation in ceilings and walls, to permit servicing of mechanical equipment and accessories, inspection of life safety or operating devices, and where specifically indicated.
- 2.3.3 Unless otherwise noted, access doors shall be minimum: 24" (600 mm) x 24" (600 mm) for body entry, 12" (300 mm) x 12" (300 mm) for hand entry, 8" (200 mm) x 8" (200 mm) for cleanout access. Access doors in building surfaces shall be at least as large as duct access panels accessed through them and shall be oversized when necessary. Size to suit masonry modules when located in masonry wall.
- 2.3.4 Locate access doors so concealed items are readily accessible for adjustment, operation and maintenance. Locate in service and storage areas wherever possible. Do not locate in paneled, feature or special finish walls, without prior approval of Consultant.
- 2.3.5 Access doors in fire separations of  $\frac{3}{4}$  hour rating and higher, and firewalls shall have compatible fire rating and ULC label with tamper-proof latch and be self-closing.
- 2.3.6 Minimum Requirements:
  - .1 180 degree door swing, mitered rounded safety corners flush welded, concealed hinges, screwdriver latches, and anchor straps or lugs to suit construction, steel prime coated.
  - .2 Plaster or wet wall construction: 14 ga (1.99 mm) bonderized steel flush with wall or ceiling type with concealed flange.
    - .1 Acceptable Product: Acudor PS-5030.
  - .3 Drywall construction in **all** areas only: 16 ga (1.61 mm) for 16" (400 mm) x 16" (400 mm) and smaller, 14 ga (1.99 mm) for 18" (450 mm) x 18" (450 mm) and larger bonderized steel face of wall type with concealed flange.
    - .1 Acceptable Product: Acudor DW-5040.

- .4 Masonry construction in all areas: 16 ga (1.61 mm) for 16" (400mm) x 16" (400mm) and smaller, 14 ga (1.99mm) for 18" (450mm) x 18" (450mm) and larger bonderized steel face of wall type with exposed flange.
  - .1 Acceptable Product: Acudor UF-5000.
- .5 Tile, ceramic tile, marble, terrazzo, plaster or wet wall construction in washrooms and other special areas: 14 ga (1.98 mm) stainless steel flush with wall or ceiling with concealed flange.
  - .1 Acceptable Product: Acudor PS-5030 stainless.
- .6 Acoustical tile ceiling and similar block materials: 14 ga (1.99 mm) bonderized steel recessed ceiling type.
  - .1 Acceptable Product: Acudor AP-5010 or AT-5020.
- .7 Feature wall construction: Recessed wall type selected to complement and conform with architectural module, treatment, or paneling, size shall conform to adjacent finished areas.

### 3. **EXECUTION**

#### 3.1 **Concealment**

- 3.1.1 Conceal piping, ductwork and conduit in partitions, walls, crawlspaces and ceiling spaces, unless otherwise noted.
- 3.1.2 Do not install piping and conduit in outside walls or roof slabs unless specifically indicated. When required, install them inside the building insulation.

#### 3.2 **Access**

- 3.2.1 Install work to be readily accessible for adjustment, operation and maintenance. Furnish access doors where required in building surfaces for installation by building trades.
- 3.2.2 Provide  $\frac{3}{4}$ " (20 mm) diameter brass/aluminum/stainless steel number tags or "Allflex" plastic tags with type or service and valve number stamped in black, secured to valve wheel with key chain for all valves. Provide typewritten valve directory giving number, service and location. For valves hidden in suspended ceilings, provide flexible plastic film with permanent pressure-sensitive adhesive type label on the ceiling grid indicating location of valves. Include in Maintenance Manuals and under glass, wall mounted, location determined by Consultant.



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**3.3 Protection of Work**

- 3.3.1 Protect equipment and materials, stored or in place, from weather, moisture, dust and physical damage.
- 3.3.2 Mask machine surfaced finishes and edges. Secure covers over equipment openings and open ends of piping, ductwork and conduits, as installation progresses.
- 3.3.3 Equipment having operating parts bearing on machined surfaces, showing signs of rusting, pitting or physical damage will be rejected.
- 3.3.4 Refinish damaged or marred factory finish.
- 3.3.5 Air systems shall have temporary air filters installed before fans are operated. Install new air filters before system acceptance.

**3.4 Cutting, Patching, Digging, Canning and Coring**

- 3.4.1 Lay out cutting, patching, digging, canning and coring required to accommodate mechanical services. Coordinate with other Divisions.
- 3.4.2 Refer to Structural drawings for permissible locations of openings and permissible opening sizes in concrete floors and walls. Openings through Structural members shall not be made without approval of Consultant.
- 3.4.3 Be responsible for correct location and sizing of openings required under Mechanical, including pipe sleeves and duct openings. Allow oversized openings for fire dampers and pipe penetrations where insulation is specified.
- 3.4.4 Verify location of existing service runs and steel reinforcing within existing concrete floor and walls prior to core drilling and/or cutting. Cost of repairs to existing services and structural components damaged as a result of core drilling and cutting will not be considered.

**3.5 Fastening to Building Structure (also refer to Section 23 05 29 Hangers and Supports for HVAC Piping and Equipment.**

- 3.5.1 General:
  - .1 Do not use inserts in base material with compressive strength less than 2,000 psi (13,790 kPa). **Refer to structural drawings**
  - .2 Inserts shall have factor of safety of 4.
  - .3 Power/powder actuated fastenings and drop-in anchors are not permitted to be used for tensile loading (i.e. suspension of mechanical equipment) or for seismic anchorage and/or restraint.
- 3.5.2 Types:
  - .1 Cast-in-place type:

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- .1 Channel type - Burndy, Canadian Strut, Unistrut, Cantruss or Hilti Channel.
  - .2 Cast-in Anchor: Hilti KCM-WF and KCM-PD.
  - .3 Wedge type galvanized steel concrete insert, Grinnell Fig. 281 for up to 8" (200 mm) pipe size.
  - .4 Universal type malleable iron body insert, Grinnell Fig. 282 for up to 8" (200 mm) pipe size.
  - .5 Screw concrete insert, Grinnell Fig. 152 for up to 12" (300 mm) pipe size.
  - .2 Drilled, mechanical expansion type:
    - .1 Hilti HSL-3 or UCAN LHL heavy duty anchor for using in concrete with compressive strength not less than 2,840 psi (19.6 kPa).
    - .2 Hilti Kwik-Bolt-3 or UCAN WED stud anchor for concrete (do not use in seismic restraint applications).
    - .3 Hilti HDI or UCAN IPA drop-in anchor for concrete. Wherever possible, HDI's or drop-in anchors shall be avoided in tension zones of concrete (i.e. underside) due to cracking of concrete and reduced holding value.
    - .4 Hilti or UCAN Sleeve Anchor (medium and light duty) for concrete and masonry.
    - .5 Hilti Metal-HIT or UCAN Zamac pin bolt (light duty) for concrete and masonry
  - .3 Drilled, adhesive type:
    - .1 Hilti HVA or UCAN Adhesive Anchor consisting of anchor rod assembly with a capsule containing a two-component adhesive, resin and hardener.
    - .2 Hilti HY150- MAX-SD or RE500-SD consisting of anchor rod with a two part adhesive system.
    - .3 For use in concrete housekeeping bases (in vertical downward position) where distance to edge of concrete base could cause weakness if mechanical expansion type anchor were used.
    - .4 Rod assemblies shall extend minimum 2" (50 mm) into concrete slab below housekeeping bases.

### 3.5.3 Installation:

- .1 Drilling for inserts shall be performed using appropriate tool specifically designed for insert. Diameter and depth of each drilled hole shall be exact dimensions as specified by insert Manufacturer.
- .2 Refer to Manufacturer's recommendations for tightening torques to be applied to inserts.

- .3 Where specifically called for, drills shall include a dust vacuum system, Hilti DRS Dust Vacuum System.

**3.6 Service Penetrations in Rated Fire Separations**

- 3.6.1 Refer to Section 23 05 05 Firestopping for firestop requirements.

**3.7 Service Penetrations in Non-Rated Separations**

- 3.7.1 Piping, tubing, ducts, wiring, conduits, etc. passing through non-rated fire separations and non-rated walls and floors shall be tightly fitted and sealed on both sides of separation with silicon sealant to prevent passage of smoke and/or transmission of sound.
- 3.7.2 For compliance with LEED IEQ Pre-Requisite 2 – Environmental Smoke Control – A blower door test shall be conducted in accordance with ANSI/ASTM-E779-03, Standard Test Method for Determining Air Leakage Rate By Fan Pressurization and a progressive sampling methodology as defined in Chapter 4 (Compliance Through Quality Construction) of the Residential Manual for Compliance with California's 2001 Energy Efficiency Standards. Individual suite units must demonstrate an Equivalent Normalized Leakage Area of less than 1.65cm<sup>2</sup>/m<sup>2</sup> of enclosure area as per Can/CGSB-149.10-M86 calculation methodology.

**3.8 Pipe Sleeves**

- 3.8.1 Provide pipe sleeves for piping passing through rated walls and floors. Sleeves shall be concentric with pipe.
- 3.8.2 Pipes and ducts passing through fire rated separations that have no fire resistance (non-rated separations) do not require sleeve, but insulation at separation shall be wrapped with 24 ga (0.70 mm) thick galvanized sheet steel band for application of flexible caulking compound.
- 3.8.3 Pipe sleeves for floors and interior walls shall be minimum 24 ga (0.70 mm) thick galvanized sheet steel with lock seam joints.
- 3.8.4 Seal penetrations through aboveground exterior walls, and underground exterior walls and slabs including slabs on grade, where no hydrostatic pressure exists, with flexible, non-hardening, weatherproof caulking compound. Seal around exterior circumference of sleeves and annular space between pipes and sleeves.
- 3.8.5 Pipe sleeves for perimeter walls and foundation walls shall be cast-iron sleeve or Schedule 40 steel pipe with annular fin continuously welded at midpoint and protruding 6" (150 mm) beyond sleeve diameter. Annular fin shall be embedded into centre of wall.
- 3.8.6 Provide Link Seal wall gasket to seal exposed sides of opening between pipe and sleeve on foundation walls with caulking fill. Provide water proofing mastic seal on concealed side of opening.

- .1 Acceptable Sealing Products: Garlock Link-Seal, Metraflex MetraSeal.
- 3.8.7 Pipe sleeves for wet or wash down floor areas such as washrooms, janitors rooms, laboratories and mechanical equipment rooms shall be Schedule 40 steel pipe.
- 3.8.8 Except as otherwise noted, pipe sleeves are not required for holes formed or cored in interior concrete walls or floors.
- 3.8.9 Pipe sleeves shall extend 2" (50 mm) above floors in unfinished areas and wet areas and ¼" (6.0 mm) above floors in finished areas.
- 3.8.10 Pipe sleeves shall extend 1" (25 mm) on each side of walls in unfinished areas and ¼" (6.0 mm) in finished areas.
- 3.8.11 Pipe sleeves shall extend 1" (25 mm) beyond exterior face of building. Caulk with flexible caulking compound.
- 3.8.12 Sleeve Size: ½" (15 mm) clearance all around, between sleeve and pipe or between sleeve and pipe insulation.
- 3.8.13 Paint exterior surfaces of ferrous sleeves with heavy application of rust inhibiting primer.
- 3.8.14 Packing of Sleeves:
  - .1 Where sleeves pass through foundation walls and perimeter walls, space between sleeve and pipe or between sleeve and pipe insulation shall be caulked with waterproof fire retardant non-hardening mastic.
  - .2 Pack future-use sleeves with mineral wool insulation and then seal with ULC approved fire stop sealant for rated fire separations.

### **3.9 Escutcheons and Plates**

- 3.9.1 Provide on pipes passing through finished walls, partitions, floors and ceilings.
- 3.9.2 Plates shall be stamped steel, split type, chrome-plated or stainless steel concealed hinge, complete with springs, suitable for external dimensions of piping insulation. Secure to pipe or finished surface. For pipes passing through suspended ceilings and annulated piping passing through walls, outside diameter shall cover opening or sleeve.
- 3.9.3 Where pipe sleeve extends above finished floor, escutcheons or plates shall clear sleeve extension.

### **3.10 Equipment Supports**

- 3.10.1 Provide stands and supports for equipment and materials supplied.
- 3.10.2 Lay out concrete bases and curbs required under Mechanical. Coordinate with Division 3. All concrete work is under Division 3.

- 3.10.3 Concrete bases shall be minimum 4" (100 mm) thick, or as noted and shall project at least 6" (150 mm) outside bedplate, unless otherwise directed. Bases and curbs shall be keyed to floor and incorporate reinforcing bars and/or steel mesh. Chamfer edges of bases.
- 3.10.4 Equipment with bedplates shall have metal wedges places under edges of bedplates to raise them 1" (25 mm) above base after levelling. Wedges shall be left permanently in place. Fill space between bedplate and base with non-shrink grout - Embeco or In-Pakt.
- 3.10.5 Construct equipment supports of structural steel or steel pipe. Securely brace. Employ only welded construction. Bolt mounting plates to structure.
- 3.10.6 Support ceiling hung equipment with rod hangers and/or structural steel.

### **3.11 Equipment Installation**

- 3.11.1 Provide unions, grooved couplings and flanges to permit equipment maintenance and disassembly and to minimize disturbance to piping and duct systems and without interfering with building structure or other equipment.
- 3.11.2 Provide means of access for servicing equipment including permanently lubricated bearing.
- 3.11.3 Pipe equipment drains to floor drains
- 3.11.4 Line up equipment, rectangular cleanouts and similar items with building walls wherever possible.

### **3.12 Mechanical and Electrical Coordination of Responsibilities**

- 3.12.1 All starters motor control centres, etc., along with input and output power wiring shall be by the Electrical Contractor. This is with the exception of packaged equipment.
- 3.12.2 Packaged equipment shall have integral starters and only power feeders will be provided. The packaged equipment starters shall be provided by the Mechanical Contractor.
- 3.12.3 Electrical Contractor shall provide all remote disconnect switches.
- 3.12.4 All control wiring (including BAS), except fire alarm, shall be provided by the Mechanical Contractor. This also includes Mechanical 120 volt control wiring, and interlock, and control wiring between controls transformers and low voltage terminal equipment, including infrared flushometers and transformers.
- 3.12.5 Unless specifically noted otherwise, voltage for motors ½ HP and larger shall be 600 V 3-phase, and voltage for motors smaller than ½ HP shall be 120 V single-phase or 208 V 1- or 3-phase.

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- 3.12.6 All multi-speed motors shall be consequent pole, permanent split capacitor type unless specifically noted otherwise (e.g. electronically-commutated motors).
- 3.12.7 All motors for mechanical equipment shall be by the Mechanical Contractor.
- 3.12.8 Thermistor protection to be provided on motors 25 HP and larger using approved thermistors as part of the Mechanical Scope of Work.
- 3.12.9 Thermistors will be provided by Mechanical Contractor.
- 3.12.10 Electrical Contractor shall provide manual reset devices for motor starters for thermistor interface (only for starters that are provided by Electrical Contractor).
- 3.12.11 All fire alarm work shall be done by the Electrical Contractor. Electrical Contractor shall provide all relays for interface to control wiring for fan shutdown and fan start-up for air handling units used as part of the smoke control system(s) and any other hard-wired mechanical components connected for fire alarm interlocks.
- 3.12.12 Electrical Contractor shall wire smoke dampers with end switches to reflect open and closed status.
- 3.12.13 All end switches shall be provided by the Mechanical Contractor.
- 3.12.14 Electrical Contractor shall wire EP switches for smoke damper control. Life safety control wiring and relays to interface to general control wiring shall be provided by the Electrical contractor (refer to Mechanical Specification for type of smoke dampers that have been specified).
- 3.12.15 All relays required for Mechanical work shall be provided by the Mechanical Contractor.
- 3.12.16 Mechanical Contractor shall provide all pressure switches, supervisory valves, flow switches, dry pipe alarm valves, etc. for interface to fire alarm system. All wiring of these items shall be provided by the Electrical Contractor.
- 3.12.17 All electric tracing shall be by the Mechanical Contractor with power connections by the Electrical Contractor. All electric tracing shall be 208 V unless specifically noted otherwise. All electric tracing shall be self-limiting type of cable. Mechanical Contractor shall provide loads for the circuits to the Electrical Contractor for connection requirements.
- 3.12.18 Electric Resistance Heaters
- .1 All standalone electric heaters shall be supplied by the Mechanical Contractor and installed by the Electrical Contractor. Mechanical Contractor shall provide any form work for recessed heaters.

- .2 All standalone electric heaters (e.g. baseboard or force-flow) shall be supplied by the Electrical Contractor and installed by the Electrical Contractor. Mechanical Contractor shall provide any duct- or pipe-mounted heaters such as electric duct heaters or electric boilers.
- 3.12.19 All level switches for sump pumps shall be wired by the Mechanical Contractor.
- 3.12.20 Variable speed motor drive controllers and motors shall be installed by the Mechanical Contractor and be complete with load and line side filters/reactors.
  - .1 The controller shall be specified with the following characteristics:
    - .1 Line side voltage distortion shall not exceed 3%.
    - .2 Line side current distortion shall not exceed 10%.
    - .3 Line and load sides shall be provided with chokes to prevent any transient or harmonic distortion being backfed into the main power supply. Provide a 5% reactor on the line side and the output shall be provided with an output filter consisting of a reactor and a capacitor.
  - .2 Power for the VSD control circuit shall be taken from the line side contactor, but after the line side choke for the drive fault relay.
  - .3 Drive BX cabling shall be provided between the VFD and VFD motor.
  - .4 Refer to VFD mounting details on drawings which reflects the responsibilities for supply of power and control wiring.
- 3.12.21 Mechanical Contractor shall provide Transient Voltage Surge Suppressor for all of their microprocessor based equipment, i.e. BAS, etc.
- 3.12.22 Mechanical Contractor and controls contractor shall provide the Electrical Contractor with locations where power circuits are required for mechanical control systems, i.e. Electronic Devices (trap primers, infrared plumbing trim, etc.) control transformers BAS panels, etc.
- 3.12.23 Should the Mechanical Contractor change or modify motor sizes or electrically powered mechanical equipment from what is reflected on the Bid Documents during any stage of this project, they shall be responsible to cover all associated electrical costs for the changes, such as revised motor starter and feeds etc.

### **3.13 Miscellaneous Metal/Metal Fabrications**

- 3.13.1 Be responsible for miscellaneous steel work relative to Mechanical, including, but not limited to:

- .1 Support of equipment - including cooling tower
  - .2 Hanging, support, anchoring, guiding and relative work as it applies to piping, ductwork, heat exchangers, hot water storage tanks, expansion tanks, fans and mechanical equipment.
  - .3 Access platforms, ladders and catwalks.
  - .4 Pipe anchor and/or support posts.
  - .5 Ceiling ring bolts - secure to structure or steel supports.
  - .6 Pipe protection at columns in vehicle and receiving areas.
- 3.13.2 All steel work shall be primed and undercoat painted ready for finish under Division 9. Refer to drawings for details.
- 3.13.3 Coordinate with and comply with Section 05 50 00 Metal Fabrications.

### **3.14 Flashing**

- 3.14.1 Flash and counterflash where mechanical equipment passes through weather or water proofed walls, floors and roofs.
- 3.14.2 Flash, vent/soil pipes penetrating roofs with aluminum 18" (450 mm) x 18" (450 mm) (base dimension) sheet. Flashing shall terminate flush with top of 12" (300 mm) high vent pipe. Gap between flashing and pipe shall be closed with separate aluminum cap 3" (80 mm) high. Main flashing shall not be turned over pipe. For pipes through outside walls turn flange back into wall and caulk.
- 3.14.3 Flash floor drains over finished areas to floor waterproof membrane. Fasten floor membrane to drain clamp device.
- 3.14.4 Provide curbs for mechanical roof installations 8" (200 mm) minimum high above roof insulations. Flash and counterflash with galvanized steel or aluminum, made waterproof.
- 3.14.5 Provide continuous neoprene safes for built-up mop sinks, and shower stalls located above finished rooms. Solder at joints, flash into floor drains and turn up 6" (150 mm) into walls or to top of curbs and caulk into joints.

### **3.15 Di-Electric Couplings**

- 3.15.1 Provide wherever pipes of dissimilar metals are joined.
- 3.15.2 Provide insulating unions for pipe sizes NPS 2 (50 mm) and under and flanges for pipe sizes over NPS 2 (50 mm) .
- 3.15.3 Provide felt or rubber gaskets to prevent dissimilar metals contact.
- 3.15.4 Acceptable Products: Capital, Walter Vallet, EPCO, Victaulic Series 647.



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**3.16 Lubrication of Equipment**

- 3.16.1 Lubricate new equipment prior to operating, except sealed bearings, which shall be checked.
- 3.16.2 Use lubricant recommended by Manufacturer for service.
- 3.16.3 Extend lubricating connections and sight glasses to outside of housings, where lubricating positions are not readily accessible.
- 3.16.4 Submit check list, showing that operated equipment has been lubricated prior to and during any temporary heating period and demonstration and instruction period.

**3.17 Painting**

- 3.17.1 Finish painting of piping and ductwork shall be carried out by other trades. Refer to Division 9 - Finishes.
- 3.17.2 Provide factory finish on manufactured items. At completion, touch up damaged surfaces to match original. Do not paint over nameplates.

**3.18 Equipment Protection and Clean-Up**

- 3.18.1 Protect equipment and material in storage, on site and after installation until final acceptance. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of piping and duct systems.
- 3.18.2 Mechanical equipment stored on site shall be kept in dry, heated and ventilated storage area.
- 3.18.3 Thoroughly clean piping, ducts and equipment of dirt, cuttings and other foreign material.
- 3.18.4 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.
- 3.18.5 Provide, install and maintain 30% efficient temporary filters to return and exhaust air openings from ceiling spaces to prevent air born dust from entering ducts, plenums and coils. Install filters to return air grilles when fans are operated and building is not clean.

**3.19 Start-Up**

- 3.19.1 Before starting equipment or systems, provide certificate stating plant is ready for start-up and the following conditions have been met.
  - .1 Safety controls installed and fully operational.
  - .2 Qualified personnel available to operate plant.
  - .3 Permanent electrical connections made to equipment.
  - .4 Boiler(s) started up and adjusted by Manufacturer's Representatives.

- .5 Chillers started up and adjusted by Manufacturer's Representative.
- .6 Air filters installed.
- .7 Pump and fan drives properly aligned by journeyman millwright.
- .8 Mechanical equipment rooms, including plenums, vacuum cleaned.

**3.20 Turnover Seminar for Operating Staff**

- 3.20.1 At completion of project, Mechanical Contractor shall organize and conduct **three** day seminar to instruct Owner and Representatives in operation and preventative maintenance of equipment and systems.
- 3.20.2 Provide services of qualified personnel, including Sub-Trades, major equipment suppliers and Consultant to attend seminar and instruct on his equipment or system(s). Seminar shall be chaired by Mechanical Contractor.
- 3.20.3 Mechanical Contractor shall submit agenda and list of Representatives to Consultant for approval 30 days before seminar. Confirm attendance by written notification to participants, followed by verbal confirmation before seminar date.
- 3.20.4 At seminar, submit final copies of Record Drawings and Operating and Maintenance Manuals to Owner.
- 3.20.5 Mechanical Contractor shall submit to Consultant, written follow-up of seminar complete with attendance list and signed acceptance from the operating staff representative indicating they have accepted the demonstrations and instructions. Coordinate with the commissioning agent for project deliverables.

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**APPENDIX "A"**

**MECHANICAL CHECKLIST FOR SUBSTANTIAL COMPLETION**

Date: \_\_\_\_\_

Project No: \_\_\_\_\_

Project Name: \_\_\_\_\_

Mechanical Contractor: \_\_\_\_\_

Contractor is to initial all items that have been completed and email checklist back to Introba 48 hours prior to final review. For any items that are not applicable to your project, please mark "N/A" in the right side of the column.

**1. GENERAL**

- .1 Maintenance Manuals submitted to Consultant for review. \_\_\_\_\_
- .2 Letter of Completion from control sub-trade forwarded and documentation forwarded. \_\_\_\_\_
- .3 All certification, test and inspection certificates submitted (refer to requirements at the end of this checklist). \_\_\_\_\_
- .4 Record Drawings completed, checked and submitted for mechanical and plumbing. \_\_\_\_\_
- .5 Record Drawings completed, checked and submitted for fire protection. \_\_\_\_\_
- .6 Record Drawings completed, checked and submitted for heat reclaim system. \_\_\_\_\_
- .7 Confirm program for warranty period, including site visits and assistance to Owners for operations and maintenance and controls. Extended warranty forms completed. \_\_\_\_\_
- .8 Performance tests carried out. \_\_\_\_\_
- .9 Cleanup completed (air filters, strainers, etc.). \_\_\_\_\_
- .10 Confirm access to components (valves, dampers, etc.). \_\_\_\_\_
- .11 Thermometers, pressure gauges and filter gauges in place. \_\_\_\_\_
- .12 Flexible connections and isolators free from binding. \_\_\_\_\_
- .13 Painting, identification and valve tagging completed. \_\_\_\_\_
- .14 Equipment lubricated and accessible for maintenance. \_\_\_\_\_
- .15 Balancing completed or nearing completion. \_\_\_\_\_

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|-----|--|---|
| .16 | Vibration and sound control checked.   | — |
| .17 | Pipe, duct and equipment identification completed.                               | — |
| .18 | Firestopping completed.  | — |
| .19 | “Residential Unit Completion Checklist” completed for each suite (see attached). | — |
- 2. PLUMBING**
- |     |  |   |
|-----|--|---|
| .1  | All backflow preventers installed and functioning.                   | — |
| .2  | Plumbing fixtures cleaned and water flows adjusted.                  | — |
| .3  | Proper access to all cleanouts confirmed.                            | — |
| .4  | Confirm that roof and floor drains are located at low points.        | — |
| .5  | Equipment drains taken to hub or funnel drain.                       | — |
| .6  | Expansion and contraction provisions satisfactory.                   | — |
| .7  | Domestic hot water system functioning properly.                      | — |
| .8  | Equipment and units isolated and provided with union or flanges.     | — |
| .9  | Thermometers and gauges installed.                                   | — |
| .10 | Gas connections to all equipment completed and inspected.            | — |
| .11 | Medical gas piping/outlets/manifolds/equipment tested and certified. | — |
| .12 | Medical gas alarms systems tested and certified.                     | — |
- 3. FIRE PROTECTION AND LIFE SAFETY SYSTEMS**
- |    |   |   |
|----|---|---|
| .1 | Sprinkler systems tested and inspected as per NFPA 13.  | — |
| .2 | Standpipe systems tested and inspected as per NFPA 14.  | — |
| .3 | Fire pump systems tested and inspected as per NFPA 20.  | — |
| .4 | Smoke control systems tested and inspected as per OBC requirements, including vestibule and stair pressurization systems. | — |
| .5 | Fire protection extinguishers installed.  | — |
| .6 | Spare sprinklers and cabinet provided.  | — |
- 4. HOT WATER HEATING/HYDRONIC SYSTEMS**
- |    |   |   |
|----|---|---|
| .1 | Chemical cleaned piping and treatment charged.                                | — |
| .2 | Expansion tank charged.   | — |
| .3 | Terminal units operating.   | — |
| .4 | Radiant panels have clearance for expansion and insulation backing installed. | — |
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.5	Heating coils operating.	—
.6	Element fins combed and cleaned.	—
.7	Pumps running smoothly.	—
.8	Boiler test fired and results submitted.	—
<b>5.</b>	<b><u>CHILLED WATER SYSTEMS</u></b>	
.1	Chemical cleaned piping, feed pump installed and treatment charged.	—
.2	Expansion tank charged.	—
.3	Cooling coils operating.	—
.4	Pumps running smoothly.	—
.5	Chiller and tower isolators installed and units secured to mounting pads.	—
.6	Heat trace and freeze protection installed and tested.	—
.7	Refrigerant charged.	—
.8	Chiller controls tested and operating.	—
.9	Chiller commissioned test and results submitted.	—
.10	Leak exhaust system installed and tested.	—
<b>6.</b>	<b><u>STEAM PIPING AND BOILER SYSTEMS</u></b>	
.1	Chemical cleaned piping, feed pump installed and treatment charged.	—
.2	Steam traps cleaned and operating.	—
.3	Pressure reducing station trimmed and set.	—
.4	Condensate return and feed water systems tested.	—
.5	Boiler test fired and results submitted.	—
.6	Humidifier operation and modulation verified.	—
<b>7.</b>	<b><u>VENTILATION SYSTEMS</u></b>	
.1	Air handling equipment installed and commissioned.	—
.2	Equipment controls commissioned and tested.	—
.3	Ductwork and plenums cleaned.	—
.4	Air outlets adjusted.	—
.5	Clean air filters provided.	—
.6	Ductwork noises eliminated.	—
.7	Balancing dampers installed.	—
.8	Fire and smoke dampers installed and tested.	—

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- 
- |     |  |   |
|-----|--|---|
| .9  | Drive pulley adjusted for design conditions. | — |
| .10 | Cooling coil condensate drains installed.    | — |
- 8. ROOFTOP HVAC EQUIPMENT**
- |    |   |   |
|----|---|---|
| .1 | Shipping blocks removed.                    | — |
| .2 | Sound levels confirmed as satisfactory.     | — |
| .3 | Start-up reports completed.                 | — |
| .4 | Controls check out and operate properly.    | — |
| .5 | Seismic attachments complete.               | — |
| .6 | Traps installed on condensate drains.       | — |
| .7 | Thermostats mounted and programmed.         | — |
| .8 | Roof-mounted exhaust fans secured on bases. | — |
- 9. DDC/CONTROLS SYSTEMS**
- |    |  |   |
|----|--|---|
| .1 | Panel layout sheets complete with point name, point address and wire identification number. One copy attached to each respective panel door. | — |
| .2 | All points tagged with point name, point address and panel number.   | — |
| .3 | “As-built” control drawings submitted.   | — |
| .4 | “As-built” program flowcharts submitted.   | — |
| .5 | “As-built” ladder wiring diagrams showing all hardware interlocks submitted.   | — |
| .6 | Complete Operator’s Manual submitted (including apparatus and Maintenance Manual for all sensors, transducers, solid state relays, etc.).    | — |
| .7 | Turnover seminar and instructions to Owner completed.  | — |

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**CERTIFICATES AND LETTERS OF CERTIFICATION ARE REQUIRED FOR THE FOLLOWING:**

**Copies to be emailed to Introba and included in the Maintenance Manual as per Section 23 05 00.**

- .1 Plumbing, piping test certificates (water, sanitary and storm). —
- .2 Gas piping tests and certifications inspections from Gas Safety Branch and/or gas fitters form letter. —
- .3 Sprinkler system certification from the Sprinkler Engineer confirming system installation to NFPA 13 with seal. —
- .4 Contractors Material and Test Certificates for above-ground and below ground piping for sprinkler system. —
- .5 Verification of proper operation and indication of sprinkler system components on fire alarm panel. —
- .6 WHMIS requirements completed. —
- .7 Heating system pressure test certificates of installation. —
- .8 Certification of proper installation from Radiant Floor Heating System Contractor. —
- .9 Report on Chemical Treatment, glycol charging and test results submitted. —
- .10 Backflow preventer test certificates. —
- .11 Boiler start-up and combustion tests. —
- .12 Sealed certification from Seismic Engineer for seismic restraint system. —
- .13 Sealed certification from Vibration Isolation Agent for proper adjustment of spring curbs. —
- .14 Performance and start-up testing of heat reclaim system and certificate confirming installation in accordance with Manufacturer's recommendations. —
- .15 Megger and capacitance tests on trace cable with verification from supplier for each circuit. —
- .16 Start-up reports for each piece of refrigeration equipment and chiller. —
- .17 Letter of Completion from control sub-trade, including: —
  - .1 Seven day acceptance testing of control system completed.
  - .2 Control calibration check sheets.
  - .3 Confirmation of proper control and sequencing of components.
  - .4 Control system "as-built" with setpoints.
  - .5 Items under DDC system below.

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.18 Smoke control system tested in accordance with British Columbia Fire Code  
and report issued. —

Date Returned to Introba: \_\_\_\_\_

Submitted By: \_\_\_\_\_

Signed By: \_\_\_\_\_



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**DOCUMENTATION REQUIRED FOR  
MECHANICAL SUBSTANTIAL  
COMPLETION**

The following documents, or copies of, are to be submitted for release of the substantial completion of the project and release of Introba's Schedule C-B. These documents are to be submitted 48 hours prior to the Consultant walkthrough.

**The following must be submitted and cannot be accepted as a deficiency:**

1. Schedule C-B for Sprinklers.
2. Schedule C-S for Seismic Restraint and anchorage for Mechanical Equipment.
3. Commissioning Report.
4. Fire Alarm Verification Report.
5. Smoke Exhaust/Pressurization Fans Verification.
6. Parkade Fan Verification.
7. Fire Damper Test Letter from Contractor.
8. Municipal/City Plumbing Final Certificate.
9. Heat Trace Report for Sprinkler System.
10. Provincial Gas Inspection Certificate or sign off letter from gas fitter.
11. Firestop Shop Drawings and Material Data Sheet Submission.
12. Certificate for Chlorination of Domestic Water Systems.
13. Operation and Maintenance Manuals.

**The following items are to be submitted, but can be held as a deficiency and payment will be withheld until submissions are complete:**

1. HVAC Air Balancing Report.
2. Water Balancing Report of Hydronic Systems
3. Shop drawings for all mechanical equipment.
4. Refrigeration Contractor Certification Letter.
5. Material Test Certificates.
6. Warranty Letter from Mechanical Contractor for Warranty period.
7. As-built record drawings.
8. Photographs taken during construction and for underground services/concealed piping.

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**APPENDIX "B"**

**RESIDENTIAL UNIT COMPLETION CHECKLIST**

This checklist is to be completed by Mechanical Contractor for each residential unit in building. Submit completed copies prior to requesting Semi-final Field Review.

FLOOR NUMBER: \_\_\_\_\_

UNIT NUMBER: \_\_\_\_\_

- \_\_\_\_\_ Plumbing fixtures cleaned. Acoustic isolators installed on water closets and jetted bathtubs
- \_\_\_\_\_ Hot and cold water supplied to each fixture; escutcheons and wall caps on all pipe penetrations through walls or cabinets.
- \_\_\_\_\_ Washroom exhaust fan functional (rattle free) on both timer and manual switch.
- \_\_\_\_\_ Kitchen range hood vent connected and operational.
- \_\_\_\_\_ Dryer vent connected and operational.
- \_\_\_\_\_ Natural gas connected to fireplace and cooktops. Gas lines purged.
- \_\_\_\_\_ Sprinkler escutcheons installed throughout and sprinklers secured.
- \_\_\_\_\_ Baseboard radiation cabinet complete and finish touched-up. Access panels installed at valves and vents. Joiner pieces, corners, and end caps and dampers secured.
- \_\_\_\_\_ Baseboard thermostats adjusted to maintain 70°F (21°C).
- \_\_\_\_\_ Temperature limit stops set at 115°F (46°C) on shower valve with main water heaters set at 125°F (52°C) supply temperature.

Checklist Completed by: \_\_\_\_\_

For: \_\_\_\_\_  
Contractor's Name

Date submitted: \_\_\_\_\_

**END OF SECTION**

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## 1. GENERAL

### 1.1 Related Documents

- 1.1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Section, apply to work specified in this section.

### 1.2 Definitions

- 1.2.1 Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies.

### 1.3 General Description of the Work of this Section

- 1.3.1 Only tested firestop systems shall be used in specific locations as follows:
- 1.3.2 Penetrations for the passage of duct, piping, and other mechanical equipment through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.
- 1.3.3 Repetitive plumbing penetrations in fire-rated floor assemblies. Penetrations exist for the installation of tubs, showers, aerators and other plumbing fixtures.

### 1.4 Related Work of Other Sections

- 1.4.1 Coordinate work of this section with work of other sections as required to properly execute the work and as necessary to maintain satisfactory progress of the work of other sections, including:
- .1 Section 03 30 00 - Cast-In-Place Concrete
  - .2 Section 21 05 06 - Common Work Results for Fire Protection
  - .3 Section 23 05 00 - Common Work Results for HVAC
  - .4 Section 23 07 13 - Duct Insulation
  - .5 Section 23 07 16 - HVAC Equipment Insulation
  - .6 Section 23 07 19 - HVAC Piping Insulation
  - .7 Section 22 05 00 - Plumbing

### 1.5 References

- 1.5.1 Test Requirements: CAN/ULC-S115, "Standard Method of Fire Tests of Through Penetration Fire Stops".
- 1.5.2 Underwriters Laboratories of Canada (ULC) of Scarborough runs CAN/ULC-S115 under their designation of ULC-S115 and publishes

the results in their "FIRE RESISTANCE RATINGS DIRECTORY" that is updated annually.

- 1.5.3 Underwriters Laboratories (UL) of Northbrook, IL runs ASTM E-814 under their designation of UL 1479 and publishes the results in their "FIRE RESISTANCE DIRECTORY" that is updated annually. UL tests that meet the requirements of ULC-S115-M are given a cUL listing and are published by UL in their "Products Certified for Canada (cUL) Directory".
- 1.5.4 Omega Point Laboratories runs ASTM E-814 and publishes the results annually in their "Omega Point Laboratories Directory".
- 1.5.5 International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments
- 1.5.6 CAN/ULC-S102, Standard Test Method for Surface Burning Characteristics of Building Materials.
- 1.5.7 Test Requirements: ASTM G-21, "Standard Test for Determining Resistance of Synthetic Polymeric Materials to Fungi". Materials used under this section must carry a "Level 1" or lower test rating.
- 1.5.8 All major building codes: NBC, OBC, BCBC, and ABC.
- 1.5.9 NFPA 101 - Life Safety Code.

## **1.6 Quality Assurance**

- 1.6.1 A manufacturer's direct representative (not distributor or agent) to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.
- 1.6.2 Firestop System installation must meet requirements of CAN4-S115 tested assemblies that provide a fire rating as shown in Section 2.03 Clauses J & K.
- 1.6.3 Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.
- 1.6.4 Firestop Systems do not re-establish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.
- 1.6.5 For those firestop applications that exist for which no ULC or cUL tested system is available through a manufacturer, a manufacturer's firestop custom detail derived from similar ULC or cUL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Firestop custom detail drawings must follow requirements set forth by the International Firestop Council (September 7, 1994).

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**1.7 Submittals**

- 1.7.1 Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of ULC or cUL firestop systems to be used and manufacturer's installation instructions to comply with Section 1300.
- 1.7.2 Manufacturer's engineering judgment identification number and drawing details when no ULC or cUL system is available for an application. Engineer judgment must include both project name and contractor's name who will install firestop system as described in drawing.
- 1.7.3 Submit material safety data sheets provided with product delivered to job-site.
- 1.7.4 Submit signed letter from firestopping installation firm on company letterhead certifying penetrations of fire suppression piping through vertical & horizontal rated separations have been firestopped in accordance with ULC-S115.

**1.8 Installer Qualifications**

- 1.8.1 Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.
- 1.8.2 The work is to be installed by a contractor with at least one of the following qualifications:
  - .1 FM 4991 Approved Contractor
  - .2 UL Approved Contractor
  - .3 Hilti Accredited Fire Stop Specialty Contractor (HAFSC)
- 1.8.3 Installer shall have minimum 3 years of experience with fire stop installation.

**1.9 Delivery, Storage, and Handling**

- 1.9.1 Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and ULC or cUL label where applicable.
- 1.9.2 Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.
- 1.9.3 Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements.
- 1.9.4 Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.
- 1.9.5 Do not use damaged or expired materials.

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### 1.10 Project Conditions

- 1.10.1 Do not use materials that contain flammable solvents.
- 1.10.2 Scheduling
  - .1 Schedule installation of CAST IN PLACE firestop devices **after** completion of floor formwork, metal form deck, or composite deck but **before** placement of concrete.
  - .2 Schedule installation of other firestopping materials after completion of penetrating item installation but prior to covering or concealing of openings.
- 1.10.3 Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
- 1.10.4 Weather conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.
- 1.10.5 During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

## 2. PRODUCTS

### 2.1 Firestopping, General

- 2.1.1 Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.
- 2.1.2 Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.
- 2.1.3 Firestopping Materials are either "cast-in-place" (integral with concrete placement) or "post installed." Provide cast-in-place firestop devices prior to concrete placement.

### 2.2 Acceptable Manufacturers

- 2.2.1 Subject to compliance with through penetration firestop systems listed in U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Directory, provide products of the following manufacturers as identified below:
  - .1 Hilti (Canada) Corporation, Mississauga, Ontario
  - .2 1-800-363-4458/www.ca.hilti.com
  - .3 Nuco

- .4 3M
- .5 Tremco
- .6 JV Firestop

2.2.2 Alternatives not listed in Part 2.2.1 will not be accepted.

## 2.3 **Materials**

2.3.1 Use only firestop products that have been ULC-S115 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.

2.3.2 Pre-Installed firestop devices for use with non-combustible and combustible pipes (closed and open systems) penetrating concrete floors and/or gypsum walls, the following products are acceptable:

- .1 Hilti Cast-In Place Firestop Device (CP 680-P)
  - .1 Add Aerator Adaptor when used in conjunction with aerator system.
- .2 Hilti Tub Box Kit (CP 681) for use with tub installations.
- .3 Hilti Cast-In Place Firestop Device (CP 680-M) for use with non-combustible penetrants.
- .4 Hilti Speed Sleeve (CP 653) for use with cable penetrations.
- .5 Hilti Firestop Drop-In Device (CFS-DID) for use with non-combustible and combustible penetrants.
- .6 Hilti Firestop Block (CFS-BL)
- .7 Acceptable Products: Nuco, 3M, Tremco, JV Firestop.

2.3.3 Sealants or caulking materials for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT), the following products are acceptable:

- .1 Hilti Intumescent Firestop Sealant (FS-ONE MAX)
- .2 Hilti Self Leveling Firestop Sealant (CFS-S SIL SL)
- .3 Hilti Fire Foam (CP 620)
- .4 Hilti Flexible Firestop Sealant (CP 606)
- .5 Hilti Elastomeric Firestop Sealant (CFS-S SIL GG)
- .6 Acceptable Products: Nuco, 3M, Tremco, JV Firestop.

2.3.4 Sealants or caulking materials for use with sheet metal ducts, the following products are acceptable:

- .1 Hilti Elastomeric Firestop Sealant (CFS-S SIL GG)
- .2 Hilti Flexible Firestop Sealant (CP 606)
- .3 Hilti Intumescent Firestop Sealant (FS-ONE MAX)
- .4 Hilti Self Leveling Firestop Sealant (CFS-S SIL SL)
- .5 Acceptable Products: Nuco, 3M, Tremco, JV Firestop.

- 
- 2.3.5 Intumescent sealants or caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe, the following products are acceptable:
- .1 Hilti Intumescent Firestop Sealant (FS-ONE MAX)
  - .2 Acceptable Products: Nuco, 3M, Tremco, JV Firestop.
- 2.3.6 Firestop collar or wrap devices attached to assembly around combustible plastic pipe (closed and open piping systems) tested to 50 Pa. differential, the following products are acceptable:
- .1 Hilti Firestop Collar (CP 643N)
  - .2 Hilti Firestop Collar (CP 644)
  - .3 Hilti Wrap Strips (CP 648E/648S)
  - .4 Acceptable Products: Nuco, 3M, Tremco, JV Firestop.
- 2.3.7 Materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
- .1 Hilti Firestop Mortar (CP 637)
  - .2 Hilti Firestop Block (CFS-BL)
  - .3 Hilti Fire Foam (CP 620)
  - .4 Hilti Firestop Board (CP 675T)
  - .5 Acceptable Products: Nuco, 3M, Tremco, JV Firestop.
- 2.3.8 Non curing, re-penetrable materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
- .1 Hilti Firestop Block (CFS-BL)
  - .2 Hilti Firestop Board (CP 675T)
  - .3 Acceptable Products: Nuco, 3M, Tremco, JV Firestop.
- 2.3.9 For blank openings made in fire-rated wall or floor assemblies, where future penetration of pipes, conduits, or cables is expected, the following products are acceptable:
- .1 Hilti FS 657 Fire Block (for walls and floors)
  - .2 Hilti CP 658T Firestop Plug (for walls and floors)
  - .3 Hilti CP 680 Cast-In Place Firestop Device (for floors only)
- 2.3.10 For penetrations through a Fire Separation wall provide a firestop system with a "F" Rating as determined by ULC or cUL as indicated below:



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Fire Resistance Rating of Separation	Required ULC or cUL "F" Rating of Firestopping Assembly
30 minutes	20 minutes
45 minutes	45 minutes
1 hour	45 minutes
1.5 hours	1 hour
2 hours	1.5 hours
3 hours	2 hours
4 hours	3 hours

2.3.11 For combustible pipe penetrations through a Fire Separation provide a firestop system with a "F" Rating as determined by ULC or cUL which is equal to the fire resistance rating of the construction being penetrated.

2.3.12 For penetrations through a Fire Wall or horizontal Fire Separation provide a firestop system with a "FT" Rating as determined by ULC or cUL which is equal to the fire resistance rating of the construction being penetrated.

### 3 . **EXECUTION**

#### 3.1 **Preparation**

3.1.1 Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

- .1 Verify penetrations are properly sized and in suitable condition for application of materials.
- .2 Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
- .3 Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
- .4 Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
- .5 Do not proceed until unsatisfactory conditions have been corrected.

#### 3.2 **Coordination**

3.2.1 Coordinate location and proper selection of cast-in-place Firestop Devices with trade responsible for the work. Ensure device is installed before placement of concrete.

- 3.2.2 Responsible trade to provide adequate spacing of field run pipes to allow for installation of cast-in-place firestop devices without interferences.

### **3.3 Installation**

- 3.3.1 Regulatory Requirements: Install firestop materials in accordance with ULC Fire Resistance Directory or UL Products Certified for Canada (cUL) Directory.
- 3.3.2 Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration joint materials.
- .1 Seal all holes or voids made by penetrations to ensure an air and water resistant seal.
  - .2 Consult with mechanical consultant, project manager, and damper manufacturer prior to installation of ULC or cUL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
  - .3 Protect materials from damage on surfaces subjected to traffic.

### **3.4 Field Quality Control**

- 3.4.1 Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
- 3.4.2 Keep areas of work accessible until inspection by applicable code authorities.
- 3.4.3 Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.
- 3.4.4 Install a warning card that is clearly visible adjacent to all large and medium openings that may be re-penetrated. This card should contain the following information:
- .1 Warning that the opening has been fire stop protected
  - .2 Indicate the fire stop system used (ULC or cUL)
  - .3 F rating or FT rating
  - .4 Fire stop product(s) used
  - .5 Person to contact and phone number in case of modification or new penetration of fire stop system

### **3.5 Adjusting and Cleaning**

- 3.5.1 Remove equipment, materials and debris, leaving area in undamaged, clean condition.
- 3.5.2 Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

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**END OF SECTION**

## 1. GENERAL

### 1.1 Related Work

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

### 1.2 Quality Assurance

- 1.2.1 Motors shall be UL listed and CSA certified.
- 1.2.2 Full Voltage Start Applications:
- .1 All motors shall be in accordance with the National Electrical Manufacturers Association (NEMA) standards, and CSA C390. Motors also shall comply with applicable portions of Canadian Electrical Code.
- 1.2.3 Variable Frequency Drive and soft start applications:
- .1 Motors shall be in accordance with NEMA standards (MG-1) Part 31 and inverter duty class. Motors also shall comply with applicable portions of Canadian Electrical Code.
- .2 Motors connected to VFDs shall be wound using inverter spike resistant magnet wire capable of 1600V.
- 1.2.4 Electronic Commutation Motors (ECM) shall be provided in unitary equipment as specified in their respective sections (small fans, pumps, etc.).
- 1.2.5 Noise level of each motor shall comply with NEMA standards, less than 80 dBA at 39" (1 m).

### 1.3 Submittals

- 1.3.1 Submit data of test method used and motor efficiencies with shop drawings.

## 2. PRODUCTS

### 2.1 Electric Motors – General

- 2.1.1 Provide motors for mechanical equipment as specified.
- 2.1.2 Unless noted otherwise, provide open drip-proof, ball or roller bearing motors with grease fittings.
- 2.1.3 Motors shall have standard voltage ratings consistent with project distribution voltages. Motors less than ½ hp (0.37 KW) to be 120 volt, 60 cycle, single phase power. Motors ½ hp (0.37 KW) and larger to be 3 phase power and for scheduled voltage. Confirm

electric voltage, phase and starter requirements with electrical specification.

- 2.1.4 Motors shall be designed and manufactured to operate with  $\pm 10\%$  voltage and  $\pm 5\%$  frequency variations of the nameplate ratings.
- 2.1.5 Motors shall be rated for 1.15 service factor in 105°F (40°C) ambient environment.
- 2.1.6 Motors shall be standard 1750 RPM unless specifically scheduled otherwise.
- 2.1.7 Provide motors with terminal boxes, suitable for power connections.
- 2.1.8 Provide screw adjustable bases on belt-connected motors.
- 2.1.9 Motors shall be of capacitor start type when they may be manually cycled from starting switch, located in finished space.
- 2.1.10 Lubricate motors exposed to outdoor temperature with lubricants suitable for operation at the lowest temperature indicated by the Climatic Information contained in the National Building Code for the location in which they are installed.

## 2.2 **Electric Motors – Premium Efficient**

- 2.2.1 Motors shall be provided with premium efficiency inverter duty classification with non-wicking leads, class 'B' for motors and class 'F' for TEFC motors insulation (minimum). Provide motor shaft grounding for variable frequency driven motors for all VFD applications.

- .1 Premium efficiency open drip-proof motors shall have the following typical full load efficiencies (nominal):

HP	Premium Efficient - Minimum Efficiency (%)		
	3500 RPM 2 Pole	1750 RPM 4 Pole	1150 RPM 6 Pole
1	80.0	85.5	82.5
1.5	84.0	86.5	86.5
2	85.5	86.5	87.5
3	86.5	89.5	88.5
5	91.0	89.5	90.2
7.5	88.5	91.0	92.4
10	90.2	91.7	92.4
15	91.0	93.0	92.4
20	92.5	93.0	92.4

- .2 Premium efficiency inverter duty totally enclosed fan cooled motors shall have the following typical load efficiencies (nominal).

HP	Premium Efficient - Minimum Efficiency (%)		
	3500 RPM 2 Pole	1750 RPM 4 Pole	1150 RPM 6 Pole
1	n/a	85.5	81.5
1.5	85.5	85.5	86.5
2	85.5	85.5	87.5
3	87.5	88.5	88.5
5	89.5	89.5	89.5
7.5	91.0	91.7	91.7
10	91.7	91.7	91.7
15	91.7	92.4	91.7
20	92.4	93.0	92.4

2.2.2 ECM Motors (Electronic Commutation Motors) shall be provided for unitary equipment as specified in their respective sections. ECM motors shall be permanently lubricated complete with heavy duty ball bearings to match the device (fan, pump, equipment type) and pre-wired to the specific voltage and phase. Internal motor circuitry shall convert the supplied AC power to the motor DC power to operate the motor. Motor shall be speed controllable down to 20% of rated full speed. Speed shall be controlled by either a Potentiometer dial mounted at the motor, or by a 0-10V signal from controls. Motor shall be a minimum of 85% efficient at all speeds.

## 2.3 **Belt Drives**

2.3.1 Provide belt drives to the following requirements:

- .1 Steel, cast-iron or aluminum sheaves for motors less than  $\frac{3}{4}$  hp (0.56 KW).
- .2 Steel or cast-iron sheaves keyed to shafts, for motors  $\frac{3}{4}$  hp (0.56 KW) and larger.
- .3 For motors less than 10 hp (7.5 KW), provide standard adjustable pitch drive sheaves having  $\pm 10\%$  range. Use mid-position of range for specified RPM.
- .4 For motors 10 hp (7.5 KW) and larger, provide fixed pitch drive sheaves with split tapered bushing and keyway. Provide final drive sheaves of size to suit final balancing.

2.3.2 Match drive and driven sheaves.

2.3.3 V-belts shall conform with the American Belt Manufacturers standards. Multiple belts shall be matched sets.

2.3.4 Not less than 2-belt configuration is required for each drive for motors  $\frac{3}{4}$  hp (0.56 KW) and larger.

2.3.5 Minimum drive rating shall be 150% of nameplate rating of motor. Keep overhung loads within Manufacturer's design requirements on prime mover shafts.

- 2.3.6 Motor slide rail adjustment baseplate with double draw bolt shall allow for centre line adjustment.
- 2.3.7 Tension belts to manufactures recommendations before start-up and after 100 hours of operation using calibrated belt tensioning gauge.
- 2.3.8 Provide one spare set of belts for each piece of equipment with each belt separately identified for the equipment item served.

## **2.4 Shaft Couplings**

- 2.4.1 Shaft couplings shall be of the pin or jaw neoprene insert type, gear type, or flexing steel insert type and shall allow coupling inserts to be easily removed without disassembly of equipment.

## **2.5 Guards**

- 2.5.1 Provide removable protective guards on exposed V-belt drives and shaft couplings in accordance with Worker's Compensation Board requirements.
- 2.5.2 Guards for drives shall have:
  - .1 18 ga (1.31 mm) expanded metal screen welded to 1" (25 mm) steel angle frame.
  - .2 16 ga (1.61 mm) thick galvanized sheet metal tops and bottom.
  - .3 Removable sides(s) for servicing.
  - .4 1½" (40 mm) diameter holes on both shaft centres for insertion of tachometer.
  - .5 Sectionalize if necessary so one man can handle removal.
- 2.5.3 Provide means to permit lubrication and use of test instruments with guards in place.
- 2.5.4 Fabricate and install belt guards for V-belt drives to permit movement of motors for adjusting belt tension and for belt slap.
- 2.5.5 Provide removable "U" shaped guards for flexible couplings with 12 ga (2.75 mm) thick galvanized frame and 16 ga (1.61 mm) thick expanded mesh face.
- 2.5.6 Provide guards on unprotected fan inlets and outlets. Guards to be provided by fan Manufacturer.
- 2.5.7 Prime coat guards and finish paint to match equipment.
- 2.5.8 Secure guards to equipment allowing for ease of removal.

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**3 . EXECUTION**

**3.1 Electric Motors**

- 3.1.1 Unless otherwise noted starters and protection devices will be included under Electrical Division.
- 3.1.2 Assist Electrical Division to ensure proper connection, correct thermal overload protection and correct motor controls.
- 3.1.3 Where starters included in this Division as integral part of packaged equipment, they shall contain thermal overload protection.

**3.2 Setting and Alignment**

- 3.2.1 Employ journeyman millwright to align V-belt drives and/or shaft coupling drives prior to initial start-up. Millwright shall check that centrifugal fan wheels are properly centered on fan shafts.
- 3.2.2 Align shaft couplings to within  $\pm 0.002"$  ( $\pm 0.051$  mm) after grouting is complete and piping system is operational.
- 3.2.3 Align V-belt drives using straight edge.
- 3.2.4 Submit certificate from millwright, certifying that shaft couplings and V-Belt drives have been aligned and centrifugal fan wheels centered prior to initial start-up and checked again after final system balance adjustment.

**END OF SECTION**



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## 1. **GENERAL**

### 1.1 **Related Work**

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.
- 1.1.2 Where integrated pump mounted and packaged pump/VFD units are used – refer to Section 23 21 23 Hydronic Pumps.

### 1.2 **Quality Assurance**

- 1.2.1 Variable speed drives (VSD) shall be UL/CSA/NRTL-C certified. Equipment supplied to site without proper certification will be immediately removed from site. Variable speed drives shall comply with the following standards:
  - .1 NEMA-250 Enclosures to 1000 V maximum.
  - .2 EN 50178 (LVD).
  - .3 EN 61800-3.
  - .4 EN 61000-2-1, EN 61000-4-2 (-3, -4, -5, -6)/A2.
  - .5 EN 60146-1-1/A1.
  - .6 IEEE-519.
  - .7 UL-608C Power Conversion.
- 1.2.2 VSDs shall be supplied by one Manufacturer.

### 1.3 **Shop Drawings**

- 1.3.1 Provide complete dimensional data, operating data, system setpoints, written detailed sequence of operation and engineering data, including wiring diagrams, electrical schematics, and programming instructions.
- 1.3.2 Provide drawings showing field installation of electrical, electronic and pneumatic component requirements.

### 1.4 **System Activation**

- 1.4.1 Provide services of qualified technician to set up variable speed motor control system on site. Include minimum of half (½) man day per system to adjust and monitor system operation in conjunction with Balancing Sub-Trade and Controls Sub-Trade **and Commissioning Agent**.
- 1.4.2 Provide written start-up report to the Engineer listing operating setpoints, characteristics and identification.
- 1.4.3 Provide two site inspections during the warranty period to check operation, maintenance and calibration of variable speed drive.

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**1.5 Power Supply**

- 1.5.1 Variable speed system shall accept 3-phase line voltage as defined in Electrical.
- 1.5.2 The tolerate supply line voltage deviation for the VSD shall be as follows:
  - .1 208 to 240V: Undervoltage Trip 135V, Overvoltage Trip 312V.
  - .2 380 to 480V: Undervoltage Trip 247V, Overvoltage Trip 624 V.
  - .3 500 to 600V: Undervoltage Trip 325V, Overvoltage Trip 780V.
- 1.5.3 For 600V networks, the input voltage of the VSD shall be rated for 500V to 600V +/- 10% minimum VSDs rated 575V +/- or less shall not be acceptable.
- 1.5.4 Input frequency shall be to 60 Hz  $\pm 5\%$ . Provide current limiting devices to protect electronics from excessive current.

**1.6 DDC Interface**

- 1.6.1 The VFD shall have a TIA-485 port as standard. The standard VSD firmware shall include BACnet, Siemens P-1-FLN, Johnson N2 Metasys and Modbus serial communication protocols. Lonworks shall be available on an under the cover option board.
- 1.6.2 Provide remote operator interface to accept and transmit 4-20 milliamp, 0-10 VDC and 0-5 VDC signals to and from DDC system to control or monitor the following functions:
  - .1 Start/stop.
  - .2 Acceleration of variable speed drive unit.
  - .3 Deceleration of variable speed drive unit.
  - .4 Speed of drive.
  - .5 Failure of unit.
- 1.6.3 Monitoring shall also be provided by key pad operator on speed drive box complete with auxiliary displays.

**1.7 Warranty**

- 1.7.1 VSD shall be warrantied by Manufacturer for period of 36 months from date of commissioning. Warranty shall include parts, labour, travel costs and living expenses incurred by Manufacturer to provide factory authorized on-site service.

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## 2. PRODUCTS

2.1 Acceptable Manufacturers: ABB, Danfoss, AC Tech, Reliance, Cerus (E.H. Price supplier), LG (BMS Consultants Inc. - 604-723-6340).

### 2.2 General Requirements

2.2.1 Provide variable speed drive (VSD) for each fan and pump (or fan and pump set) as specified,.

2.2.2 Variable speed drive shall be of pulse width modulated (PWM) type utilizing transistors and shall have the following minimum specifications:

- .1 VSD package shall provide the following minimum protective devices:
  - .1 208/230 volt systems shall include 5% impedance line and load reactors.
  - .2 460 volt systems:
    - .1 Shall include minimum 5% impedance line and load reactors for control of harmonics, 3% impedance load reactors when connected to NEMA MG1 Part 30 motors.
    - .2 No output filter is required when connected to NEMA MG1 Part 31 motors.
  - .3 575 volt systems:
    - .1 Shall include minimum 5% impedance line and load reactors for control of harmonics and LRC Snubber Filter where cable length between VSD and motor exceeds 10'-0" (3.0 m) and LC Sine Wave Output Filter where cable length between VSD and motor exceeds 15'-0" (4.5 m) where connected to NEMA MG1 Part 30 motors.
    - .2 No output filtering required when connected to NEMA MG1 Part 31 motors.
- .2 Provide incoming horsepower rated door interlock at padlockable disconnect switch. Also provide fast acting input line fuses where characteristics are coordinated with drive's electronic protection circuits to not blow under normal output faults such as overcurrent, short circuit or ground fault.
- .3 Provide line over and under voltage protection, phase loss protection and phase unbalance protection.
- .4 Provide protection against overvoltage on DC bus.
- .5 Provide inherent short circuit protection for line to line and line to ground faults. If either fault occurs on output of VSD, VSD shall shut-down without damaging power circuit

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- devices. Controllers utilizing fuses or isolation transformers to provide protection shall not be acceptable.
- .6 Provide electronic instantaneous overcurrent protection.
  - .7 Drive shall have continuous duty service factor of 110% of rated output current with I2t motor overload protection above 100% current.
  - .8 Minimum efficiency of 97% at maximum load and speed.
  - .9 Provide two separately adjustable acceleration and deceleration ramps from 1 to 999 seconds (0 to 110% speed).
  - .10 Provide controller internal thermal protection.
  - .11 Provide automatic restart after inverter fault trip. Drive shall attempt to restart automatically three times with lock-out after third attempt if restart has not occurred.
  - .12 Provide rotating motor restart feature complete with soft lock capability during start-up to allow motor/fan unit which has been shut-down or has fault tripped, but is still rotating, to be restarted. VSD shall restart motor at speed at which it is rotating and then re-accelerate to speed called for by speed reference signal.
  - .13 Provide auto-restart after power outage (provided run enable is maintained).
  - .14 Provide three frequency reject points with adjustable bandwidth from 0.5 to 9.9 Hz to prevent fan from operating at resonant speed.
  - .15 Provide automatic/manual signal follower for:
    - .1 4-20 mA.
    - .2 0-10 VDC.
    - .3 0-5 VDC.

**2.3 Controls: Provide door mounted and microprocessor driven, digital operator control module to allow station operations personnel to set up and monitor drive parameters, observe output speed, load, voltage and time, monitor status and fault information, date and time stamped, as detailed below:**

- 2.3.1 Read-out information shall be displayed with LCD alpha-numeric high resolution display or approved equal. Information being displayed shall be presented in "user friendly" descriptive word format. Use of coded or abbreviated displays shall not be acceptable.
- 2.3.2 Speed load (power) and output voltage shall be continuously displayed when in run mode. Three display values shall be user selectable from a menu.

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- 2.3.3 Direct keypad entry shall be provided to observe the following parameters:
- .1 Maximum speed setting.
  - .2 Minimum speed setting.
  - .3 Acceleration rate.
  - .4 Deceleration rate.
  - .5 Current limit – monitoring.
  - .6 Current limit – regenerating.
  - .7 Up to three pre-set operating speeds.
  - .8 Up to three frequency reject points to avoid operating at resonant speed points. Centre frequency and band width shall be displayed.
- 2.3.4 Direct keypad entry shall be provided to initially set or change above noted parameters and only after password entered by authorized personnel.
- 2.3.5 Provide diagnostics for operator online status information. Each of the following status points shall be indicated by individual LED or digital display
- .1 Power on.
  - .2 Ready.
  - .3 Run.
  - .4 Jog.
  - .5 Motor accelerating.
  - .6 Motor decelerating.
  - .7 Direction of rotation (forward or reverse) (if function enabled).
  - .8 Auto mode (if function enabled).
  - .9 Manual mode.
  - .10 Stop.
  - .11 Low reference (missing or zero speed reference).
  - .12 External trip (interlocks open).
  - .13 Power lost.
- 2.3.6 Provide fault diagnostics to simplify troubleshooting. Each of the following points shall be indicated by individual LED or digital display:
- .1 Lockout (fault shut-down after three restart attempts).
  - .2 Line fault (line over/under voltage, phase loss/unbalance).
  - .3 Controller over temperature.
  - .4 I2t motor overload protection.
  - .5 DC bus overvoltage.
  - .6 DC bus under voltage.

- .7 Auxiliary power supply fault.
  - .8 Output fault – Phase A.
  - .9 Output fault – Phase B.
  - .10 Output fault – Phase C.
- 2.3.7 Provide keypad accessibility to non-volatile fault history memory which is not operator erasable. Memory shall store the following data for each of ten most recent drive shut-downs:
- .1 Fault which caused shut-down.
  - .2 Output frequency at time of trip.
  - .3 Output voltage at time of trip.
  - .4 Output load (power) at time of trip.
  - .5 Whether load was accelerating or decelerating.
  - .6 Time and date fault occurred.
- 2.3.8 Provide the following control functions on door mounted keypad:
- .1 Run.
  - .2 Stop.
  - .3 Jog (enabled in stop mode only).
  - .4 Auto/manual (if auto mode is enabled).
  - .5 Forward/reverse (if function is enabled).
  - .6 Accelerate (manual mode).
  - .7 Decelerate (manual mode).
  - .8 Direct speed set (manual mode).
- 2.3.9 Provide terminals for interlocking of up to six external interlocks (e.g., Firestat, Freezestat, etc.).

## **2.4 Harmonics**

- 2.4.1 All VFD's for pumps and fans 25HP and above, shall have a passive filter installed upstream to reduce the total harmonic current distortion (THID) to %5 upstream of that specific VFD.
- 2.4.2 VSD installations shall meet IEEE 519 harmonics guidelines for control of harmonics. Total harmonic voltage distortion shall be below 5% for normal applications and below 3% for special applications such as hospitals and airports, at point of common coupling with utility power supply. Calculation to demonstrate compliance shall be included in shop drawing submission. Failure to confirm compliance shall result in rejection of products.

## **2.5 Manual Bypass**

- 2.5.1 Provide integral 3-contactor manual bypass in NEMA 1 enclosure wired and mounted with VSD to transfer motor from VSD to line power or from line to controller. Bypass circuitry shall be wired to

isolate VSD from line. Motor overload protection shall be provided in both drive and bypass mode.

### **3 . EXECUTION**

#### **3.1 General**

- 3.1.1 Install equipment in accordance with Manufacturer's instructions, details and procedure.
- 3.1.2 In HAND position, power applied to each VSD shall provide soft motor start. In AUTO position, power shall be applied to VSD for soft start only when signal from DDC system allows. Soft start means power consumption shall be fully ramped.
- 3.1.3 MANUAL/AUTO switch in AUTO positing shall cause motor to accelerate at a rate determined by stability component until speed controller setpoint has been attained.
- 3.1.4 Loss of power at VSD input terminals or fault conditions shall cause VSD to go into orderly shut-down. Resumption of power shall cause VSD to go into orderly automatic restart sequence and provide soft start for motor.
- 3.1.5 Short circuit sensed anywhere in motor control loop shall interrupt current flow.
- 3.1.6 Acceleration and deceleration shall be set during commissioning of DDC system to ensure spurious tripping does not occur during normal operations.

#### **3.2 Start-Up Service**

- 3.2.1 Start-up commissioning service shall include factory and/or authorized service agent, to provide the following:
- 3.2.2 Verification of contractor wire terminations to VSD and optional circuitry.
- 3.2.3 Verification of interface wiring to building energy management system.
- 3.2.4 Measurement of motor voltage and frequency.
- 3.2.5 Calibration check for minimum speed, maximum speed, acceleration and deceleration rates.
- 3.2.6 Start-up and verification form to be provided to the Consultant and the Commissioning Agent.

**END OF SECTION**

**1.    GENERAL**

**1.1    Related Work**

1.1.1 This Specification Section forms part of Contract Document and is to be read, interpreted and coordinated with other parts.

**1.2    Scope**

1.2.1 Flexible pipe connections.

1.2.2 Expansion joints and compensators.

1.2.3 Pipe loops, offset and swing joints.

**1.3    Reference Standard**

1.3.1 Conform to Standard of "Expansion Joint Manufacturers Association" and Manufacturer's recommendations.

**1.4    Shop Drawings**

1.4.1 Product data shall include Manufacturer, model number, pressure and temperature rating, axial, lateral and angular movement handled, nominal size and dimensions, details of construction and assembly.

**1.5    General Requirements**

1.5.1 Examine piping layout and notify Consultant of additional anchors, guides or expansion joints required to adequately protect system. Where the on-site pipe routing and configuration differs from the plans, reengage specialist supplier or engineer to verify that changes will not affect the installation as designed or recommend changes required.

1.5.2 Make provisions for expansion and contraction of pipe work. Piping shall be anchored and supported in such a manner that strain and/or weight does not bear on any apparatus and pipe branch connections. Expansion joints and compensators shall be installed and guided as per Manufacturer's recommendations. Equipment shall be connected with unions, grooved couplings or flanges to provide for easy removal. Where piping passes through walls or floor slabs sleeves shall be provided of sufficient size to accommodate expansion and pipe insulation without binding or crushing insulation or preventing expansion of piping.



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## 2. PRODUCTS

### 2.1 Flexible Hoses – Braided

- 2.1.1 Phosphor bronze convoluted bellows with braided bronze sleeve or stainless steel convoluted bellows with braided stainless steel sleeve.
- 2.1.2 Suitable for system operating temperature and pressure.
- 2.1.3 Connections:
  - .1 NPS 2 (50 mm) and under, screwed connections
  - .2 NPS 2½ (65 mm) and over, flanged connections
- 2.1.4 Length shall be as recommended by Manufacturer, unless noted otherwise.
- 2.1.5 Acceptable Products:
  - .1 Flexonics Flex Con, Flextech Industries, Hydro Flex, Keflex, Vibra-Flo, Metraflex BBCT, Metraflex MLP.

### 2.2 Flexible Pipe Connectors – Low Temperature

- 2.2.1 Flexible pipe connectors complete with control rods, manufactured from polyester tire cords and bridge bearing quality neoprene or EPDM, cover and liner to CSA Standard CAN3-S6-M88. Provide flanges, bolts, etc. for outdoor installation.
- 2.2.2 Twin sphere design with reinforcing ring.
- 2.2.3 Suitable for a maximum temperature of 105°F (40°C) (chilled and condenser water systems only).
- 2.2.4 Safety factor for burst and flange pullout shall be a minimum of 3:1
- 2.2.5 Solid steel rings shall be used within face rubber flanged ends to prevent pullout.
- 2.2.6 Control rods shall have ½" (15 mm) thick neoprene or EPDM washer bushing large enough in diameter to take the thrust at 1,000 psi (6,895 kPa) maximum.
- 2.2.7 Use control rods on flexible pipe connectors serving piping system which are not anchored on both sides of the connector or when system pressure exceeds 150 psi (1,034 kPa).
- 2.2.8 Where grooved piping systems are used, three flexible type couplings may be used in lieu of flexible pipe connectors.
- 2.2.9 Acceptable Products:
  - .1 Mason Safeflex SFDEJ complete with Mason CR control rods, Flextech Industries, Unisource Ultra-Sphere U302 EPDM, Metraflex Double Cablesphere, Victaulic Style 177, 77, W77 couplings and Series 380/381/382 VIPDs.

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**2.3 Flexible Pipe Connections – High Temperatures**

- 2.3.1 Double braided, heat resistant, up to 392°F (200°C) bronze braid, up to 446°F (230°C) stainless steel braid.
- 2.3.2 Chemically inert and resistant to steam and moisture.
- 2.3.3 Capacity to absorb 6" (150 mm) with length across flexible portion not less than six diameters.
- 2.3.4 Adapter union shall be **male, swivel**. Flanges shall be steel **Class 150**.
- 2.3.5 Acceptable Products:
  - .1 Anaconda, Flexonics.

**2.4 Expansion Compensators**

- 2.4.1 Copper Pipe Expansion Compensator - Low Pressure:
  - .1 Bronze or stainless steel convoluted bellows.
  - .2 Suitable for 60 psi (415 kPa) working pressures.
  - .3 ¾" (20 mm) to 1¼" (32 mm) diameter, suitable for ½" (15 mm) compression and ¼" (6 mm) extension.
- 2.4.2 Steel Pipe Expansion Compensator:
  - .1 Factory assembled unit, with stainless steel or phosphor bronze in carbon steel casing.
  - .2 Anti-torque groove in casing, internal pipe guide at both ends, full length internal liner.
  - .3 Suitable for 150 psi (1,034 kPa) operating pressure.
  - .4 Suitable for 1½" (40 mm) compression and ¼" (6 mm) extension.
  - .5 Acceptable Products:
    - .1 Adscos, Flexonics, Flextech Industries, Hydroflex, Metraflex, Vibra-Flo.

**2.5 Expansion Joints**

- 2.5.1 Bellow Type:
  - .1 For axial, lateral or angular movements.
  - .2 Bellows type, corrugated, packless.
  - .3 Designed for maximum operating pressure and temperature of \_\_\_\_psi (\_\_\_\_ kPa) and \_\_\_\_°F (\_\_\_\_°C).
  - .4 **External Internal** stainless steel guide sleeves.
  - .5 External machined cast-iron control rings, full circumference.
  - .6 **With Without** external guide rods.
  - .7 Flanged Welded ends.
  - .8 Shrouds over external surfaces for insulation.

- .9 Two sets of alignment guides on each side of expansion joint, spaced to Manufacturer's recommendations, complete with guiding cylinder and base, cast or fabricated spider.
- .10 Acceptable Products:
  - .1 Adsko, Anaconda, Flexonics, Hydro-Flex, Tube Turns, United Flexible, Vibra-Flo.
- 2.5.2 Sleeve Type:
  - .1 For axial movement.
  - .2 Slip type, located centrally between two anchors without bases.
  - .3 Designed for \_\_\_\_psi (\_\_\_\_kPa).
  - .4 Sleeve ends fitted with forged steel flanges.
  - .5 With drip connections.
  - .6 Accessories to permit repacking under full line service **from one side**.
  - .7 Two sets of alignment guides on each side of expansion joint, spaced to Manufacturer's requirement.
  - .8 Acceptable Products:
    - .1 Badger, Flexonic, Tube Turn, Yarway.
- 2.5.3 Grooved Type:
  - .1 For axial movement.
  - .2 Grooved type, located as indicated on drawings or per the manufacture's design between anchors.
  - .3 Designed to a minimum of 400 psi (2,760 kPa) to 12" (300 mm), maximum of 300 psi (2,068 kPa) for 14" (350 mm) – 24" (600 mm).
  - .4 Two sets of alignment guides on each side of expansion joint, spaced to Manufacturer's requirement.
  - .5 Selected compressed, neutral or expanded per the manufacture's design. External bracings are not to be removed until the system is fully pressurized.
    - .1 Acceptable products: Victaulic Style 155 Expansion Joint.

## 2.6 Anchors

- 2.6.1 Contractor and Engineer to confirm with the Structural Engineer that the structure is suitable for mounting of the Anchor and the load placed on the structure before level one is poured and prior to install.
- 2.6.2 Anchors shall be fabricated from mild steel plate and structural steel angle and channel sections, in accordance with ANSI B.31.
- 2.6.3 Anchors shall securely attach piping to structural members. Size anchors to accommodate forces due to pipe expansion and weight.

- 2.6.4 Where bolts secure anchor to structure, weld bolts to plate. Arrange anchors so that bolts are in shear not in tension.
- 2.6.5 Provide anchors on both sides of expansion devices, as indicated on drawings, and as required to control flexing of the piping system.
- 2.6.6 Fabricated structural anchors shall be engineered and sealed by a professional engineer in the jurisdiction where the project is located. Sealed shop drawings shall be submitted and reviewed by the engineer of record prior to installation.
- 2.6.7 Riser clamps are not suitable for use as anchors.
- 2.6.8 Where grooved piping systems are utilized, incorporate as required.

## **2.7 Expansion Loops**

- 2.7.1 Provide expansion loops as required.
- 2.7.2 Expansion loops shall be of welded construction with long radius elbows. Three legs of expansion loop shall be equal.
- 2.7.3 For grooved pipe systems, flexible couplings and fittings can be used to accommodate thermal expansion and contraction.. Contractor to coordinate with grooved product manufacturer for expansion loop design and design reviewed by the consultant prior to installation

## **2.8 Riser and Horizontal Thermal Movement Accommodation**

- 2.8.1 Where grooved piping systems are utilized, contractor to coordinate with manufacturer to provide piping system design services to accommodate thermal movement and/or differential settlement of the piping system, included but not limited to, risers and horizontal piping systems. The service includes a detailed schematic design locating anchors, anchor loads, guides, expansion joints and any other required grooved components to accommodate movement. A calculation report showing thermal movement and accommodation shall be provided. The design shall be sealed by a qualified professional engineer from the jurisdiction in which the project is being constructed is required.
- 2.8.2 Where grooved components are used for thermal expansion, the contractor shall use grooved product manufacturer's anchors.

## **2.9 Guides**

- 2.9.1 Pipe alignment guides shall be sized to accommodate pipe insulation.
- 2.9.2 Riser clamps are not acceptable for use as guides.
- 2.9.3 Acceptable Product: Metraflex Style IV Guides, Hyspan Series 9500.

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### 3 . **EXECUTION**

#### 3.1 **Installation**

- 3.1.1 Install piping systems with due regard and provision for expansion avoiding strain damage to equipment and building. Provide adequate expansion and contraction for piping running horizontally across building expansion joints.
- 3.1.2 Only major expansion configuration and fittings have been shown on the drawings. Provide required additional compensators, loops and wing connection.
- 3.1.3 Provide two pipe guides per side of expansion joint or expansion loop so that movement takes place along axis of pipe only. Placement of guides shall be at a minimum of 4 and 14 pipe diameter from expansion joint.
- 3.1.4 Install welded expansion loops, cold sprung 50% of calculated expansion.
- 3.1.5 Install at least three elbows in branch connections. Where space does not permit 3 elbows, install braided flexible pipe connectors in accordance with Manufacturer's recommendations. Three elbow branch connections shall have sufficient developed length to ensure that excessive stresses are not generated in piping and shall be no less than 36" (900 mm).

#### 3.2 **Expansion Joints**

- 3.2.1 Install expansion joints where shown on drawings in strict accordance with Manufacturer's detailed installation instructions.
- 3.2.2 Be aware of temperature when expansion compensator is installed to properly establish the length.
- 3.2.3 Ensure that expansion joints are not damaged during hydrostatic testing.
- 3.2.4 Piping shall be tested hydrostatically with expansion joints in place using cold water.
- 3.2.5 Bellows Type:
  - .1 Install union on one end of each screwed expansion joint.
  - .2 Remove slippage bolts and spacers after installation.
  - .3 Locate expansion joint centrally between anchors and position guides to Manufacturer's specific requirement. Provide structure as required to properly mount guides.
  - .4 Ensure that piping is properly aligned through expansion joint, over full travel.
  - .5 Adjust installed length of expansion joint to suit ambient temperature at time of installation.

- .6 A Representative of Manufacturer shall be present when piping is energized.
- 3.2.6 Sleeve Type:
  - .1 Locate expansion joint centrally between anchors and position guides to Manufacturer's specific requirement. Provide structure as required to properly mount guides.
  - .2 Set and secure base, if base mounted. Provide structure as required.
  - .3 Ensure piping is properly aligned through expansion joint, over full travel.
  - .4 Adjust installed length of expansion joint to suite ambient temperature at time of installation.
  - .5 Pack joint for service.
- 3.2.7 Grooved Type:
  - .1 External bracings are not to be removed until the system is fully pressurized.
  - .2 A Representative of Manufacturer shall be present when piping is energized.

### **3.3 Anchors**

- 3.3.1 Contractor and Engineer to confirm with the Structural Engineer that the structure is suitable for mounting of the Anchor and the load placed on the structure before level one is poured and prior to install.

### **3.4 Guides**

- 3.4.1 Provide pipe alignment guides on each side of all expansion joints and/or expansion loops in accordance with manufacturer's requirements.
- 3.4.2 Riser clamps are not acceptable for use as guides.

### **3.5 Flexible Hoses – Braided**

- 3.5.1 Install braided flexible hoses where shown on drawings and as flexible connections to designated heating/cooling terminal units.
- 3.5.2 On screwed connections, install a union on one end.
- 3.5.3 Do not torque hose.
- 3.5.4 Ensure braided flexible hoses are not damaged during hydrostatic testing.

**END OF SECTION**

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1. **GENERAL**

1.1 **Related Work**

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

2. **PRODUCTS**

2.1 **Flow Measure Devices – Liquid**

- 2.1.1 Flow measuring device to be sized to provide a read-out signal between 10 to 40 inches WG (2488 and 9954 PA).
- 2.1.2 When required minimum straight pipe lengths cannot be provided for in-line devices, use elbow or Venturi type devices.
- 2.1.3 Each element shall be completed with instrument shut-off valves with finger tight connections and identification tag and chain.
- 2.1.4 Each element shall be complete with chained metal tag showing element size, location, volume, and differential signals.
- 2.1.5 Acceptable Products:
- .1 Elbow Type - Measurell.
    - .1 NPS 2 (50 mm) and under: cast bronze elbow, screwed ends, 125 psi (860 kPa).
    - .2 NPS 2½ (65 mm) and over: steel elbow, welded ends, 125 psi (860 kPa).
    - .3 Schedule 40: all fluids closed circuit.
    - .4 Schedule 80: on open circuits.
  - .2 In-line type - Verabar, Accutube, Flo-Probe, Presco, Valitube.
    - .1 NPS 1½ (40 mm) and under: Verabar, Model C050 series, Schedule 40 pipe nipple with factory installed sensing probe.
    - .2 NPS 2 (50 mm) and over: Verabar, Model C100 series, standard insert sensor with ½" (15 mm) threaded weld coupling.
  - .3 Venturi type - Gerand, Preso.
    - .1 NPS 2 (50 mm) and under: brass screwed.
    - .2 NPS 2½ (65 mm) and over: cast-iron or steel, flanged, butt-welded or roll grooved couplings where permitted.
- 2.1.6 Provide direct read-out dial type meter complete with connecting hoses and calibration chart to read measured flow. Flow meter shall

be calibrated inches (mm) of water and shall be suitable for water/glycol. Calibrate for water systems and provide correction data for 40% glycol.

.1 Acceptable Products:

.1 Eagle Eye, Gerand, Preso, Western Meter Model SCL101.

## **2.2 Flow Measuring Devices – Liquid (Electronic Output)**

2.2.1 Flow meters shall be manufactured by Annubar, Model No. 1151DP, consisting of flow sensor, transducer, gauges, mounting flange and accessories.

2.2.2 Accuracy shall be  $\pm 0.2\%$  of calibrated span and  $\pm 1\%$  error. Permanent pressure loss shall not exceed 25% of pressure differential reading. Accuracy shall be consistent to turndown ratio 25 to 1. Flow fitting shall be diamond shape.

2.2.3 Each flow fitting shall be complete with identification tag, conversion chart, quick disconnect gauge fittings and shut-off cocks.

2.2.4 One differential meter shall be complete with hoses, shut-off fittings, bleed valves and carrying case.

2.2.5 Flow meters shall be selected for temperature and pressure of installation. Transducer shall be selected for maximum pressure drop range.

## **2.3 Steam Meters**

2.3.1 Mechanical Type:

.1 Steam pressure rated for 250 psi (1,725 kPa) and temperature to 450°F (232°C).

.2 Body - cast-iron, cast steel or bronze.

.3 Orifice plate, spindle, turbines, damping fan and reduction drive constructed of monel.

.4 Integral direct reading counter box to register in lb (kg) steam per hour.

.5 Accuracy:  $\pm 2\%$  - maximum flow to 1/6 of maximum flow.

.6 Meter sizes larger than NPS 4 (100 mm) to be mounted with by-pass arrangement.

.7 Where by-pass installation is required, include necessary valves, bends, stainless steel orifice plate and screwed flange adaptors.

.8 Standard of Acceptance:

.1 Kent Cambridge RS/C, BIF

2.3.2 Electronic Type:

.1 Minimum Requirements:



- .1 316 stainless steel body with vortex shedding element.
- .2 Suitable for "wafer" installation between flanges.
- .3 316 stainless steel body, flanges and vortex shedding element.
- .4 Steam pressure rated at 150 psi (1,034 kPa).
- .5 Explosion and vapour proof electrical housing.
- .6 Pulse **4 to 20 MA analog** output signal.
- .7 15 to 30 volts DC input.
- .8 Accuracy:  $\pm 1.6\%$  of actual steam flow rate.
- .2 Accessories:
  - .1 Pressure Transmitter - model IGP10-A20D1C-V2, span limits 0 - 150 psi (1,034 kPa).
  - .2 Mass Flow Computer - model 75MCA-FEEFC with field-mounted enclosure.
- .3 Standard of Acceptance:
  - .1 Foxboro Vortex flow meter - model 83W-A0\*S1SSTNA.
- .4 Note: Units available from Simark Controls LTD, Telephone: (877) 940-7772.

### 3. **EXECUTION**

#### 3.1 **Flow Measuring Devices – Liquid**

- 3.1.1 Install flow measuring devices in piping circuits to establish operational flow rates. Measuring devices shall be located where shown on drawings.
- 3.1.2 Install in accordance with Manufacturer's installation instructions and in correct size of pipe. Reduce pipe size as required.
- 3.1.3 Install isolating globe, ball or needle valves with  $\frac{1}{4}$ " (6 mm) male end SAE flare connection on pressure tapping connections.
- 3.1.4 Provide and install quick-connect gauge couplings.

#### 3.2 **Steam Meters**

- 3.2.1 Install steam meter complete with strainer and isolating valve, where shown on drawings in strict accordance with meter Manufacturer's installation instructions. Take care to observe minimum dimension requirements.
- 3.2.2 Connections to DP transmitters and DDC System to be done by Controls Contractor.

**END OF SECTION**

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1. **GENERAL**

1.1 **Related Work**

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

2. **PRODUCTS**

2.1 **General**

- 2.1.1 Select thermometers and pressure gauges so that their operating range falls in middle half of scale range.

2.2 **Thermometers – Piping**

2.2.1 Acceptable Manufacturers:

- .1 Marsh, Moeller, Terice, Weiss, Weksler, Winters.

2.2.2 Minimum Requirements:

- .1 Thermometers to be in accordance with Canadian General Standards Board CGSB 14.4 - M88.  
.2 Pipe mounted stem type - mercury actuated, adjustable angle type.  
.3 Refer to flow schematics for location of pipe mounted thermometers and wells.

2.2.3 Case:

- .1 Stem type – Stainless Steel. Case shall be provided with clear glass or heat resistant plastic window.

2.2.4 Scale:

- .1 Stem type - 9" (225 mm) scale length.  
.2 White background with temperature range in black.  
.3 Dual Celsius and Fahrenheit scale.

2.3 **Thermometers – Duct/Panel Mounted**

2.3.1 Acceptable Manufacturers:

- .1 Moeller, Terice, Weiss, Weksler, Winters.

2.3.2 Minimum Requirements:

- .1 Thermometers to be in accordance with Canadian General Standards Board CGSB 14-GP-2a.  
.2 Duct mounted dial type - solid liquid filled with remote capillary element.

- .3 Panel mounted dial type (surface) type - vapour filled direct mounting.
- .4 Panel mounted dial type (flush) type - remote liquid filled capillary element.

2.3.3 Case:

- .1 Dial type - cast aluminum, black enamel steel or stainless steel with stainless steel or chrome-plated face ring.

2.3.4 Scale:

- .1 Dial type - nominal 4-½" (115 mm) unless otherwise indicated.
- .2 White background with temperature range in black.
- .3 Dual Celsius and Fahrenheit scale.

**2.4 Pressure Gauges – Piping**

2.4.1 Acceptable Manufacturers:

- .1 Marsh, Moeller, Trerice, Weiss, Winters.

2.4.2 Minimum Requirements:

- .1 Gauges to be in accordance with ANSI B40.1 Grade "A" level.
- .2 4-½" (115 mm) cast aluminum, black steel or stainless steel case, with stainless steel or chrome-plated face ring.
- .3 White background with pressure range in black.
- .4 Dual kPa and psig scale.
- .5 Phosphor bronze bourdon tube, silver brazed tip and socket ¼" (6 mm) NPT lower connection.
- .6 Rotary type bushed movement, silicone dampened to prevent pointer oscillation.
- .7 Gauges to be registered with Provincial Boiler and Pressure Vessel Safety Branches with CRN number.
- .8 ULC listed for use on fire protection systems.
- .9 Accuracy shall be 1% off full scale over the middle half of the scale.

2.4.3 Accessories:

- .1 Install needle valve ahead of each gauge.
- .2 Install an anti-syphon loop (suitable for steam pressure) ahead of each gauge on steam systems.

**2.5 Test Plugs for Pressure/Temperature**

- 2.5.1 Provide ¼" (6 mm) NPT solid brass test plug fitting complete with brass chain where indicated.

2.5.2 Test plugs shall be capable of receiving either pressure or temperature  $\frac{1}{8}$ " (3.0 mm) OD Dual seal core shall be Nordel suitable for temperature of 350°F (177°C) and shall be rated zero leakage from vacuum to 1,000 psi (6,895 kPa).

2.5.3 Provide 1 master test kit containing 2 test pressure gauge of suitable range, 1 gauge adaptor,  $\frac{1}{8}$ " (3.0 mm) OD probe and 2 stem pocket testing thermometers of suitable range.

2.5.4 Acceptable Products:

- .1 Sisco P/T Plugs.
- .2 Trerice.

## **2.6 Test Thermometer**

2.6.1 Hand over test thermometer in protective case to Owner during Owner's Demonstration and Instruction Period. Provide same make and type as permanently installed thermometers suitable for use with pipe mounted wells. 30°F (-1°C) to 140°F (60°C).

2.6.2 Obtain two signed receipts from Owner certifying that test thermometer has been received. Hand one over to Consultant.

## **2.7 Thermometer Wells**

2.7.1 For copper pipe use copper or bronze. For steel pipe use brass, separable socket,  $\frac{3}{4}$  NPT.

2.7.2 Thermowell to be registered with Provincial Boiler and Pressure Vessels Safety Branch with CRN number.

# **3 . EXECUTION**

## **3.1 General**

3.1.1 Install thermometers and gauges to be easily read from floor or platform. If this cannot be accomplished, install remote reading thermometers and gauges.

3.1.2 Install engraved lamaroid nameplates as specified in Section 23 05 53 - Identification (identifying medium).

## **3.2 Thermometers**

3.2.1 Install in wells on piping.

3.2.2 Install separable well to minimize restriction to flow and, if necessary, install in section of oversized pipe.

3.2.3 Install wells where indicated for use with test thermometers.

3.2.4 Install in locations as indicated and on inlet and outlet of:

- .1 Heat exchangers.

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- .2 Water heating and cooling coils.
  - .3 Water boilers.
  - .4 Chillers - condenser and chilled water.
  - .5 Cooling towers and fluid towers.
  - .6 Central system water source heat transfers.
- 3.2.5 Use extensions where thermometers are installed through insulation.

**3.3 Pressure Gauges**

- 3.3.1 Install the following locations:
- .1 Suction and discharge of pumps.
  - .2 Upstream and downstream of PRVs.
  - .3 Inlet and outlet of waterside of coils (excluding terminal unit coils) and heat exchangers
  - .4 In other locations indicated.
- 3.3.2 Use extensions where pressure gauges are installed through insulation.
- 3.3.3 Where single gauge is used to measure multiple points, provide needle valves to isolate each point, including pressure gauge.

**END OF SECTION**

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## 1. GENERAL

### 1.1 Related Work

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

### 1.2 General

- 1.2.1 Provide hangers and supports to secure equipment in place, prevent vibration, protect against damage from earthquake, maintain grade, provide for expansion and contraction and accommodate insulation.
- 1.2.2 Provide insulation protection saddles on insulated piping.
- 1.2.3 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS-SP58.
- 1.2.4 Set inserts in position in advance of concrete work. Use grid system in equipment rooms.
- 1.2.5 Support from top of structural members. Where structural bearings do not exist or inserts are not in suitable locations, suspend hangers from steel channels or angles. Provide supplementary structural members, as necessary.
- 1.2.6 Do not suspend from metal deck.
- 1.2.7 Hangers for copper pipe shall be copper plated or plastic dipped unless pipe hangers bear on piping insulation (cold services).
- 1.2.8 All exterior roof mounted wire braces and supports/anchors/fittings shall be of aircraft grade stainless steel, with minimum cable size of 0.15" (4.0 mm) diameter.

## 2. PRODUCTS

### 2.1 Upper Attachments

- 2.1.1 Concrete:
- .1 Inserts for cast-in-place concrete: galvanized steel wedge or universal. ULC listed for pipe NPS  $\frac{3}{4}$  (20mm) through NPS 8 (200 mm) - Anvil Fig. 281 or 282, Hilti KCM-WF and KCM-PD.
  - .2 Carbon steel plate with clevis for surface mount: malleable iron socket with expansion case and bolt. Minimum two expansion cases and bolts for each hanger - Grinnell/Anvil, plate fig. 49, socket fig. 290 and Taylor plate fig. 166, socket fig. 64.

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- .3 Drilled concrete insert shall be Hilti Model HSL.
    - .1 Acceptable Products: Holdrite #121LD, #125, #205
  - .4 Inserts shall be ICBO approved.
  - .5 Power/powder actuated fastenings and drop-in anchors are not permitted to be used for tensile loading (i.e. suspension of mechanical equipment) or for seismic anchorage and/or restraint.
- 2.1.2 Steel Beam (Bottom Flange):
- .1 Cold piping NPS 2 (50mm) and under: ductile iron C clamp - Anvil fig. 92 with fig. 89X retaining clip, Taylor fig. 406 with fig. 416 retaining clips.
  - .2 Cold piping NPS 2½ (65 mm) and larger and hot piping: forged steel beam clamp - Anvil fig. 292, Holdrite #280, Holdrite #261, Taylor 450.
- 2.1.3 Steel Beam (Top):
- .1 Cold piping NPS 2 (50 mm) and under: ductile iron “top of beam” C clamp - Anvil fig. 92 with fig. 89X retaining clip, and Taylor fig. 406 with fig. 416 retaining clip.
  - .2 Cold piping NPS 2½ (65 mm) and larger and hot piping: steel jaw, hook rod with nut, spring washer and plain washer - Anvil fig. 227, Holdrite #261.
- 2.1.4 Steel Joist (Top Chord):
- .1 Cold piping NPS 2 (50 mm) and under: steel washer plate with double locking nuts - Anvil fig. 60, Taylor fig. 80.
  - .2 Cold piping NPS 2½ (65 mm) and larger and hot piping: steel washer plates with double locking nut, carbon steel clevis and malleable iron socket - Anvil: washer plate fig. 60, clevis fig 66, socket fig. 290, Holdrite #261 or #115 with #271 Silencer, Taylor: washer plate fig. 80, clevis fig. 67, socket fig. 64.
- 2.1.5 Steel Channel or Angle (Bottom):
- .1 Cold piping NPS 2 (50 mm) and under: malleable iron C clamp - Anvil fig. 86, Taylor fig. 301.
  - .2 Cold piping NPS 2½ (65 mm) and larger and hot piping: universal channel clamp - Anvil fig. 226.
- 2.1.6 Steel Channel or Angle (Top):
- .1 Cold piping NPS 2 (50 mm) and under: malleable iron “top of beam” C clamp - Anvil fig. 61.
  - .2 Cold piping NPS 2½ (65 mm) and larger and hot piping: steel jaw, hook rod with nut, spring washer and plain washer - Anvil fig. 227.
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**2.2 Middle Attachments (Rod)**

2.2.1 Carbon steel black (electro-galvanized/cadmium plated for mechanical rooms) continuous threaded rod - Anvil fig 146, Myatt fig. 434, Taylor fig. 54.

**2.3 Pipe Attachments**

2.3.1 Cold piping, steel or cast-iron: hot piping steel, with less than 1" (25 mm) horizontal movement; hot piping, steel, with more than 12" (300 mm) middle attachment (rod) length: adjustable clevis - Anvil fig. 260, Taylor fig. 24.

2.3.2 Cold copper piping: hot copper piping with less than 1" (25 mm) horizontal movement; hot copper piping with more than 12" (300 mm) middle attachment (rod) length: adjustable clevis copper plated - Anvil fig. CT-65, Taylor fig. 52.

2.3.3 Suspended hot piping, steel and copper, with horizontal movement in excess of 1" (25 mm); hot steel piping with middle attachment (rod) 12" (300 mm) or less pipe roller - Grinnell/Anvil fig. 174 or Grinnell/Anvil fig. 181, Taylor fig. 93, up to NPS 6 (150 mm) and Anvil fig. 171, Taylor fig. 95 NPS 8 (200 mm) and larger.

2.3.4 Bottom supported hot piping, steel and copper: pipe roller stand - Anvil fig. 271, Taylor 2795.

2.3.5 Spring hangers; where required to offset expansion on horizontal runs which follow long vertical risers - Anvil fig. 171, Taylor fig. 95, single pipe roll hanger with Anvil fig. 178, Taylor fig. 178.

**2.4 Riser Clamps**

2.4.1 Steel or cast-iron pipe: **galvanized** carbon steel - Anvil fig. 261, Taylor fig. 82, or Myatt fig. 182.

2.4.2 Copper pipe: carbon steel copper finished - Anvil fig. CT-121, Taylor fig. 85.

2.4.3 Isolated Clamp – Holdrite #273 with 10 ga bearing plates and pads.

**2.5 Saddles and Shields**

2.5.1 Cold piping: NPS ¾ (20 mm) and under: high density insulation with uninterrupted vapour barrier.

2.5.2 Cold piping: NPS 1 (25 mm) and over: protection shield with high density insulation under shield with uninterrupted vapour barrier. - Kingspan "Kooltherm Insulated Pipe Support Inserts", Shur-Fit Pro-Pipe.

2.5.3 Hot piping: NPS 3 (75 mm) and under: insulation over pipe hanger, Holdrite Insulation Coupling hanger.



- 2.5.4 Hot piping: NPS 4 (100 mm) and over: protective saddle with insulation under saddle - Anvil fig. 160 to 166, Taylor fig. 70-77.

## **2.6 Wall Supports**

### **2.6.1 Horizontal pipe adjacent to wall:**

- .1 Angle iron wall brackets with specific hangers.
- .1 Acceptable Products: Holdrite #261, #280, #255 and #285.

### **2.6.2 Vertical pipe adjacent to wall:**

- .1 Exposed pipe wall support for lateral movement restraint - Anvil fig. 262 or 263, Taylor fig. 46.
- .2 Channel type support - Burndy, Canadian Strut, Cantruss or Unistrut (arrangement to be acceptable to BC Boiler Inspection Department).

## **2.7 Floor Supports**

### **2.7.1 Horizontal Pipe:**

- .1 Do not support piping from the floor unless specifically indicated.

### **2.7.2 Vertical Pipe:**

- .1 Mid-point of risers between floor slabs - adjustable fabricated steel supports. Refer to Section 23 05 49 Seismic Restraints.

## **3 . EXECUTION**

### **3.1 Hanger Spacing**

#### **3.1.1 Spacing and middle attachment (rod) diameter as specified in paragraphs below or as in table below, whichever is more stringent.**

- .1 Plumbing piping: most stringent requirements of the Plumbing Code or authority having jurisdiction.
- .2 Fire protection: to applicable fire code; toggle hangers are unacceptable.
- .3 For Gas Piping refer to Gas Code CAN/CGA-B149.1.
- .4 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.
- .5 Within 12" (300 mm) of each horizontal elbow, tee, joints, etc.
- .6 Provide oversize hangers and high density insulation and saddle for cold piping with vapour barrier to accommodate maintaining vapour barrier. Use Kingspan "Kooltherm

Insulated Pipe Support Inserts" or Shur-Fit Pro-Pipe high density insulation products.

3.1.2 Maximum hanger spacing table:

Pipe Size: NPS	Rod Diameter inches (mm)	Maximum Spacing Steel Pipe ft (m)	Maximum Spacing Copper Pipe ft (m)
½	⅜" (9.5 mm)	6'-0" (1.8 m)	5'-0" (1.5 m)
¾, 1	⅜" (9.5 mm)	8'-0" (2.4 m)	6'-0" (1.8 m)
1 ¼, 1 ½	⅜" (9.5 mm)	10'-0" (3.0 m)	6'-0" (1.8 m)
2	⅜" (9.5 mm)	10'-0" (3.0 m)	10'-0" (3.0 m)
2 ½, 3, 4	½" (15 mm)	10'-0" (3.0 m)	10'-0" (3.0 m)
5, 6, 8	⅝" (16 mm)	10'-0" (3.0 m)	
10, 12	⅞" (22 mm)	10'-0" (3.0 m)	

### 3.2 Hanger Installation

- 3.2.1 Offset hanger so that rod is vertical in operating position.
- 3.2.2 Adjust hangers to equalize load.
- 3.2.3 Install hanger to provide minimum 1" (25 mm) clear space between finished covering and adjacent work.
- 3.2.4 Install high density insulation and saddle for cold piping with vapour barrier to accommodate maintaining vapour barrier.
- 3.2.5 Support vertical piping at every other floor.
- 3.2.6 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- 3.2.7 Where practical, support risers piping independently of connected horizontal piping.
- 3.2.8 Install plastic inserts between steel studs and piping.
- 3.2.9 For beam clamps, extend hanger rod tight to underside of beam with top bolt and washer.

### 3.3 Inserts

- 3.3.1 Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practical.
- 3.3.2 Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying piping over 4" (100 mm) or ducts over 60" (1,500 mm) wide.
- 3.3.3 Where concrete slabs form finished ceiling, finish inserts, flush with slab surface.

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- 3.3.4 Where inserts are omitted, drill through concrete slab from below and provide rod with recessed square plate and nut above slab, in concealed locations.
  - 3.3.5 Provide test mock-up for review.
  - 3.3.6 Provide inserts above chillers, pumps and sump pumps to permit equipment servicing. Provide an eyebolt.
  - 3.3.7 Inserts shall be installed in accordance with Manufacturer's recommendations and in no case closer than 7'-0" (2.1 m) apart.

**END OF SECTION**

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## 1. **GENERAL**

### 1.1 **Summary**

- 1.1.1 Section includes a complete pipe freeze protection system for above ground water piping consisting of a self-regulating heating cable, connection kits, electronic controller, and installation accessories.
- 1.1.2 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

### 1.2 **References**

- 1.2.1 Reference Standards
  - .1 UL515 – Electrical Resistance Heat Tracing for Commercial Applications
  - .2 IEEE 515.1-2012 Standard for the Testing, Design, Installation & Maintenance of Electric Resistance Trace Heating for Commercial Applications.
  - .3 CSA C22.2 No. 130-03 Requirements for Electrical Resistance Heating Cables & Heating Device Sets
  - .4 NFPA70 - National Electrical Code
  - .5 C22.1 – Canadian Electrical Code

### 1.3 **Submittals**

- 1.3.1 Product Data
  - .1 Heating cable data sheet
  - .2 UL, CSA, FM approval certificates for freeze protection for aboveground hydronic lines
  - .3 Pipe freeze protection design guide
  - .4 System installation and operation manual
  - .5 System installation details
  - .6 Connection kits and accessories data sheet
  - .7 Controller data sheet
  - .8 Controller wiring diagram
- 1.3.2 Shop Drawings
  - .1 Provide heat tracing circuit layout drawings indicating power connections, tees, end seal, cable length and circuit cable length.

### 1.4 **Quality Assurance**

- 1.4.1 Source Limitations: Obtain all heat tracing system cable & components from a single source from a single manufacturer.

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1.4.2 Qualifications

- .1 Manufacturers
  - .1 Manufacturer to show minimum of ten (10) years of experience in manufacturing electric self-regulating heating cables.
  - .2 Manufacturer will be ISO-9001 registered.
  - .3 Manufacturer to provide products consistent with UL 515, CSA 22.2 No 130-03 and IEEE 515.1 requirements.

1.4.3 Certifications

- .1 The system (heating cable, connection kits, and controller) shall be UL Listed, CSA Certified and FM Approved for freeze protection of aboveground hydronic piping.

**1.5 Delivery, Storage, and Handling**

1.5.1 Delivery and Acceptance Requirements

- .1 Deliver and handle products to prevent their deterioration or damage due to moisture, temperature changes, contaminates or other causes.
- .2 Deliver products to site in original, unopened containers or packages with intact and legible manufacturers' labels identifying the following:
  - .1 Product and Manufacturer
  - .2 Length/Quantity
  - .3 Lot Number
  - .4 Installation and Operation Manual
  - .5 MSDS (if applicable)

1.5.2 Storage and Handling Requirements

- .1 Store the heating cable in a clean, dry location with a temperature range 0°F (-18°C) to 140°F (60°C).
- .2 Protect the heating cable from water damage by protecting all cables ends from water ingress.

**1.6 Warranty**

1.6.1 Manufacturer Warranty

- .1 Provide material and system warranty for all goods listed below for two (2) years from date of purchase against faulty workmanship and use of defective materials when such goods are properly installed, operated, and maintained according to product documentation.
  - .1 Heating Cables, connection kits & accessories

- .2 Thermostats, controllers, panels contactors, sensors and accessories.

## 2. PRODUCTS

### 2.1 Heat Tracing System

#### 2.1.1 Manufacturers

- .1 Basis of Design Manufacturer: Subject to compliance with requirements, provide Raychem heat tracing products of **Pentair Thermal Building Solutions**. Email: **thermal.info@pentair.com** Website: **www.pentairthermal.com**
- .2 Submit comparable products of one of the following for approval by Mechanical Engineer:
  - .1 Hevi-Duty, Nelson, Termon, Nuheat
  - .2 Submit request for substitutions in accordance with Instructions to Bidders and Division 01 General Requirements.

#### 2.1.2 Materials

- .1 Heating cables shall be Raychem model XL Trace, self-regulating type heating cables.
  - .1 The Raychem XL Trace Heating Cables shall be designed for the following voltage/wattage:
    - .1 208-277VAC – 12 watts/ft @ 50°F -12XL-2-CT
  - .2 The heating cables shall have a **FLUOROPOLYMER** outer insulating jacket with the following information clearly printed on the cable – cable model #, agency listings, meter marks & batch ID.
  - .3 The heating cable shall have a modified polyolefin inner jacket and a tinned-copper braid to provide a ground path and enhance the cables ruggedness.
  - .4 The heating cable shall consist of a continuous core of conductive polymer that is radiation cross-linked, extruded between two (2) 16 AWG nickel-plated copper bus wires.
  - .5 The heating cable shall be UL part of a UL Listed, CSA Certified and FM Approved system.
  - .6 Constant wattage cables are not acceptable.
- .2 Heating Cable Connection Kits
  - .1 Heating cable connection kits shall be Raychem model
    - .1 RayClic.
    - .2 FTC.

- 
- .2 Contractor shall provide power connections, splices/tees and end seal kits to properly connect & terminate the heating cable circuit along the specified length of above ground water piping.
  - .3 All splices, tees and crosses shall be installed underneath the pipe insulation with service loops installed to allow for future service of the piping.
  - .4 Connection kits shall be rated NEMA 4X to prevent water ingress and corrosion. All components shall be UV stabilized.
  - .5 Connection kits shall be UL Listed or CSA Certified.
  - .3 Attachment of Heating Cable
    - .1 Attachment method of heating cable to the piping shall be Raychem model
      - .1 GT-66 – general purpose, high temperature, glass filament tape for operation @ 40°F and above.  
Contractor to install heating cable to pipe every 12" (300 mm) by wrapping around the pipe & over the heating cable.
      - .2 GS-54 – general purpose, high temperature, glass filament tape for operation @ 40°F and below.  
Contractor to install heating cable to pipe every 12" (300 mm) by wrapping around the pipe & over the heating cable.
      - .3 AT-180 – aluminum tape, high temperature for all plastic piping for operation @ 32°F and above.  
Tape is installed lengthwise over the heating cable.
    - .2 Metal cable ties are not permitted.
  - .4 Identification of Heating Cable System
    - .1 Contractor shall provide & install Raychem model **ETL "Electric Heat Traced" labels** on exterior of pipe insulation every 10' (3.0 m) feet on opposite sides of the pipe for the entire length of heat traced piping.
    - .2 In addition, all splices, tees, crosses and power connections shall be labeled on the exterior of the pipe insulation indicating that presence of a connection kit.
  - .5 Control
    - .1 Contractor shall provide **ONE (1) Raychem model C910-485** controller for **each heat tracing circuit** as indicated on heat tracing schedule.
    - .2 See table below for complete list of required controller capabilities:

Supply Voltage	100VAC to 277VAC		
Enclosure	NEMA4X FRP	Operating Temp Range	-40°F - 140°F
Display	6 character alphanumeric LED		
Control	Relay Type: DP, mechanical	Voltage: 277VAC max	Current: 30 A @ 104°F
Control Algorithms	On/Off	Proportional Ambient Sensing Control for energy saving	
Monitoring			
	Temperature	Low Alarm: 0°F to 180°F	High Alarm: 0°F to 200°F
	Ground Fault	Alarm Range: 20mA - 100mA	Trip Range: 20mA - 100mA
	Current	Low alarm range: .3A to 30A or off	
	Autocycle Test	Interval: 1-240 minutes or 1-240 hours	
Temp Sensor Inputs	Quantity: Two (2)	Type: 100Ω, platinum 3 wire	
Alarm Outputs			
	AC Relay: Isolated solid state triac, SPST, 0.75A max, 100VAC to 277VAC nominal		
	Dry Contact Relay: Pilot duty, 48VAC/DC, 500mA maximum, 10VA max. resistive switching		
	Outputs: Normally Opened or Normally Closed		
Stored Parameters			
	Minimum Temperature	Maximum Temperature	Max. ground fault current
	Maximum Heater current	Contactor cycle count	Time in Use
Alarm Conditions			
	Low & high temperature	Low current	Ground fault alarm & trip
	RTD failure	Loss of programmed values	EMR failure
Communications			
	Protocol: Modbus RTU	Topology: daisy chain	26AWG shielded twisted pair

.6 Temperature Sensors

- .1 Contractor shall provide **ONE (1) Raychem model RTD-50CS**, 100Ω, platinum 3 wire RTD for ambient temperature sensing for each C910-485 Heat tracing controller.
- .2 Temperature sensor shall be installed as indicated on drawings.

.7 Approval



- .1 The complete heat trace system shall be listed by a NRTL for freeze protection of above ground, hydronic piping.

### **3 . EXECUTION**

#### **3.1 Examination**

##### **3.1.1 Verification of Conditions**

- .1 Prior to installation of heating cable system, verify that all piping which will be heat trace has passed all hydrostatic/pressure test and is signed off by consultant.

##### **3.1.2 Preinstalling Testing**

- .1 Prior to installing heating cable on the piping an insulation resistance test shall be performed by the installing contractor to ensure integrity of heating cable as describe in the operation & maintenance manual. Provide written assurance of test and letter to be filed in operation and maintenance manual.

#### **3.2 Preparation**

##### **3.2.1 Protection of in-Place Conditions**

- .1 All heating cable ends shall be protected from moisture ingress until cable is terminated.
- .2 Acceptable methods are heat shrinking or installing Rayclic-E end seals.

#### **3.3 Installation**

##### **3.3.1 Comply with manufacturer's recommendations in the XL-Trace System Installation and Operation Manual.**

##### **3.3.2 Install electric heating cable according to the drawings and the manufacturer's instructions. The installer shall be responsible for providing a complete functional system, installed in accordance with applicable national and local requirements.**

##### **3.3.3 Interface with Other Work**

##### **3.3.4 Connection of all electrical wiring shall be according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."**

##### **3.3.5 Grounding of controller shall be according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."**

##### **3.3.6 Pipe Insulation shall be according to Section 23 07 19 "HVAC Piping Insulation" and is required for a properly operating heat trace system.**

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**3.4 Field Quality Control**

**3.4.1 Field Tests and Inspections**

- .1 The following test shall be performed after the heat cable has been installed but before the insulation and after insulating the piping. The results of both sets of tests shall be recorded as detailed in the Raychem Pipe Freeze Protection Installation and Maintenance Manual and included in submittals to owner:
  - .1 Continuity Test
  - .2 Insulation Resistance – 2500VDC
  - .3 Capacitance Check – Circuit Length Verification
  - .4 Power Check
  - .5 Ground Fault Test

**3.4.2 Non-Conforming Work**

- .1 Any heat tracing circuit which fails the any of the above test must be corrected prior to commissioning or startup of the system.

**3.5 System Start-Up**

- 3.5.1 Provide a factory-certified technician or manufacturer's representative for startup & commissioning of the heat tracing system and controller.
- 3.5.2 Coordinate all controller settings with mechanical engineer prior to programming the controller.
- 3.5.3 Provide commissioning report in submittals package to consultant for review, and for copy to be placed in the operations and maintenance manual.

**END OF SECTION**

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## 1. GENERAL

### 1.1 Related Work

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.
- 1.1.2 Provide vibration isolation on motor driven equipment, piping and ductwork, such that noise transmitted to occupied space by any other path than airborne is less than airborne noise transmitted from mechanical space to occupied space. The following are considered minimum requirements to meet this criterion.

### 1.2 Regulatory Requirements

- 1.2.1 Supply isolators and seismic restraints meeting the structural requirements of the **Ontario Building code and Ontario Fire Code<sup>3</sup>**, including Part 4 requirements with respect to seismic snubbers or provide equivalent requirements where integral seismic restraint is provided in isolators/bolting.
- 1.2.2 Provide vibration isolator housings as a safety guard with respect to isolated equipment and any contained compressed springs. Include "Fail Safe" Seismic restraint in vibration isolation designed to hold mechanical equipment and springs in place.

### 1.3 Shop Drawings, Qualifications and Submittals

- 1.3.1 Anchorage of equipment shall be certified by ON registered professional Structural Engineer who specializes in seismic restraint of resiliently mounted systems. Seismic integral isolation mounts or snubbers shall be approved and the associated OSHPD number clearly indicated on seismic device. Where OSHPD certification is not available, results of tests consistent with OSHPD procedures and approvals shall be submitted and certified by registered professional Structural Engineer.
- 1.3.2 Obtain relevant equipment information and provide shop and placement drawings for vibration isolation elements and steel bases for review before materials are ordered.
- 1.3.3 Provide attachment to both equipment and structure meeting specified forces involved. Attachment details to structure to be reviewed by Structural Consultant for project.
- 1.3.4 Submit samples of materials required to complete work of this section for inspection and review, as requested.
- 1.3.5 Post disaster dynamic analysis shall consist of computer printout where equipment has been modeled as single 3-dimensional rigid body composed of several rigidly attached lumped masses. For

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purpose of analysis at each support, non-linear snubber/air or spring isolator combination may be replaced by single equivalent linear spring which is dependent upon displacement amplitude. System analysis must be conservative and consider six natural modes and associated frequencies. Resultant data shall be combination of modal responses presented in form of most probable value (RMS of six modes) and upperbound value sum of absolute values of six modes.

#### **1.4 General**

- 1.4.1 This project is deemed a post disaster facility.
- 1.4.2 Provide vibration isolation on motor driven equipment with motors of  $\frac{1}{2}$  hp (0.37 KW) and greater (as indicated on the motor nameplate) and on piping and ductwork, as specified herein. For equipment less than  $\frac{1}{2}$  hp (0.37 KW), provide vibration isolation grommets at support points.
- 1.4.3 Provide seismic restraint for equipment including seismic restraint related hardware (bolts and anchors) from point of attachment to equipment to attachment to structure. Required anchors shall be indicated on shop drawings and clearly identified for correct location and to be readily identified after installation. Provide clear instructions for installation.
- 1.4.4 Place isolators under equipment so minimum distance between adjacent corner isolators is at least equal to height of centre of gravity of equipment. Include height of centre of gravity on shop drawings. Otherwise, design for increased forces on supports, and submit design calculations with shop drawings for approval. In particular, provide chiller isolation meeting this requirement.
- 1.4.5 Ensure isolation systems have a vertical natural frequency less than one third of lowest forcing frequency, unless otherwise unspecified. Use dynamic stiffness correction factors for elastomers and do not exceed 60 durometer.
- 1.4.6 Isolators and restraining devices, factory supplied with equipment, shall meet requirements of this section. Isolation supplier to check with pump supplier for number and location of isolators and if there is requirement for structural or inertia bases.
- 1.4.7 Provide concrete inertia bases or structural steel bases, where specified or required by equipment Manufacturer, located between vibrating equipment and vibration isolation elements, unless equipment Manufacturer certifies direct attachment capabilities. Coordinate with Division 3 for provision of concrete work.
- 1.4.8 Coordinate with Division 3 for provision of housekeeping pads at least 4" (100 mm) high under isolated equipment, or greater thickness where specified. Provide minimum 12" (300 mm)

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clearance between drilled inserts and edge of housekeeping pads. Housekeeping pads shall be tied to structure with reinforcement to meet Code seismic requirements.

- 1.4.9 For isolated equipment, design anchors, bolts, isolators and bases to meet Code requirements. For larger isolators, where Code requirement cannot be met by isolator housing, provide Type 6 seismic snubbers or Type 6P where post-disaster requirement is specified.
- 1.4.10 Use ductile materials in vibration and seismic restraint equipment.
- 1.4.11 Follow Structural Consultant's instructions for drilled inserts.
- 1.4.12 Coordinate with Section 23 33 00 "Air Duct Accessories" for ductwork connections to fans or plenums.
- 1.4.13 Provide flexible connectors between equipment and piping where required by Manufacturers to protect equipment from stress and reduce vibration in piping system. Meet connector Manufacturer's installation requirements as well as equipment Manufacturer's requirements.
- 1.4.14 Coordinate with Electrical for the provision of a minimum 180° hanging loop of flexible conduit for electrical connections to isolated equipment.
- 1.4.15 Supply isolators assembled and clearly labelled with instructions for installation by Contractor.

## 2. **PRODUCTS**

### 2.1 **Isolators – General**

- 2.1.1 Supply of vibration isolation equipment by one approved supplier with exception of isolators which are factory installed and are standard equipment with machinery. Confirm with Manufacturer that factory-installed isolators meet seismic requirements.
- 2.1.2 Select isolators at supplier's optimum recommended loading and do not load beyond limit specified in Manufacturer's literature.
- 2.1.3 Provide neoprene isolators and components using maximum 60 duro "Bridge bearing quality neoprene," as defined by CSA Standard CAN3-S6-M78. Ensure design of isolation and restraint elements allows adequate clearance to avoid binding.
- 2.1.4 Design springs "iso-stiff" ( $k_x/k_y = 1.0$  to  $1.5$ ) with a working deflection between 0.3 and 0.6 of solid deflection.
- 2.1.5 Provide hot dipped galvanized housings and neoprene coated springs, or other acceptable weather protection, for isolation equipment located outdoors or in areas where moisture may cause corrosion.

2.1.6 Elastomeric components in Type 1 and Type 2 isolation products and Type 6 and 6P seismic snubbers shall be bridge bearing neoprene meeting CSA Standard CAN3-S6 and CAN/CSA-S6-88. Durometer shall be defined per ASTM D 675 and within +/- of stated durometer. Minimum tensile strength (2,000 psi (13,790 kPa) for 40 durometer and 2,500 psi (17,240 kPa) for 50 and 60 durometer) and minimum elongation at break point (40 duro = 450%, 50 duro = 400% and 60 duro = 350%) to be per ASTM D 412. Tests for aging shall be per ASTM D 573 where, when tested in a 212°F oven for 70 hours, increase in hardness is no greater than 15%, tensile strength change does not exceed 15% and elongation to break is not reduced by more than 40%. Effects of ozone on product shall be as prescribed by ASTM D 1149 and material will show no cracks when tested. Compression set will be determined by ASTM 395, Method B and 40 duro product shall not exceed 40% and 50 and 60 duro product shall not exceed 25%. Compounding of the neoprene shall be in strict accordance with the Raw Material Supplier's formulation, in order to meet the above noted test procedures.

## **2.2 Isolators – Type 1, Pads**

2.2.1 Neoprene or neoprene/steel/neoprene pad isolators. Select Type 1 pads for minimum  $\frac{3}{32}$ " (2.5 mm) static deflection or greater. Use hold down bolts selected for seismic loads. Isolate bolts from base of unit using neoprene hemi-grommets. Avoid over-compressing grommets (e.g. use Hilti HVA adhesive set bolts, or equal, with steel washers and lock nuts, adjusted finger tight to hemi-grommets). Size bolt and hemi-grommet for minimum lateral clearance. Use grommets only on light-weight equipment.

2.2.2 Where use to isolate equipment having to be anchored to meet post disaster requirements, provide dynamic analysis as per clause 1.3.5 of this section.

2.2.3 Acceptable Products:

- .1 Mason Super W pads.
- .2 Mason Industries Type HG Hemi-Grommets.
- .3 EAR Grommets.
- .4 Kinetics Noise Control Inc. Type RSP.
- .5 Vibro-Acoustics Neo+.
- .6 Vibro-Acoustics Grommet Washers.

## **2.3 Isolators – Type 2, Rubber Floor Mounts**

2.3.1 Rubber/neoprene-in-shear isolators designed to meet specified seismic requirements. Select for 0.15" (4.0 mm) minimum static deflection and bolt to structure. Rubber isolators, provide protection

in design of isolator to avoid contact of rubber element to oil in mechanical room.

2.3.2 Where use to isolate equipment having to be anchored to meet post disaster requirements, provide dynamic analysis as per clause 1.3.5 of this section.

2.3.3 Acceptable Products:

- .1 Mason BR, maximum 50 durometer.
- .2 Kinetics Noise Control Inc. Type RD, RQ.
- .3 Vibro-Acoustics SRD.

## **2.4 Isolators – Type 3, Spring Floor Mounts**

2.4.1 Spring mounts complete with levelling devices, selected to achieve 1" (25 mm) deflection under load. Spring to incorporate minimum ¼" (6.0 mm) thick neoprene sound pad or cup having 0.05" (1.3 mm) minimum deflection under load. Design isolator to meet specified seismic requirements.

2.4.2 Where use to isolate equipment having to be anchored to meet post disaster requirements, provide dynamic analysis as per clause 1.3.5 of this section.

2.4.3 Acceptable Products:

- .1 Mason SSLFH.
- .2 Mason SSLR (for chillers and cooling towers only).
- .3 Kinetics Noise Control Inc. FLS.
- .4 Vibro-Acoustics SCSR

## **2.5 Isolators – Type 4, Hanger Mounts**

2.5.1 Spring hangers, complete with ¼" (6.0 mm) thick neoprene cup/bushing sized for 0.05" (1.3 mm) minimum deflection, or neoprene hangers.

2.5.2 Acceptable Products:

- .1 Mason HS.
- .2 Kinetics Noise Control Inc. SH.
- .3 Vibro-Acoustics SH

## **2.6 Isolators – Type 5, Air Springs with Seismic Snubbers**

2.6.1 Air springs complete with air spring levelling valves assembly and Type 6 seismic stops, seismic restraints.

2.6.2 Design to operate at maximum air pressure of 100 psi (690 kPa). Provide air compressor where necessary.

2.6.3 Suitable for outdoor installation.

2.6.4 Acceptable Products:

- .1 Mason MAS air mount, Mason No. WF-39368-3 valves.

**2.7 Isolators – Type 6, Seismic Snubbers**

2.7.1 Seismic snubbers complete with minimum  $\frac{1}{8}$ " (3.0 mm) neoprene brushing and  $\frac{1}{4}$ " (6 mm) air gap. Snubber to act omni-directionally. Ensure brushing can easily be turned by hand after installation.

2.7.2 Acceptable Products:

- .1 Manson Z-1225.  
.2 Kinetics Noise Control Inc. - HS Series.

**2.8 Isolators – Type 6P, "Post Disaster" Seismic Snubbers**

2.8.1 Seismic stop complete with  $\frac{3}{4}$ " (20 mm) neoprene bushing, 50 durometer maximum, and  $\frac{1}{8}$ " (3.0 mm) air gap with removable sleeve for accurate installation. Snubber shall be designed to act omni-directionally and keep acceleration to equipment during seismic event, below fragility level of equipment (Equipment to function after earthquake).

2.8.2 Acceptable Products:

- .1 Mason Z-1011.  
.2 Kinetics Noise Control Inc. - HS Series.

**2.9 Closed Cell Foam Gaskets/Neoprene Grommets – Type 7N**

2.9.1  $\frac{3}{4}$ " (20 mm) thick continuous perimeter closed cell foam gasket to isolate base of package equipment, AHUs, exhaust fans, etc. from concrete floors/roof curbs. Select width for nominal 3 psi loading under weight of equipment and allow for 25% compression  $\frac{3}{16}$ " (4.5 mm). Increase width of curb using steel shim to accommodate gasket. For light equipment such as exhaust fans, deflection should be a minimum of 0.05" (1.3 mm). Contractor to check fire rating requirements specified for project.

2.9.2 Acceptable Products:

- .1 American National Rubber-EPDM-SBR blend SCE 41 type neoprene.  
.2 Mason Industries Type HG Hemi-Grommets.  
.3 Kinetics Noise Control Inc. Neoprene/EPDM Grommets.  
.4 Vibro-Acoustics Grommet Washers.

**2.10 Spring Isolation Curb/Curb Mounted Rooftop – Type 7S**

2.10.1 Packaged air handling equipment, curb mounted shall be mounted on spring isolation curbs. Lower member shall consist of sheet metal "Z" section containing adjustable and removable springs (see Type 3 above) that support upper floating section. Upper frame must provide continuous support for equipment and must be captive to



resiliently resist wind and seismic forces. All directional neoprene snubber bushings shall be minimum  $\frac{1}{4}$ " (6 mm) thick. Steel springs shall be laterally stable and rest on  $\frac{1}{4}$ " (6 mm) neoprene acoustical pads. Hardware shall be plated and springs provided with rust-resistant finish. Curb's waterproofing shall consist of continuous galvanized flexible counter-flashing nailed over lower curb's waterproofing and joined at corners by EPDM bellows. Spring locations shall have access ports with removable waterproof covers. Lower curbs shall have provision for 2" (50 mm) of insulation. Roof curbs shall be built to seismically contain rooftop unit. Unit shall be solidly fastened to top floating rail, and lower "Z" section anchored to roof structure. Curb shall have anchorage OSHPD pre-approval "R" number attesting to maximum certified horizontal and vertical load ratings.

2.10.2 Acceptable Products:

- .1 Mason RSC.
- .2 Vibro-Acoustics ARTR.

**2.11 Pipe Riser Guide/Anchor – Type 8**

2.11.1 Telescoping all direction acoustical pipe anchor consisting of two concentric steel tubes separated by  $\frac{1}{2}$ " (15 mm) thick neoprene isolation material. Hot application isolators.

2.11.2 Acceptable Products:

- .1 Mason ADA and VSG (H), Metraflex Style IV Guides/PGQ.
- .2 Generator exhausts, PRV stations, etc. - CMT VA 50247/25 Cushions, CMT W302 isolators.

**2.12 Flexible Connectors – Type 9**

2.12.1 Twin sphere flexible connectors with floating flanges complete with grommets control rods.

2.12.2 Acceptable Products:

- .1 Mason MFTNC Connector.
- .2 Mason ACC Control Cables.
- .3 Unisource Ultra-Sphere U302 EPDM – only for service below 200°F (93°C) and 200 psig (1,380 kPa), up to 12" (300 mm) diameter.
- .4 Metraflex Double Cablesphere.

**2.13 Flexible Connectors – Grooved**

2.13.1 Where grooved piping systems are used, three grooved flexible type couplings may be used in lieu of a flexible connector for vibration attenuation at equipment connections in applicable piping systems.

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The couplings shall be placed in close proximity to the source of the vibration.

**2.14 Concrete Inertia Bases**

- 2.14.1 Concrete inertia bases to be minimum of 1.5 times weight of isolated equipment. Base thickness shall be 1/12 of longest dimension of base, but no less than 6" (150 mm). Include with base, steel channel concrete form with required steel reinforcement (as determined by suppliers' Registered Professional Engineer). Provide additional steel as required by sleeves or inserts to receive equipment anchor bolts.
- 2.14.2 Use height saving brackets in mounting locations to maintain 1½" (40 mm) clearance below base.
- 2.14.3 Bases furnished with built-in motor slide rails. Motor location as specified/scheduled.
- 2.14.4 Acceptable Products:
  - .1 Mason Type K.
  - .2 Vibro-Acoustics CIB.

**2.15 Steel Bases**

- 2.15.1 Construct structural steel bases sufficiently rigid to keep deflection and misalignment within acceptable limits as determined by equipment Manufacturer.
- 2.15.2 Use height saving brackets in mounting locations to provide base clearance of 1½" (40 mm).
- 2.15.3 Bases furnished with built-in motor slide rails. Motor location as specified/scheduled.
- 2.15.4 Steel bases supplied as integral part of equipment to be supplied meeting above requirements.
- 2.15.5 Acceptable Products:
  - .1 Mason Type WF.
  - .2 Vibro-Acoustics DS.

**2.16 Grooved Connections to Pumps and AHU's**

- 2.16.1 3" (80 mm) to 12" (300 mm) Pump Connections. Enamel coated assembly, consisting of a Class 150 flange for pump connection, tri-service valve assembly consisting of a spring-actuated valve and butterfly valve with offset stem for 360-degree circumferential seating, and pipe spool with thermometer and pressure ports. Assembly comes with flexible couplings to accommodate vibration attenuation and stress relief. Assembly rated for working pressure to 300 psi (2,065 kPa).

- .1 Standard of Acceptance: Victaulic Series 380 Discharge Vibration Isolation Pump Drop.
- 2.16.2 3" (80 mm) to 12" (300 mm) Pump Connections. Enamel coated assembly, consisting of a suction diffuser with stainless steel basket and diffuser and Class 150 flange for pump connection, butterfly valve with offset stem for 360-degree circumferential seating, and pipe spool with thermometer and/or pressure ports. Assembly comes with flexible couplings to accommodate vibration attenuation and stress relief. Assembly rated for working pressure to 300 psi (2,065 kPa).
  - .1 Standard of Acceptance: Victaulic Series 381 Suction Vibration Isolation Pump Drop.
  - .2
- 2.16.3 3" (80 mm) to 12" (300 mm) Pump Connections. Enamel coated assembly, consisting of a 90-degree base elbow with Class 150 flange for pump connection, Wye pattern strainer with stainless steel perforated metal basket, butterfly valve with offset stem for 360-degree circumferential seating, and pipe spool(s) with thermometer and/or pressure ports. Assembly comes with flexible couplings to accommodate vibration attenuation and stress relief. Assembly rated for working pressure to 300 psi (2,065 kPa).
  - .1 Standard of Acceptance: Victaulic Series 382 Strainer Vibration Isolation Pump Drop.
- 2.16.4 2" (50 mm) through 6" (150 mm) Air Handling Unit Coil Supply and Return Connections. Enamel coated drop, consisting of ASTM A53 carbon steel pipe spool(s), straight and/or reducing tees or mechanical-T fittings, with base end cap with drain outlet and brass drain valve. Supply connections include a butterfly valve and Y-pattern strainer with PT ports, and the return connection includes a circuit balancing valve. Installation-ready, with flexible couplings to accommodate vibration attenuation and stress relief, rated for working pressure to 300 psi (2,065 kPa).
  - .1 Standard of Acceptance: Victaulic Series 385 Vibration Isolation Air Handling Unit Drop.

### 3. **EXECUTION**

#### 3.1 **Installation**

- 3.1.1 Execute work in accordance with specifications and in accordance with Manufacturer's instructions.
- 3.1.2 For equipment mounted on vibration isolators, provide minimum clearance of 2" (50 mm) to other structures, pipe equipment, etc.

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- 3.1.3 Before bolting isolators to structure, start equipment and balance so isolators can be adjusted to correct operating position before installing (seismically rated) anchors and/or welding.
  - 3.1.4 After installation and adjustment of isolators verify deflection under load to ensure loading within specified range and isolation is obtained.
  - 3.1.5 Where hold down bolts for isolators or seismic restraint equipment penetrates roofing membranes provide "gum cups" and sealing compound to maintain waterproof integrity of roof. Ensure sealing compound is compatible with isolator components such as neoprene. Coordinate with Roofing Sub-Contractor.
  - 3.1.6 Use Type 1 pads only where specified.
  - 3.1.7 Under equipment mounted on Type 3 mounts, which do not meet seismic requirement, provide Type 6 seismic snubbers.
  - 3.1.8 Provide Type 4 spring hangers for minimum static deflection of 1" (25 mm) for ceiling hung fans and air handling units, emergency generator exhaust piping and silencers, steam PRVs and any other vibrating sources.
  - 3.1.9 Provide Type 4 resilient hangers on piping, tanks, etc. connected to vibrating source, if piping is over NPS 1½ (40mm). Provide hangers for distance of 20'-0" (6 m) for NPS 2 (50 mm) pipe and 40'-0" (12.2 m) for NPS 10 (250 mm) pipe and chiller pipes. Isolate other pipe sizes for proportionate distance. Isolate piping serving cooling tower and chiller, including air-cooled chillers.
  - 3.1.10 Isolate pumps and axial fans rotating at more than 1170 RPM on Type 2 isolators.
  - 3.1.11 Use lowest RPM scheduled for two-speed equipment in determining isolator deflection.
  - 3.1.12 Provide concrete inertia bases on base mounted pumps unless pump Manufacturer certifies inertia base is not required. Only use pedestal support at pump intake pipe where inertia or steel base is large enough to support pedestal. Otherwise support piping using resilient hangers only.
  - 3.1.13 Provide concrete inertia bases on centrifugal fans where specified.
  - 3.1.14 Ensure pumps are installed and aligned so no piping loads are imposed on pump. Pumps and piping should be independently supported and aligned prior to final connection.
  - 3.1.15 Where ductwork, piping or boiler exhaust stacks, etc. connected to, or serving noise generating or vibrating equipment, is routed through walls, floors pipe chases, etc., to avoid contact with structure, future framing, drywall and other finishes which may

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radiate noise. Use Type 2 and Type 8 mounts. Submit proposed details to meet this requirement.

- 3.1.16 Make no connections between mechanical room equipment and drywall partitions adjoining occupied spaces. Mount equipment designed for wall mounting on non-critical block work or concrete walls. Connect hangers to concrete structure only. Where structure is steel, connect to major structural beams only, or to structural angles with gussets attached to concrete shear walls. Do not attach to light framing members such as OWSJs. Do not connect to edge of beam flange (e.g. with clips). Weld nut or threaded sleeve to bottom flange at centre, directly below web, to accommodate threaded hanger rod.
- 3.1.17 Provide Type 8 resilient elements in pipe anchors, where pipe anchors are within 40'-0" (12.2 m) of vibrating source or if located in pipe chase.
- 3.1.18 Protect neoprene isolator components from overheating or use Type 8 mounts.
- 3.1.19 Be responsible for ensuring that flexible duct connections (see Section 23 33 00) are installed with minimum 1½" (40 mm) metal-to-metal gap. Use flanges to ensure that flexible connectors are clear of airstream.
- 3.1.20 Isolate variable frequency drive controller using isolators or soft grommets such that structure borne noise transmission to occupied space is less than airborne noise transmission. Controller supplier to provide isolation, including wiring connections, to control flanking noise transmission. Provide isolation meeting seismic requirements.
- 3.1.21 Provide stabilizing springs limiting movement at flexible connections to 25% of fabric width under steady state conditions and 40% at start-up.
- 3.1.22 Floor or Pier Mounted Equipment: Isolate floor or pier mounted equipment on Type 3 isolators, unless otherwise specified.
- 3.1.23 Slab On Grade Mounted Equipment: For equipment mounted on slab on grade use on Type 2 isolators unless otherwise specified.
- 3.1.24 Pumps: Mount in-line pumps on two Type 2 isolators under each support foot.
- 3.1.25 Pumps: Isolate 25 hp (18.6 KW) pumps and larger on Type 5 air mounts. For slab on grade installations, isolate pumps on Type 2 mounts.
- 3.1.26 Chillers: Mount slab on grade chillers on Type 2 isolators. Otherwise use Type 5 air mounts, including air cooled chillers. Submit details of pipe supports on roof and wall/roof penetration

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- 3.1.27 Air Compressors: Isolate control air compressor on Type 3 isolators and concrete inertia base.
- 3.1.28 Cooling Towers: Mount cooling towers on Type 3 isolators and Type 6 seismic restraints to meet seismic requirements. Provide steel base with minimum W150 beams to distribute cooling tower weight evenly over isolators and with cross bracing designed to meet seismic requirements. Check with cooling tower Manufacturer that proposed installation provides adequate support for towers. Submit shop drawings of proposed steel base/seismic restraint assembly for review by Structural Consultant.
- 3.1.29 Cooling Towers: Mount cooling towers on Type 1 neoprene/steel/neoprene sandwich pads, unless otherwise specified. Provide steel base with minimum W150 beams to distribute cooling tower weight evenly over isolators and with cross bracing to meet seismic requirements. Submit shop drawings of proposed steel base/seismic restraint assembly for review by Structural Consultant.
- 3.1.30 Where weight of equipment may change significantly due to draining as in cooling tower or chiller, provide limit stops to limit isolator extension.
- 3.1.31 Steam PRVs: Isolate steam Pressure Reducing Stations (PRVs) and upstream and downstream piping and equipment for a distance of 50'-0" (15 m) Use Type 4 hangers only where insulated from heat. Install PRV station pipe support frames on Type 8 isolators.
- 3.1.32 Pumps: Mount base mounted end suction pumps greater than 15kw (20HP) on concrete inertia pads. Mount base mounted in line pumps on Type 2 rubber floor mats. Mount all pumps greater than 5kw (7.5HP) on Type 3 spring floor mounts unless noted otherwise.
- 3.1.33 Rooftop Air Handling Units:
- .1 Isolate rooftop air handling units on 2" (50 mm) x 40'-0" (12.2 m) x ¾" (20 mm) Type 1 neoprene waffle pads. Space waffle pads for nominal 40 psi (276 kPa) under weight of rooftop unit.
  - .2 Use hold down bolts selected for seismic loads. Isolate bolts from base of unit using neoprene hemi-grommets. Avoid over-compressing pads/gasket. Use Hilti HVA adhesive set bolts, or equal, with steel washers and lock nuts, adjusted finger tight to hemi-grommets. Size bolts and hemi-grommet for minimum lateral clearance.
  - .3 Where underside of AHU is a return plenum, provide 1" (25 mm) x ¾" (20 mm) thick continuous perimeter, closed cell foam neoprene gasket (Type 7N) between pads.
  - .4 Isolate equipment within rooftop units in accordance with this section, including fans, compressors, pumps and piping.

Ensure structure borne transmission of noise from rooftop unit is less than airborne transmission.

3.1.34 Rooftop Air Handling Units: Utilize Type 7S Isolator to spring isolate entire unit from roof deck/structure.

### 3.2 Inspections

3.2.1 Supplier shall provide assistance to Contractor as necessary during course of installation of isolation equipment.

3.2.2 Supplier shall inspect complete installation after system start-up and establish isolators for each piece of equipment are properly installed and adjusted. Supplier shall submit statutory declaration to Consultant stating complete vibration isolation installation is in accordance with his drawings and instruction and operates to his satisfaction.

### 3.3 Pipe Isolation Schedule

Pipe Size	Isolated Distance from Equipment
1" (25 mm)	120 diameters (10' (3 m))
2" (50 mm)	90 diameters (15' (4.5 m))
3" (80 mm)	80 diameters (20' (6 m))
4" (100 mm)	75 diameters (25' (7.5 m))
6" (150 mm)	60 diameters (30' (9 m))
8" (200 mm)	60 diameters (40'" (12.2 m))
10" (250 mm)	54 diameters (45' (13.5 m))

### 3.4 Equipment Isolation Schedule

Isolated Equipment	Base		Isolator	
	Type	Thickness	Type	Deflection
HVAC Pumps				
Air Cooled Water Chiller				
Fluid Coolers				

**END OF SECTION**

## 1. GENERAL

### 1.1 Related Work

- 1.1.1 This Specification Section forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- 1.1.2 References: American National Standards Institute (ANSI) – ASME A13.1 Scheme for the Identification of Piping Systems.

### 1.2 Equipment Identification

#### 1.2.1 Manufacturer's Nameplates:

- .1 Each piece of manufactured equipment shall have metal nameplate, with raised or recessed letters. Mechanically fasten plate to equipment.
- .2 Manufacturer's nameplates shall indicate Manufacturer's name, equipment model, size, serial number and electrical characteristics and pertinent information for any other service connections.
- .3 Include Underwriters' Laboratories Canada (ULC) or Canadian Standards Association (CSA) registration logos and those of other agencies, as required by respective agencies.
- .4 Nameplates shall be located so they are easily read. Do not insulate or paint over name plates.

#### 1.2.2 System Nameplates:

- .1 Each piece of equipment shall be identified with its equipment schedule identification, e.g. supply fan SF-1, cooling coil CC-1, pump P-1.
- .2 Identification letters shall be 2" (50 mm) high black letters on white background, sized to suit label or provide laminated plastic plates with black face and white centre of minimum size 3½" (90 mm) x 1½" (40 mm) x ⅜" (2.5 mm) engraved with ¼" (6.0 mm) high lettering. Use 1" (25 mm) high lettering for major equipment.
- .3 Apply nameplates securely in conspicuous places, on cool surfaces.
- .4 Identify systems, and areas or zones of building being serviced.

### 1.3 Piping Identification

#### 1.3.1 Piping Identification:

- .1 Each piping system shall be colour coded for identification and labelled with system identification code letters, including



temperature and pressure, if applicable, and directional flow arrow in accordance with Pipe Identification Colour Schedule.

.2 Identifying piping (pipe markers and direction arrows) at the following locations:

- .1 Adjacent to major valves and where valves are in series at no more than 6'-6" (2.0 m) intervals.
- .2 At least once in each room and 50'-0" (15 m) maximum spacing in open areas.
- .3 Gas piping to be identified at 6'-6" (2.0 m) intervals in ceiling plenums.
- .4 On both sides where piping passes through walls, partitions and floors.
- .5 Adjacent to major changes in direction.
- .6 At point of entry and leaving each pipe chase and/or confined space and piping accessible at each access opening.
- .7 At beginning and end points of each run and at each piece of equipment in each run.

.3 Identification labels may be stencilled. Identification arrows, labels and letters may be vinyl cloth (Brady B500) or vinyl film (Brady B946), with adhesive compatible with surface temperature.

.4 Identification colour bands for primary and secondary colours to indicate the type and degree of hazard shall be applied to overlap a minimum of 6" (150 mm). Ends to be stapled. Bands shall be Brady B550 vinyl cloth tape or Brady B946 vinyl tape, with adhesive compatible with surface temperature.

.5 Identification may consist of semi-rigid plastic vinyl labels with surface printing. On pipes larger than 6" (150 mm) diameter total O.D., these labels shall be saddle style, and shall ship complete with 34" (850 mm) long nylon cable ties for each label. Standard of acceptance: SMS Coil-Mark (<http://www.smillieltd.ca/pdfDocs/Identification-Systems/Coil-Mark.pdf>)

1.3.2 Valve Tags:

- .1 Provide valve identification tags and secure them using non-ferrous chain, braided band or plastic band (suitable for temperature). Tags may be of brass, aluminum, metalphoto, lamicoid or fibreglass, stamped or engraved, of 1" (25 mm) minimum diameter. Tags may also be 1¼" (32 mm) square, two-ply plastic with engraved black characters

on white background. Standard of acceptance: SMS valve tags (<http://www.smillieltd.ca/pdfDocs/Identification-Systems/PHSVT.pdf>)

- .2 Valves to be tagged include:
  - .1 Valves on main piping circuits.
  - .2 Valves on major branch lines.
  - .3 Valves on minor branch lines in horizontal service spaces, vertical service spaces and mechanical equipment rooms.
  - .4 DO NOT TAG valves on control valve stations, steam trap stations, fixture stops, or system drain valves.
  - .5 Drain valves and hose bibbs on systems containing glycol.
  - .6 Control valves.
- .3 Schedule valve numbers using sequential numbering system indicating location, service and the normal position (open or closed). Numbers shall be prefixed by letter "P" or letter "H" indicating valve is on plumbing or heating service.

#### **1.4 Ductwork Identification**

- 1.4.1 Identify plenum access doors with accessed items, e.g. Filter F-1, Supply Fan SF-1, Cooling Coil CC-1.
- 1.4.2 Stencil on plenum doors, downstream from air filter bank, "Do not open when fan operating."
- 1.4.3 Identify ductwork in mechanical equipment rooms to denote system and/or zone served and air flow direction arrow.
- 1.4.4 Identify automatic control dampers concealed in ductwork. Identify "open" and "closed" position of operator arm on outside of duct or duct insulation.
- 1.4.5 Identify hazardous exhaust ducts, e.g. fume hood, radioactive exhaust at not greater than 10'-0" (3.0 m) and at least once in each partitioned space. Radioisotope exhaust ducts shall be marked with radiation-warning symbol.
- 1.4.6 Identification letters shall be 2" (50 mm) high black letters on white background. Flow arrows shall be 2" (50 mm) wide by 6" (150 mm) long black arrows on white background. Stencil over final finish only.

#### **1.5 Ceiling Access Identification**

- 1.5.1 Secure 1/4" (6.0 mm) self-adhesive coloured dots (Brady Quik Dots or Avery Data Dots) to ceiling to identify location of access to equipment concealed above ceiling, according to the following schedule:

	Colour
Concealed equipment and cleaning access	Yellow
Control Equipment, including control valves, dampers and sensors	Black
Fire and smoke dampers	Red
Fire protection, including sprinkler equipment and drains	Red
Heating/Chilled water, DCW, DHW isolation valves	Green
Pipe mounted equipment, other than fire, smoke and sprinkler equipment	Green

1.5.2 When T-bar ceilings are installed, adhere coloured dots to T-bar framing, adjacent to panel to be removed.

### 1.6 Duct Access Identification

1.6.1 Secure 2" (50 mm) high, Gothic style self-adhesive stick-on letters, (Letrasign or Brady Quick Align) on duct access panels to identify their usage, according to the following schedule:

	Colour	Letters
Cleaning and service access	black	C.A.
Controls, including sensors	black	C
Dampers (backdraft, balance and control)	black	D
Fire dampers	red	Fire Damper
Smoke dampers and detectors	red	S.D.

### 1.7 Tagging Identification

1.7.1 Secure engraved laminated plastic identification tags (black face and white centre) on the following items:

- .1 Temperature control instruments, gauges and panels, coordinated with control diagrams identification.
- .2 Electrical switchgear supplied under the Mechanical.
- .3 Refer also to Controls Sections.

### 1.8 Identification Schedules

1.8.1 Submit schedules of the following for review prior to framing:

- .1 Pipe Identification Colours.
- .2 Valves.
- .3 Ceiling Access Identification Colours.
- .4 Duct Access Identification Colours.

1.8.2 Schedules will be required in each major mechanical room and at least one schedule will be required on each floor having minor mechanical room. Frame schedules under glass in matching frames and hang where directed.

- .1 Include one copy of schedules in each operating maintenance manual.

**1.9 Pipe Identification Colour Schedule**

<b>Service</b>	<b>Identification Lettering</b>	<b>Background Colour</b>	<b>Letters Colour</b>
Acid Waste	Acid	yellow	black
Boiler Blow Off Piping	-	yellow	black
Boiler Blowdown	-	yellow	black
Boiler Feed Water	B.F.W.	yellow	black
Chilled Water Return	CH.W.R.	green	white
Chilled Water Supply	CH.W.S	green	white
Cold Water Service	C.W.	green	white
Fire Combined Standpipes	SPR/S.P.	red	white
Compressed Air	COMP.A.	blue	white
Condensate - Medium Pressure	M.P.Cond.	yellow	black
Condensate - Low Pressure	L.P.Cond.	yellow	black
Condensate - Pumped	Pump.Cond.	yellow	black
Condenser Water Return	C.W.R	green	white
Condenser Water Supply	C.W.S.	green	white
Cooling Tower Sump Water Supply	C.T.W.S.	green	white
Cooling Tower Sump Water Return	C.T.W.R.	green	white
Distilled Water	Dist.W.	green	white
Domestic Cold Water	D.C.W.	green	white
Domestic H.W. Recirc.	D.H.W.R.	green	white
Domestic H.W. Supply	D.H.W.S.	green	white
Non-Potable Cold Water	N.P.W.	purple	white
Exhaust Piping	-	yellow	black
Fire lines W.S.	W.S.	red	white
Fuel oil 2,3,4,5,6	F.O.#	yellow	orange
Glycol Heating Return	GLR - do not drain	yellow	black
Glycol Heating Supply	GLS - do not drain	yellow	black
Heat Pump Water return	H.P.W.R.	yellow	black
Heat Pump Water supply	H.P.W.S.	yellow	black
Heat Recovery (cool)	HRC - do not drain	yellow	black
Heat Recovery (warm)	HRW - do not drain	yellow	black
Hot Water Return	H.W.R.	yellow	black
Hot Water Supply	H.W.S.	yellow	black
Natural Gas	Gas (Pressure)	yellow	orange
Propane	LP GAS	yellow	orange
Safety Valve Blowdown	-	yellow	black
Fire Sprinkler lines	SPR	red	white

<b>Service</b>	<b>Identification Lettering</b>	<b>Background Colour</b>	<b>Letters Colour</b>
Fire Sprinkler lines (Dry)	SPR (DRY)	Red	white
Steam	kPa	yellow	black
Sanitary Drain	SAN	None	None
Plbg Vent	PVent	None	None
Storm Drain	Storm	None	None

#### **1.10 Pipe Identification**

##### **1.10.1 Letters:**

- .1      ½" (15 mm) high – NPS 1¼ (32 mm) pipe and smaller.
- .2      1" (25 mm) high – NPS 1½ (40 mm) up to NPS 2½ (65 mm) pipe.
- .3      2" (50 mm) high – NPS 3 (80 mm) and larger pipe.

##### **1.10.2 Bands:**

- .1      1½" (40 mm) wide, except arrow bands 2" (50 mm) wide.

##### **1.10.3 Colours:**

- .1      Black arrows on yellow primary colour.
- .2      White arrows on red, blue or green backgrounds.

#### **1.11 Buried Piping Identification/Markers**

1.11.1 Metallic Pipe: Provide continuously printed 4" (100 mm) wide x 4 mil thick "Blaze Orange" plastic tape with printing indicating type of service of buried pipe. Place tape at ±12" (300 mm) above buried pipe in backfill.

1.11.2 Non-Metallic Piping: Provide detectable multi-ply tape consisting of aluminum foil core between two (2) layers of 4" (100 mm) x 4 mil thick "Blaze Orange" plastic tape with printing indicating type of service of buried pipe. Place tape at ±12" (300 mm) above buried pipe in backfill lifts.

1.11.3 Where multiple small pipes are buried in a common trench and do not exceed an overall width of 18" (450 mm), install a single tape line marker.

**END OF SECTION**

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**1. GENERAL**

**1.1 Related Work**

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

**1.2 Work Included**

- 1.2.1 Adjust and balance hydronic systems.
- 1.2.2 Adjust and balance domestic cold water systems, domestic hot water recirculation system and plumbing mixing valves.
- 1.2.3 Adjust and balance air systems.
- 1.2.4 Perform acoustic measurements.
- 1.2.5 Confirm operation of Fire Protection and Smoke Control Systems.

**1.3 Intent**

- 1.3.1 Perform work as an integral part of contract.

**1.4 Quality Assurance**

- 1.4.1 Acceptable TAB Contractors are: MDT Systems, KD Engineering, Western Mechanical Services, and Flotech Mechanical.
- 1.4.2 Acceptable TAB firms shall be credentialed by international organizations such as AABC (Associated Air Balance Council) and the NEBB (National Environmental Balancing Bureau). Exceptions to credentialed TAB firms would require submittal to the Consultant for review and approval.
- 1.4.3 Procedures shall be in accordance with current edition of AABC's National Standards for Field Measurement and Instrumentation, Total System Balance or NEBB's Procedural Standards for TAB Environmental Systems.
- 1.4.4 Each Balancing TAB Sub-Trade (other than those with proper acceptance) intending to bid for work shall submit the following information not less than seven days before close of Sub-Trade tenders. ANY FIRM THAT DOES NOT COMPLY WILL NOT BE ACCEPTED BY CONSULTANT.
- .1 List previous projects of similar scope with dates projects were executed.
  - .2 Outline depth of firm including principals, years of operation, address and phone number.
  - .3 List instruments and procedures that will be used on project.
  - .4 List name of job site supervisor and provide resume of his/her specific work experience.

- .5      Provide sample of balance report on project of similar scope.

**1.5      Submittals**

- 1.5.1      Submit name of proposed TAB firm for approval within **seven** days of contract award.
- 1.5.2      Include qualifications, including name and qualification of individual certifying reports. Failure to submit name of TAB firm within required time period shall be cause for Consultant to select an alternative firm to carry out work at no change in contract price.
- 1.5.3      Within 14 days of request, TAB schedules and agenda shall be submitted for approval. TAB work shall not commence until approved.

**1.6      Procedures**

- 1.6.1      General: Before starting TAB work, review with Consultant methods and instruments to be used. Include descriptive data, procedure data and sample forms.
- 1.6.2      Descriptive Data: Review design concepts and general function of each system including associated equipment and operation cycles including BAS Systems sequence of operations. Confirm listing of flow and terminal measurements to be performed and selection points for proposed sound measurements.
- 1.6.3      Procedure Data: Outline procedures for taking test measurements to establish compliance with requirements. Specify type of instrument to be used, method of instrument application (by sketch) and correction factors.
- 1.6.4      Data sheets required as a minimum are as follows:
- .1      Air System Schematic Diagram.
  - .2      Air Moving Equipment Test Sheet.
  - .3      Exhaust Fan Test Sheet.
  - .4      Air Distribution / Outlets Test Sheet.
  - .5      Air Distribution Duct Traverse Test Sheet.
  - .6      Air Moving Equipment Static Pressure Profile Test Sheet.
  - .7      Hydronic System Schematic Diagram.
  - .8      Circulation Water Pump Data Sheet.
  - .9      Hydronic Distribution / Terminal Test Sheet.
  - .10      Covering comments sheet detailing systems balanced setpoints.
  - .11      Note: All test sheets shall include a Column detailing achieved results as a % of design.

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**1.7 Cooperation**

1.7.1 TAB firm shall check and report defects or deficiencies that may affect balancing.

1.7.2 Mechanical Contractor shall cooperate with balancing firm to:

- .1 Provide sufficient time before final completion date so that TAB can be accomplished.
- .2 Provide labour and tools to make corrections without delay.
- .3 Place heating ventilating and air conditioning systems and equipment into full operation and continue operation.
- .4 Advise TAB firm of changes made to system during construction.
- .5 Install required test holes complete with removable and replaceable plugs.
- .6 Make necessary revisions to controls, dampers, fan and pump drives and consult with equipment Manufacturers as required to achieve specified systems performance.
- .7 Supply and install dampers as shown and where required to obtain final system balance.
- .8 Provide ladders scaffolds, tools and labour to assist work of balancing firm, including removing ceiling tiles and guards and adjusting pulleys and belts, replace when finished.
- .9 Control and/or equipment Manufacturer shall work with balancing firm when setting damper linkages and minimum outside air dampers. They shall be available for readjusting of dampers of controls improperly calibrated.
- .10 Set pressure regulating valves to operating and code conditions.
- .11 Check and set relief and safety valves to code requirements.
- .12 Clean strainers. Provide clean air filter immediately before air balancing.
- .13 Open fire dampers.
- .14 Change variable pitch pulley supplied on 15 hp (11 KW) motors and larger to fixed pulleys after air balance. Provide pulleys.
- .15 Provide drive changes required to suit final balance.

**1.8 Tests**

1.8.1 Give written 24 hour notice of date for tests.

1.8.2 Do not externally insulate or conceal work until tested and approved. Follow construction schedule and arrange for tests.

1.8.3 Conduct tests in presence of Consultant. Arrange for Owner's Representative to be present.



- 1.8.4 Bear costs including retesting and making good.
- 1.8.5 Refer to Piping Sections for specific test requirements.
- 1.8.6 Prior to tests, isolate equipment or other parts which are not designed to withstand test pressures.

## **2 . PRODUCTS**

### **2.1 Instruments**

- 2.1.1 Instruments for TAB of air and hydronic systems shall have been calibrated within six months and verified for accuracy before start of work.
- 2.1.2 Submit list of equipment to be used for balancing and calibration certificates for each instrument listed.

## **3 . EXECUTION**

### **3.1 General Procedures**

- 3.1.1 TAB to maximum flow deviation from specified values of 10% at terminal devices and -0% +5% at equipment or mean sound level deviation of 20 db. Provide air balancing volumes and settings for all air supply, exhaust and return air ducts and terminals regardless of whether a special air volume tag has been noted on the drawing.
- 3.1.2 Permanently mark setting on valves, splitters, dampers and other adjustment devices.
- 3.1.3 Take measurements to verify system TAB has not been disrupted or such disruption has been rectified.
- 3.1.4 At final field review, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner.
- 3.1.5 At completion, allow minimum two days for Consultant to witness test procedures and conduct tests for each system.
- 3.1.6 When building is occupied before completion, continue execution of work outside occupied hours.

### **3.2 Site Visits**

- 3.2.1 Schedule total of **5** site visits to correspond with site meetings held by Contractor. After each visit, submit written report to Contractor and Consultant. Site visits shall commence after start of air distribution work and be spread over remaining construction period to start of balancing.

- 3.2.2 Review of installation shall be made at scheduled visit and any additional dampers or valves required for proper balance shall be reviewed with Consultant and Contractors.
- 3.2.3 Allow for **5** visits to site to adjust systems for seasonal changes during warranty.

### **3.3 Acceptance**

- 3.3.1 Mechanical systems shall not be considered ready for final field review until TAB results are acceptable to Consultant.
- 3.3.2 If found that specified flows cannot be achieved on portions of system, actual conditions shall be reported to Consultant for consideration of correctable action before continuing TAB procedure.
- 3.3.3 If measured flow at final field review shows deviation of 10% at terminal devices, 5% at equipment or more or mean sound level deviation of 10 db or more from certified report listing, by more than 10% of selected areas, report shall be rejected.
- 3.3.4 If report rejected, systems shall be re-balanced and certified report submitted at no extra cost.

### **3.4 TAB Report**

- 3.4.1 Submit draft copies of reports before final acceptance of project. Provide [ ] copies of final report for inclusion in Operating and Maintenance Manuals.
- 3.4.2 Submit with report, fan and pump curves with operating conditions plotted.
- 3.4.3 Report shall be indexed as follows:
  - Section 1 Instrumentation and Measurement Procedures.
  - Section 2 System Data (Designed, Installed and Recorded), test sheets to be systems sequential.
- 3.4.4 Each system should include the following test sheets:
  - .1 System Schematics for both air and hydronic systems.
  - .2 Equipment test sheets.
  - .3 System distribution (inlet / outlets / valves) test sheets.
  - .4 Profile pressure test sheets.
  - .5 Comments sheet noting system setpoints.
    - .1 Section 3 Drawing.
    - .2 Section 4 Discussion of Results.
    - .3 Section 5 Warranty and Certification.

### **3.5 Air System Procedures**

- 3.5.1 Adjust duct and terminal balance dampers and adjust or change drive sheaves to balance supply, return and exhaust air systems to

provide design air qualities (within  $\pm 10\%$ ) at each outlet and inlet and maintain design relationship between outdoor and exhaust air system quantities.

- 3.5.2 Adjust air terminals to obtain optimum air distribution pattern.
- 3.5.3 Permanently mark final balance position on balance dampers and adjustable air turning devices by means of permanent custom adhesive stickers across balancing dampers to seal them in position.
- 3.5.4 Submit report to the Consultant indicating final fan rpm, motor operating amperages, system static pressure and final air quantities obtained.
- 3.5.5 Air systems shall be balanced with clean filters in place, at total 105 % to 110% of specified total airflow rates.

### **3.6 Hydronic System Procedures**

- 3.6.1 Balance liquid systems using surface temperature measuring instrument such as Alnor pyrometer or flow meter if installed. Adjust balance valves and balance fittings to obtain design flow rates or uniform temperature differences (on liquid side) across coils and heating/cooling elements acknowledging specified temperature drops and rises on air and water.
- 3.6.2 Permanently mark final balance position on the balance valves and balance fittings and lock memory stops.
- 3.6.3 Submit report to Consultant indicating final temperature drops and flows obtained.

### **3.7 Air System Procedures**

- 3.7.1 Execute air systems balancing for each air system in accordance with AABC and NEBB specifications and as described herein.
- 3.7.2 Make tests with supply, return and exhaust systems operating and doors and windows closed or in normal operation condition.
- 3.7.3 Test and adjust blower rpm/speed to design requirements.
- 3.7.4 Test and record motor full load amps.
- 3.7.5 Make air quantity measurements in supply and return ducts at each major air handling or rooftop system by pilot tube traverse of entire cross-sectional area. Take minimum of 16 readings on each air handler.
- 3.7.6 Test and record required and measured system static pressures, filter differential, coil differential and fan total static pressure.
- 3.7.7 Test and adjust systems for design recirculated airflows rates.
- 3.7.8 Test and adjust systems for design outdoor air quantities.

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- 3.7.9 Test and record entering air temperatures (DB heating) (DB/WB cooling).
  - 3.7.10 Test and record leaving air temperatures (DB heating) (DB/WB cooling).
  - 3.7.11 Adjust main supply and return ducts to design flow rates.
  - 3.7.12 Adjust zones to design, supply and return flow rates.
  - 3.7.13 Test and adjust each diffuser, grille and register to within 10% of design requirements.
  - 3.7.14 Identify each diffuser, grille and register as to location and area.
  - 3.7.15 Identify and list size, type and Manufacturer of diffusers, grilles, registers and testing equipment. Use Manufacturer's rating on equipment to make required calculations.
  - 3.7.16 Control and/or equipment Manufacturer shall set adjustments of automatically operated dampers to operate as indicated in cooperation with balancing firm.
  - 3.7.17 Adjust diffusers, grilles and registers to minimize drafts.
  - 3.7.18 Provide fire damper drop tests, in association with the sheet metal contractor in accordance with Section 23 33 00.
  - 3.7.19 Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
  - 3.7.20 Vary total system airflow rates by adjustments of fan speeds. Vary branch air quantities by damper regulation.
  - 3.7.21 Provide system schematic with required and actual air flow rates at each outlet or inlet. Schematic shall include all fire dampers shown on drawings.
  - 3.7.22 Record installed fan drive assemblies, fan sheaves, motor sheaves and belts.
  - 3.7.23 Record each installed motor Manufacturer.
  - 3.7.24 Final balanced condition of each area shall include testing and adjusting of pressure conditions. Test and record building pressurization levels **in variable volume systems throughout full range of fan delivery rates**, under both heating and cooling conditions. Test pressure conditions at ground, intermediate and upper levels. Check front doors, exits and elevator shafts for airflow so that exterior conditions do not cause excessive or abnormal pressure conditions. Document abnormal building leakage conditions noted.
  - 3.7.25 Complete TAB to achieve positive building pressure unless otherwise instructed. Positive pressure relative to outside pressure

of 0.04" w.g. (10 Pa) minimum and 0.07" w.g. (18 Pa) maximum shall be achieved, measured with negligible outside wind velocity.

### **3.8 Hydronic System Procedures**

3.8.1 Preparation of System - Phase I: Hydronic system shall be prepared for TAB by Mechanical Contractor in the following manner:

- .1 Open valves, close bypass valves.
- .2 Determine water in system has been treated and is clean.
- .3 Check pump rotation.
- .4 Confirm expansion tanks are not air bound and system is full of water.
- .5 Confirm air vents at high points are installed properly and are operating freely and air is removed from circulation system.
- .6 Set temperature controls for full flow.
- .7 Check operation of automatic bypass valves.
- .8 Check and set operating temperature of equipment to design requirements.

3.8.2 TAB Procedure - Phase II:

- .1 Set pumps to proper flow rate.
- .2 Proportionally balance flow of water through equipment.
- .3 Record leaving water temperatures and return water temperatures and pressure drops through equipment. Reset to design temperatures.
- .4 Record water temperature at inlet side of terminals. Note rise or drop of temperatures from source.
- .5 Proportionally balance each terminal or in the absence of flow measuring commissioning valves balance each terminal based on temperature differential including a check and confirmation that all auto-flow valves are correctly installed, and are set at the correct flow.
- .6 Upon completion of flow readings and adjustments, mark settings and record data.
- .7 Coordinate shaving of pump impeller to pump operating condition on pumps larger than 2 hp (1.5 KW).

3.8.3 TAB Procedure - Phase III:

- .1 After adjustments to terminals, recheck settings at pumps. Readjust if required.
- .2 Read pressure drop through each terminal and set flow rate on call for full flow. Set pressure drop across bypass valve to match terminal full flow pressure drop.

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**3.9 TAB Data**

3.9.1 TAB and equipment data shall be listed in Imperial (SI Metric) Units.

3.9.2 Air Handling Equipment Installation Data:

- .1 Arrangement, discharge and class.
- .2 Motor type, hp (KW), rpm (r/min), voltage, phase cycles and full load amps.
- .3 Location and local identification.

3.9.3 Air Handling Equipment Design Data:

- .1 Airflow rate (cfm (L/s)).
- .2 Static pressure (" w.g. (Pa)).
- .3 Motor hp (KW), rpm (r/min) and amps.
- .4 Outside airflow rate (cfm (L/s)).
- .5 Fan rpm (r/min).
- .6 Fan hp (KW).
- .7 Entering and leaving air dry and wet bulb temperatures (°F (°C)).

3.9.4 Air Handling Equipment Recorded Data

- .1 Airflow rate (cfm (L/s)).
- .2 Static pressure (" w.g. (Pa)).
- .3 Fan rpm (r/min).
- .4 Motor operating amps.
- .5 Entering and leaving air dry and wet bulb temperatures (°F (°C)).

3.9.5 Duct Air Quantities - Mains, Branches, Outside Air and Exhausts (Minimum and Maximum)

- .1 Duct sizes (at traverse normally) (inches (mm)).
- .2 Number of pressure readings.
- .3 Sum of velocity measurements.
- .4 Average velocity (ft/m (m/s)).
- .5 Duct recorded airflow rate (cfm (L/s)).
- .6 Duct design airflow rate (cfm (L/s)).

3.9.6 Air Inlets and Outlets:

- .1 Outlet identification, location and designation.
- .2 Application factors.
- .3 Design and recorded airflow rates (cfm (L/s)).

3.9.7 Building Pressurization Data

- .1 Outside air temperatures (°F (°C)).
- .2 Outside wind velocity (ft/m (m/s)).

- 
- .3 Building pressures plotted with respect to systems (" w.g. (Pa)).
  - .4 Supply air, return air and exhaust airflow rates (cfm (L/s)).
  - .5 Locations of pressure measuring points, inside and outside building.
  - 3.9.8 Pump Design Data
    - .1 Water flow rate (USgpm (L/s)).
    - .2 Pressure (ft of head (kPa)).
    - .3 Pump Motor rpm (r/min).
    - .4 Pump Motor hp (KW)
  - 3.9.9 Pump Installation Data
    - .1 Size.
    - .2 Drive type.
    - .3 Motor type, hp (KW), rpm (r/min), voltage phase, cycles and full load motor amps.
  - 3.9.10 Pump Recorded Data
    - .1 Discharge and suction pressures (full flow and no flow) (ft of head (kPa)).
    - .2 Pressure and total dynamic head (ft of head (kPa)).
    - .3 Water flow rate (from pump curves if metering not provided) (USgpm (L/s)).
    - .4 Motor amps.
  - 3.9.11 Expansion Tank Installation Data
    - .1 Manufacturer, size and capacity (inches (mm)) and USgal (L)).
    - .2 Pressure reducing valve setting (psi (kPa)).
    - .3 Pressure relief valve setting (psi (kPa)).
  - 3.9.12 Heating Equipment Design Data
    - .1 Heat transfer rate (mbh (kw)).
    - .2 Water flow rate (USgpm (L/s)).
    - .3 Entering and leaving water temperatures (°F (°C)).
    - .4 Water pressure drop (ft of head (kPa)).
  - 3.9.13 Heating Equipment Recorded Data
    - .1 Element type and identification (location and designation).
    - .2 Entering and leaving water temperatures (°F (°C)).
    - .3 Water pressure drop (ft of head (kPa)).
    - .4 Water flow rate (USgpm (L/s)).
  - 3.9.14 Heat Exchanger Design Data
    - .1 Manufacturer, model, and type.
-

- 
- .2 Water flow rates (tube and shell) (USgpm (L/s)).
  - .3 Inlet and outlet temperatures (°F (°C)) (tube and shell).
- 3.9.15 Heat Exchanger Recorded Data
- .1 Heated media flow rate (USgpm (L/s)).
  - .2 Heating media flow rate (USgpm (L/s)).
  - .3 Heated media entering and leaving temperatures (°F (°C)) and pressure drop (ft of head (kPa)).
  - .4 Heating media entering and leaving temperatures (°F (°C)) and pressure drop (psi (kPa)).
- 3.9.16 Air Heating and Cooling Equipment Design Data
- .1 Heat transfer rate (mbh (kw)).
  - .2 Water flow rate (USgpm (L/s)).
  - .3 Airflow rate (cfm (L/s)).
  - .4 Water pressure drop across coil (ft of head (kPa)).
  - .5 Air static pressure drop (" w.g. (Pa)).
  - .6 Entering and leaving water temperatures (°F (°C)).
  - .7 Entering and leaving air dry and wet bulb temperatures (°F (°C)).
- 3.9.17 Air Heating and Cooling Equipment Recorded Data
- .1 Element type and identification (location and designation).
  - .2 Entering and leaving air dry and wet bulb temperatures (°F (°C)).
  - .3 Entering and leaving water temperatures (°F (°C)).
  - .4 Water pressure drop across coil (ft of head (kPa)).
  - .5 Water pressure drop across bypass valve (ft of head (kPa)).
  - .6 Air static pressure drop (" w.g. (Pa)).
  - .7 Water flow rate (USgpm (L/s)).
  - .8 Airflow rate (cfm (L/s)).
  - .9 Adjusted temperature rise or drop (°F (°C)).
- 3.9.18 Water Chiller Design Data
- .1 Manufacturer and model.
  - .2 Motor type, hp (KW), rpm (r/min), voltage, cycles, phase and full load amps.
  - .3 Water flow rates (USgpm (L/s)).
  - .4 Water pressure drops (ft of head (kPa)).
  - .5 Entering and leaving water temperatures (°F (°C)).
- 3.9.19 Water Chiller Recorded Data
- .1 Water flow rates (USgpm (L/s)).
  - .2 Water pressure drops (ft of head (kPa)).
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- .3 Entering and leaving water temperatures (°F (°C)).
- 3.9.20 Hydronic Heat Pump Design Data
  - .1 Manufacturer and Model.
  - .2 Fan and compressor motor type, hp, rpm, voltage cycle, phase and full load amps.
  - .3 Water flow rates (USgpm (L/s)).
  - .4 Water temperatures entering and leaving (°F (°C)).
  - .5 Airflow rates (cfm (L/s)).
  - .6 Entering and leaving air dry and wet bulb temperatures (°F (°C)).
  - .7 Static pressure (" w.g. (Pa)).
- 3.9.21 Hydronic Heat Pump Recorded Data
  - .1 Water flow rates (USgpm (L/s)).
  - .2 Water temperatures entering and leaving (°F (°C)).
  - .3 Airflow rates (cfm (L/s)).
  - .4 Entering and leaving air dry and wet bulb temperatures (°F (°C)).
  - .5 Static pressure (" w.g. (Pa)).
- 3.9.22 Sound Level Data
  - .1 Diagram or description of relationship of sound source to measuring instrument.
  - .2 Overall DB (A) level.
  - .3 Reading at each octave band frequency from 31.5 Hz to 16 kHz.
  - .4 NC curves plotted and compared to those recommended by ASHRAE or AABC publications.

### **3.10 Fire Protection and Smoke Control**

- 3.10.1 Mechanical Contractor shall test systems in conjunction with Electrical Contractor to ensure proper sequencing and monitoring of mechanical equipment and devices as indicated on drawings five days before application for Occupancy Permit. Make corrections to systems as required and retest deficient items. Provide written verification to Consultant that Fire Protection and Smoke Control Systems are operating with indication/control on Fire Alarm Panel.
- 3.10.2 Testing shall include but not be limited to the following:
  - .1 Stair and vestibule pressurization fans and associated motorized dampers.
  - .2 Smoke evacuation systems (fans and associated motorized dampers).
  - .3 Correct smoke damper positions indicated on fire alarm panel (open/closed).

- .4 Automatic shut-down of air systems connected to fire alarm panel and restarting of systems when panel returned to normal operation.
- 3.10.3 Mechanical Contractor shall be represented during final testing with Authorities having jurisdiction present.

**END OF SECTION**

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**1. GENERAL**

**1.1 Related Work**

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

**1.2 General**

- 1.2.1 Provide external thermal insulation for plenums and ductwork where specified.
- 1.2.2 Provide internal acoustical insulation for plenums and ductwork where specified.
- 1.2.3 Journeyman insulation applicators shall supervise the insulation work.
- 1.2.4 Be responsible for ensuring sufficient space is provided for proper installation of insulation materials.
- 1.2.5 Install insulation with related materials and accessories in accordance with the manufacturer's recommended installation instructions.

**1.3 Regulatory Requirements**

- 1.3.1 Flame spread ratings and smoke developed classifications shall be as required by applicable code, CAN/ULC-S102 and NFPA 90A. Flame spread rating throughout material shall not exceed 25 and smoke developed shall not exceed 50. Materials shall not flame, smoulder, smoke, or glow at temperatures they are exposed to in service.
- 1.3.2 Minimum insulation thickness and insulating values shall be in accordance with NECB or ASHRAE Std 90.1 or as per the schedule in this specification, whichever is more stringent.
- 1.3.3 Glass mineral wool duct wrap shall comply with:
- .1 CAN/ULC-S102.
  - .2 CAN/CGSB-51.5M; Type II (FSK Facing).
  - .3 CAN/CBSB-51.11-92.
  - .4 CCG Low FS Laminate Cert. #GI-141.
  - .5 ULC Listed and classified.
  - .6 ASTM C 553; Type I, II III.
  - .7 ASTM C 1136; Type II (FSK and PSK facings only).
  - .8 ASTM C 1290; Specification for flexible fibrous glass blanket/HVAC ducts.
  - .9 ASTM E-84 Surface Burning Characteristics, 25/50 Flame/Smoke.

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- .10 CAN/ULC-S102 "Test for Surface Burning Characteristics of Building Materials".
- 1.3.4 Glass mineral wool insulation board shall comply with:
- .1 CAN/ULC-S102.
  - .2 CBSB 51-GP-10M.
  - .3 CGSB 51-GP-52M (facings).
  - .4 ASTM C 612.
  - .5 ASTM C 795.
  - .6 ASTM E-84 Surface Burning Characteristics, 25/50 Flame/Smoke.
  - .7 CAN/ULC-S102.
  - .8 ASTM C.1136 for Facings.
  - .9 ULC listed and classified.
- 1.3.5 Duct liner (internal lining) shall comply with:
- .1 CAN/ULC-S102.
  - .2 CAN/CGSB 51.11-92.
  - .3 ULC listed and classified.
  - .4 ASTM C 1071; Type I.
  - .5 NFPA 90A and 90B.
  - .6 Microbial Growth; ASTM C 1338, G21, G22.
- 1.3.6 Vapour Barriers
- .1 ASTM C755-20.
- 1.3.7 All insulation products shall be validated formaldehyde-free by a recognized third party.
- 1.4 Qualifications and Samples**
- 1.4.1 Submit Manufacturer documentation (and samples when requested) for materials, applications and finishing methods to establish they satisfy specification and meet applicable code requirements, before commencing work.
- 1.5 Definitions**
- 1.5.1 "Concealed" means insulated mechanical services in furred spaces, shafts and hung ceilings.
- 1.5.2 "Exposed" will mean not concealed.
- 1.6 Quality Assurance**
- 1.6.1 Surface-Burning Characteristics: For insulation and related materials, UL/ULC Classified per UL 723 or meeting ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic,

tapes, and cement material containers, with appropriate markings of applicable testing agency.

- .1 Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - .2 Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- 1.6.2 Formaldehyde Free: Third party certified with UL Environment Validation.
- 1.6.3 Biosoluble: As determined by research conducted by the International Agency for Research on Cancer (IARC) and supported by revised reports from the National Toxicology Program (NTP) and the California Office of Environmental Health Hazard Assessment. Certified by European Certification Board for Mineral Wool Products (EUCEB).
- 1.6.4 Recycled Content: A minimum of 50 percent recycled glass content certified and UL Validated.
- 1.6.5 Low Emitting Materials: For all thermal and acoustical applications of Glass Mineral Wool Insulation Products, provide materials complying with the testing and products requirements of UL GREENGUARD Gold Certification.
- 1.6.6 Products shall contain no polybrominated diphenyl ethers (PBDE) such as Penta-BDE, Octa-BDE or Deca-BDE fire retardants; whenever possible.

## 2. **PRODUCTS**

- 2.1 **Insulation products shall contain none of the following, Asbestos, Lead, Mercury, Formaldehyde or any related compounds. Insulation products shall be certified UL Green Guard Gold or 'Indoor Advantage Gold'. Insulation products shall contain 50% or more recycled content and provide verification.**

- 2.1.1 Insulation materials applied to carbon steel shall be Mass Load Corrosion Rate (MLCR) tested per ASTM 1617.
- 2.1.2 Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

## 2.2 **External Flexible Insulation**

- 2.2.1 External flexible glass fibre insulation with integral vapour barrier:
  - .1 Minimum density – 0.75 lb/ft<sup>3</sup> (12kg/m<sup>3</sup>).
  - .2 Thermal conductivity at 75°F - 0.024 BTU/hr/ft/°F (24°C - 0.042 W/m/°C).
  - .3 Acceptable Manufacturers:

- .1 Certainteed STD Ductwrap #75 FSK, Manson Alley-Wrap FSK, Owens Corning Soft.R.FSK Ductwrap, Knauf Atmosphere FSK Ductwrap with ECOSE technology, Johns-Manville Micro Lite FSK.

## 2.3 Duct Liner

### 2.3.1 Rigid Duct Liner:

- .1 Yellow or naturally coloured internal rigid glass mineral wool acoustical insulation with black sealer coating on one face.
- .2 Minimum sound absorption (NRC) of 0.70 as tested per ASTM C423 using Type "A" mounting.
- .3 Thermal conductivity at 75°F - 0.020 BTU/hr/ft/°F (24°C - 0.035 W/m/°C).
- .4 Acceptable Manufacturers:
  - .1 Certainteed Toughgard 300#, Manson Akousti-Liner R, Knauf Atmosphere Rigid Plenum Liner with ECOSE technology, Johns-Manville Permacoat R300, Owens Corning Quiet-R Rigid Coated Duct Liner.

### 2.3.2 Flexible Duct Liner:

- .1 Yellow or naturally coloured internal flexible glass fibre acoustical insulation with one face faced with non-woven fibreglass mat.
- .2 Minimum sound absorption (NRC) of 0.60 as tested per ASTM C423 using Type "A" mounting.
- .3 Thermal conductivity at 75°F - 0.023 BTU/hr/ft/°F (24°C - 0.040 W/m/°C).
- .4 Acceptable Manufacturers:
  - .1 Certainteed Toughgard Duct Liner 150# or Type 150, Manson Akousti-Liner, Knauf Duct Liner with ECOSE technology, Owens Corning Quiet-R Rotary Duct Liner.

### 2.3.3 Grease Duct Enclosure System Fire-Wrap:

- .1 For applications where NFPA-96 kitchen exhaust ducts are to be wrapped in a fire-rated material, provide Morgan Thermal Ceramics FireMaster® Fastwrap®-XL, 3M 615 PLUS or approved equivalent. Duct enclosure flexible blanket composed of high temperature fibers classified for applications to 2192°F (1200°C) and fully encapsulated in glass fiber reinforced foil faced finish. Must be ULC listed for 1 and 2 hour fire resistive enclosure protection, and for zero clearance for kitchen exhaust ducts. Minimum 1½" (40 mm) thick, 6 lbs/cu.ft. (96 kg/m<sup>3</sup>) density, Greenguard Microbial Resistance Listing, and compliant to IMC, NFPA-96, UMC and CMC. Frame and smoke spread rating less than 25/50.

Acceptable alternatives may be submitted for review, provided they meet or exceed the required compliances.

## **2.4 Accessories**

### **2.4.1 Insulation Adhesive:**

- .1 Bakelite 230-39, Childers CP-82, CP-56W, Design Polymerics DP2502, Foster 85-20, Polymer Glasstack #25, Robson Ticki-Tuff.

### **2.4.2 Vapour Barrier Tape (FSK):**

- .1 Finishing tape to meet flame spread rating and smoke developed classification requirements of applicable code and compatible with facing material, CAN/ULC-S102.
- .2 Foil, scrim and kraft paper FSK foil faced retarder tape complying with ASTM 1136 self-adhesive tape.

### **2.4.3 Vapour Barrier Adhesive:**

- .1 Bakor 230-21, Childers CP-82, Design Polymerics DP2502, Foster 85-20, 3M 4230.

### **2.4.4 Insulation Coating Water Based for Indoor Use:**

- .1 Foster 30-33/30-65; Childers CP 33/35.

### **2.4.5 Weather/Abuse Coating – for Outdoor Use:**

- .1 Aluminum: 26 ga. (0.55mm) thick with longitudinal slip joints and 2" (50mm) end laps, 0.4mm thick die shaped fitting covers with factory attached protective liner on interior surface.
- .2 3M VentureClad Insulation Jacketing System classified as zero permeability.

### **2.4.6 Reinforcing Membrane:**

- .1 Glass reinforcing membrane as commercially available.

### **2.4.7 Seal Coating, Fabric Adhesive and Fabric Coating:**

- .1 Bakor 120-09, Childers CP-50 AMV1, Design Polymerics DP3050, Foster 30-36/81-42.

## **2.5 Duct Insulation Schedule and Thickness**

- 2.5.1 External Flexible Insulation with vapour barrier. (Exposed within room which is being served by exposed ducts, do not require external insulation).

<b>Service</b>	<b>Thickness</b>
Cooling and heating supply ducts - where temperature difference between space where duct is located and design air temperature in duct is less than or equal to 40°F (22.2°C).	1" (25 mm)
All cooling and heating supply ducts - where the temperature difference between the space within which the duct is located and	1½" (40 mm)

Service	Thickness
the design air temperature in the duct is greater than 40°F (22.2°C).	
Outdoor air ductwork and plenums (from intake to mixing plenum).	2" (50 mm)
Combustion intake/relief air.	2" (50 mm)
Exhaust air discharge through roof (including sides and bottom of plenum).	2" (50 mm)
Exhaust air ductwork outside the building.	1" (25 mm)
All exhaust air ductwork from the outside wall or roof to 5'-0" (1.5 m) inside building.	1½" (40 mm)
Exhaust ductwork from ERV/HRV to wall	1" (25 mm)

#### 2.5.2 Internal Flexible Duct Liner

Service	Thickness
All ductwork where indicated by cross hatching.	1" (25 mm)
All supply ductwork in the mechanical room (From AHU discharge to duct shaft), or to 3 m beyond fan/mechanical room.	2" (50 mm)

#### 2.5.3 Internal Rigid Duct Liner

Service	Thickness
Built-up site fabricated air handling unit(s). Line sheet metal walls and tops from inlet dampers to discharge dampers. Do not line transverse walls containing coils, filters or fan discharge.	2" (50 mm)
Built-up site fabricated heat recovery exhaust unit(s). Line sheet metal walls and tops.	2" (50 mm)
Cold and hot supply air plenums. Line walls, tops and bottoms from discharge dampers to supply duct connections.	2" (50 mm)
All outdoor air plenums. Line sheet metal walls and top.	2" (50 mm)

### 3. EXECUTION

#### 3.1 Application

- 3.1.1 Apply external insulation to ductwork only after pressure tests have been made and systems accepted.
- 3.1.2 Apply insulation and insulation finish so finished product is uniform, smooth in finish, with longitudinal seams concealed from view. Apply ductwork insulation materials, accessories and finishes in accordance with Manufacturer's recommendations. Fix and supply duct insulation by staples, washer pins or wire wraps at minimum 24" (600 mm) centres. Use weld-pin washers where duct dimension is larger than 26" (650 mm) high or wide.



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- 3.1.3 Insulation and vapour barrier shall be continuous through non-rated separations.
- 3.1.4 Grease and fire rated flexible duct insulation shall be applied and installed in accordance with the Manufacturer's instructions.
- 3.1.5 Insulation and vapour barrier shall be continuous through non-rated separations. Where vapour barrier is indicated, seal joints, seams and penetrations in insulation at hangers, supports, anchors and other projections with vapour-barrier mastic.
- .1 Install insulation continuously through hangers and around anchor attachments.
  - .2 For insulation application where vapour barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachments to structure with vapour-barrier mastic. Install insulation continuously through hangers and around anchor attachments.
  - .3 Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- 3.1.6 Install insulation with non-self-sealing factory-applied jackets as follows:
- .1 Draw jacket tight and smooth.
  - .2 Cover circumferential joints with 3" (80 mm) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4" (100 mm) o.c.
  - .3 Overlap jacket longitudinal seams at least 1½" (40 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at **2" (50 mm) 4" (100 mm)]** o.c.
    - .1 For below ambient services, apply vapour-barrier mastic over staples.
    - .2 Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
    - .3 Where vapor barriers are indicated, apply vapour-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- 3.1.7 Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.

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**3.2 Insulation Termination**

- 3.2.1 Terminate insulation short of control, smoke and fire dampers so as not to interfere with operation, seal all edges to maintain continuous vapour barrier.
- 3.2.2 Terminate insulation 24" (600 mm) short of duct mounted electric heating coils.

**3.3 Insulation for Cooling Coil Headers and Return Bends**

- 3.3.1 Pack flexible mineral wool insulation around headers and return bends on all cooling coils in built up air handling units and at re-cool coils in terminal ductwork systems to control condensation

**3.4 External Flexible Insulation with Vapour Barrier**

- 3.4.1 On rectangular duct work and plenums, over 24" (600 mm) in width, spotweld pins ¼" (6 mm) longer than insulation thickness, one per square foot of duct minimum. If pins are installed in field, capacitor gun shall be used. Impale insulation over pins, and hold in place using metal or nylon clips (washers). Alternatively, use assembly consisting of welded pin with integral head washer welded in place over insulation (Clinched pins not acceptable).
- 3.4.2 Adhere foil faced vapour barrier tape over butt joints, raw edges, holding washers and other points of penetration of vapour barrier jacket on exposed hot and cold ducts and concealed cold ducts. Provide 16 ga (1.61 mm) wire wrap on 18" (450 mm) centers as additional exterior insulation reinforcing, to snug-tight so insulation is not crushed/compressed.

**3.5 Internal Flexible Duct Liner Application**

- 3.5.1 Adhere insulation with insulation adhesive applied to whole of metal surface, with the coating side of insulation exposed to airstream.
- 3.5.2 Ducts 24" (600 mm) in width and less require no further adhesion.
- 3.5.3 Duct sides and plenum panels greater than 24" (600 mm) in width shall have metal clips or pins adhered to metal surface at 12" (300 mm) centres to supplement adhesive. (Welding pins may be used provided capacitor type gun is used.) Impale insulation or pins or clips with coated side of insulation exposed to airstream and secured with holding washers. Cover holding washers with reinforcing membrane and insulation coating/sealer.
- 3.5.4 Seal transverse joints, raw edges, and other points of penetration of coating with reinforcing membrane and insulation coating/sealer.
- 3.5.5 Seal longitudinal and butt joints with insulation coating sealer.
- 3.5.6 No raw edges of internal insulation material shall be exposed to moving airstream. Provide 26 ga (0.55 mm) sheet metal nosing at

all leading edges of exposed lining to overlap insulation by at least 1" (25 mm) downstream.

3.5.7 Duct size indicated is inside dimension of the insulation. Metal duct sizes shall be increased to allow for internal acoustic insulation thickness. No external duct insulation is required when internal duct insulation provided.

3.5.8 Adhere Alpha Temp cloth over internal surface of acoustic insulation. Overlap edges and seal joints with insulation adhesive/coating/sealer.

### **3.6 Internal Rigid Duct Liner Application**

3.6.1 Adhere internal rigid duct liner in same manner as internal flexible duct liner.

3.6.2 Adhere Alpha Temp #1610/1067 UL Class #1 Material film over internal surface of acoustic insulation. Overlap edges and seal joints with insulation adhesive/coating/sealer.

3.6.3 Cover plenum wall insulation with galvanized perforated metal sheet having over 50% open area. Protective metal shall be held in place by securing it to projecting pins with washers.

3.6.4 Cover plenum wall insulation with solid galvanized sheet metal for 48" (1,200 mm) downstream from cooling coils.

3.6.5 Cover insulated walk on plenum floors with solid galvanized sheet metal to protect insulation from damage. Provide supports under sheet metal to prevent insulation and pins from being crushed.

3.6.6 Sheet metal and perforated sheet metal is under Section 23 31 00.

3.6.7 Duct size indicated is inside dimension of the insulation. Metal duct sizes shall be increased to allow for internal acoustic insulation thickness. No external duct insulation is required when internal duct insulation provided.

### **3.7 Ductwork Insulation Finishes**

3.7.1 "Concealed" ductwork insulation, in horizontal and vertical service spaces, will require no further finish.

3.7.2 "Exposed" ductwork insulation, in unfinished floor space will have no further finish.

3.7.3 "Exposed" duct insulation in warehouse type spaces shall be painted with one sealer coat of insulation coating.

3.7.4 "Exposed" ductwork insulation in finished floor spaces, fan rooms, **valve rooms** and shall be finished with two coats of white, foil-finishing, insulation coating.

3.7.5 "Exposed" duct work insulation outside the building shall have weatherproof finish. Finish ducts exposed to outdoors with

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aluminum jacket. Caulk all joints on jacket for weatherproof finish. Locate longitudinal joints in least exposed position.

- 3.7.6 "Exposed" insulated duct work **outside** shall be recovered all around with aluminum jacketing. Exterior application shall be vapour sealed installation. Over insulation, apply 22 ga (0.64 mm) thick Childers corrugated aluminum. Moisture barrier shall be continuous across full width of jacketing. Longitudinal seams shall be located to shed water. Attach with holding straps at 6" (150 mm) on centres. Provide complete aluminum jacket system using installation procedures of the Manufacturer. Seal outdoor jacketing watertight.

**END OF SECTION**

**1. GENERAL**

**1.1 Related Work**

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

**1.2 General**

- 1.2.1 Provide thermal insulation for heating and cooling equipment as indicated and scheduled.
- 1.2.2 Journeyman insulation applicators shall supervise the insulation work.
- 1.2.3 Provide mechanical contractor wall and pipe spacing requirements before project begins. Be responsible for ensuring that sufficient space is provided for proper installation of insulation materials.
- 1.2.4 Minimum insulation thickness and insulating values shall be as per the schedule in this section.
- 1.2.5 Install insulation and related materials and accessories in accordance with the suppliers and manufacturers recommended installation instructions/

**1.3 Regulatory Requirements**

- 1.3.1 Flame spread ratings and smoke developed classifications shall be as required by applicable code and NFPA 90A. Flame spread rating throughout material shall not exceed 25 and smoke developed shall not exceed 50. Materials shall not flame, smoulder, glow, or smoke at temperatures they are exposed to in service.
- 1.3.2 Minimum insulation thickness and insulating values shall be in accordance with NECB or ASHRAE Std 90.1 or as per the schedule in this section, whichever is most stringent.
- 1.3.3 All insulation products shall be formaldehyde-free.
- 1.3.4 Vapour Barriers
- .1 ASTM C755-20.

**1.4 Qualifications and Samples**

- 1.4.1 Submit Manufacturer documentation (and samples when requested) for materials, applications and finishing methods to establish they satisfy specification and meet applicable code requirements, before commencing work.

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## 1.5 Quality Assurance

- 1.5.1 Installer qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program.
- 1.5.2 Surface-Burning Characteristics: For insulation and related materials, UL/ULC Classified per UL723 or meeting ASTM E 84, by testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesives, mastic, tapes and cement material containers, with appropriate markings of applicable testing agency.
  - .1 Insulation installed indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - .2 Insulation installed outdoors: Flame spread index of 75 or less, and smoke-developed index of 150 or less.
- 1.5.3 Formaldehyde free: Third party certified with UL Environment Validation.
- 1.5.4 Recycled content: A minimum 50 percent recycled glass content.
- 1.5.5 Bio soluble: As determined by research conducted by the International Agency for Research on Cancer (IARC) supported by revised reports from the National Toxicology Program (NTP) and the California Office of Environmental Health Hazard Assessment. Certified by European Certification Board for Mineral Wool Products (EUCB).
  - .1 Low emitting materials: For all thermal and acoustical applications of Glass Mineral Wool Insulation Products, provide materials complying with the testing and products requirements of UL Greenguard Gold Certification.
- 1.5.6 Products shall contain no polybrominated diphenyl ethers (PBDE) such as Penta-BDE, Octa-BDE or Deca-BDE fire retardants; whenever available.

## 1.6 Definitions

- 1.6.1 "Exposed" equipment shall be considered to be exposed in boiler room, chiller room, valve room and fan rooms, and where line of sight visibility above "cloud ceilings" exists.

## 2. PRODUCTS

- 2.1 Insulation products shall contain none of the following, Asbestos, Lead, Mercury, Formaldehyde or any related compounds. Insulation products shall be certified UL Green Guard Gold or 'Indoor

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**Advantage Gold'. Insulation products shall contain 50% or more recycled content and provide verification.**

- 2.1.1 Insulation materials applied to carbon steel shall be Mass Load Corrosion Rate (MLCR) tested per ASTM 1617.
- 2.1.2 Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

**2.2 Pre-formed Block and Board Insulation**

- 2.2.1 Mineral Fibre (High Temperature) Rigid:
  - .1 Thermal conductivity at 199°F – 0.027 BTU/hr/ft/°F (93° C - 0.046 W/m/°C).
  - .2 Acceptable Manufacturers:
    - .1 Roxul RHT-80, IIG Min Wool 1200, Thermafibre Industrial Board 8.016 Nominal Density, Knauf-Elevated temperature board with ECOSE technology.
- 2.2.2 Calcium Silicate (High Temperature) Rigid:
  - .1 Thermal conductivity at 199°F – 0.035 BTU/hr/ft/°F (93° C - 0.060 W/m/°C).
  - .2 Acceptable Manufacturers:
    - .1 IIG Thermo-12 Gold.
- 2.2.3 Perlite Insulation - High Temperature:
  - .1 Without integral jacket.
  - .2 Thermal conductivity
  - .3 Acceptable Products:
    - .1 Sproule WR-1200, Howred Goodtemp
- 2.2.4 Phenolic Insulation Rigid Board:
  - .1 With integral FRK jacket.
  - .2 Thermal conductivity at Flame spread and smoke density does not exceed 25/50 per CAN/ULC-S102 with or without integral jacket.

**2.3 Flexible Sheet Insulation**

- 2.3.1 Flexible Closed Cell
  - .1 Thermal conductivity at 199°F – 0.027 BTU/hr/ft/°F (93° C - 0.046 W/m/°C).
  - .2 Acceptable Manufacturers:
    - .1 Therma-Cel.
- 2.3.2 Flexible Foamed Elastomeric
  - .1 Thermal conductivity at 199°F – 0.027 BTU/hr/ft/°F (93° C - 0.046 W/m/°C).
  - .2 Acceptable Manufacturers:

- .1 F/R Armacell, Aerocell, K-Flex USA.

**2.4 Removable Insulation Covers**

- 2.4.1 Flexible mineral fibre or fibre glass fully enclosed on sides and edges with Alpha Maritex #8459-2-8S silicone fibre glass cloth suitable for temperatures involved with stainless steel wire mesh against hot surface, or acceptable equal. All products must conform to ASTM-C1965 and CAN/ULC-S102
- 2.4.2 Insulation covers laced in place with brass/stainless steel hooks and copper/stainless steel wire and be easily removed.

**2.5 Accessories**

- 2.5.1 Jacket Fastenings (Multi-Purpose):
- .1 Staples (flare type). Galvanized.
- .2 Compatible jacket finishing tape.
- 2.5.2 Corner Beads:
- .1 1½" (40 mm) x 1½" (40 mm) x 0.015" (0.37 mm) thick galvanized steel or aluminum.
- 2.5.3 Finish Jacket:
- .1 Thermocanvas Jacket:
- .1 Fattal's Thermocanvas, Robson Flamex FR Canvas
- .2 Metal Jacket:
- .1 ITW 24 ga (0.70 mm), Ideal products
- 2.5.4 Reinforcing Membrane:
- .1 Glass reinforcing membrane.
- 2.5.5 Reinforcing Mesh:
- .1 1" (25 mm) square galvanized wire mesh.
- 2.5.6 Insulating Cement:
- .1 Ryder Thermokote MW high temperature, or as commercially available.
- 2.5.7 Hard Finish Cement:
- .1 As commercially available.
- 2.5.8 Fabric Adhesive:
- .1 Bakor 120-18, Childers CP-52, Design Polymeric DP3050, Foster 30-36, Robson White Lag.
- 2.5.9 Fabric Coating:
- .1 Bakor 120-18, Childers CP-52, Design Polymeric DP3050, Foster 30-36, Robson White Lag.



## 2.6 Acoustic Lagging Material

- 2.6.1 Acoustic lagging material shall be equal to Vibrasonic Controls VSC-0-10NL-25RP Decoupled Blanket Barrier.
- 2.6.2 Material shall consist of 1 lb per square foot (0.042 kg/sq.m) Barium impregnated vinyl permanently and continuously affixed to a ¼" (6 mm) 2 lb density open cell polyester foam.
- 2.6.3 Barrier to have minimum STC of 27 with the following characteristics: 125HZ – 15dB; 250HZ – 19dB; 500 HZ – 21dB; 1000 HZ – 28 dB; 2000 HZ – 33dB; 4000 Hz – 37 dB.
- 2.6.4 Material to be tested and labelled to meet maximum 25/50 fire rating.

## 2.7 Equipment Insulation Schedule and Thickness

Equipment	Thickness	Scope
Boiler breeching	4" (100 mm) (2 x 2" (50 mm))	A
Boiler stack (s)	2" (50 mm)	A
Exterior boiler stacks, to CAN B149.1	4" (100 mm)	A
Condensate receiver tank(s)	2" (50 mm)	A
Condensate cooler shell(s)	2" (50 mm)	A
Chiller(s) (all components subject to condensation)	1" (25 mm)	B, D
Chilled water pump housings	1" (25 mm)	B, D
Deaerator shell and tower	2" (50 mm)	A
Domestic hot water storage tank(s)	2" (50 mm)	A
Domestic cold water meter(s)	1" (25 mm)	B, D
Expansion joints	2" (50 mm)	C
Flash tank	2" (50 mm)	A
Heat Exchanger(s) (shell, end and head)	2" (50 mm)	A
Humidifier separator bodies	2" (50 mm)	C
Oil heater (boiler)	1" (25 mm)	A
Steam pressure reducing valve	2" (50 mm)	C

**SCOPE A:** Pre-formed block insulation (high temperature).

**SCOPE B:** Flexible sheet insulation.

**SCOPE C:** Removable insulation cover.

**SCOPE D:** Pre-formed board insulation.

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### 3. EXECUTION

#### 3.1 Application

- 3.1.1 Apply insulation to equipment only after connections are complete and tests made and systems accepted.
- 3.1.2 Apply insulation and insulation finish, securing it permanently to surfaces of equipment. Finish work so finished product is uniform in application and smooth in finish with edges protected and sealed.
- 3.1.3 When more than one layer of insulating material is used to achieve the specified thickness, stagger seams and joints to eliminate leakage paths.
- 3.1.4 Weld insulation attachment fittings to surfaces, as required, to completely secure block insulation with mechanical wire or strap fastenings. Some pressure vessels will not allow welding to surface, coordinate and confirm with equipment manufacturer.
- 3.1.5 Apply insulation to the equipment surface with the joints firmly butted and as close as possible to the equipment surface.

#### 3.2 Nameplates

- 3.2.1 Install insulation so that name and registration plates, cleanouts, manholes, inspection opening and gauge and controller tapings are uncovered. Cut back insulation around base of these items at 45° and finish with finishing cement, or mastic finish. When finishing with metal re-covering, provide mitred picture frame flashing, sealed and caulked around edges.
- 3.2.2 For cold water applications provide a plug made of elastomeric foam manufactured on site to cover the opening, friction fitted to allow easy removal and reinstallation.

#### 3.3 Insulation – Hot Applications

- 3.3.1 Apply high temperature insulation block and/or pre-formed/molded pipe insulation and secure firmly to surfaces with mechanical, wire or strap fastenings. Insulation shall be cut, shaped and fitted neatly to contours, without voids.
- 3.3.2 Insulation on equipment heads shall be fabricated in orange peel sections, and receive ½" (15 mm) trowel coat, dry thickness of insulating hard coat finishing cement, to provide smoothly contoured surface. Cement shall be reinforced with layer of reinforcing mesh or reinforcing membrane.
- 3.3.3 Apply high temperature mineral fibre rigid insulation to boiler breeching. Exterior application shall be sealed from moisture. Over insulation, apply 22 ga (0.64 mm) thick aluminum. The longitudinal seams shall be located to shed water. Attach with holding strap at 6" (150 mm) on centres. Provide complete aluminum jacket system

using parts, accessories and installation procedures of Manufacturer. Seal outdoor jacketing watertight. Overlap seams by minimum of 3" (80 mm). Apply expansion springs on bands where required.

**3.4 Insulation – Cold Applications**

- 3.4.1 Apply flexible sheet insulation on cold surfaces. Secure material and longitudinal and butt joints with foam plastic adhesive. Insulation shall be cut, shaped and fitted neatly to contours, without voids.
- 3.4.2 Chiller to be insulated in accordance with Manufacturer's recommendation.
- 3.4.3 Chiller flange insulation to be easily removable without damage.
- 3.4.4 Secure board insulation on ducts and flat surfaces with adhesive and pins. Seal vapour barrier finish joints with self-adhesive foil tape.

**3.5 Axial Fans – Insulation Wrap**

- 3.5.1 Axial fans, not in plenums shall have 2" (50 mm) thick pre-formed block insulation (Roxul Everwrap or equal) on casing held in place with ½" (15 mm) wide stainless steel banding.
- 3.5.2 Cover insulation with barium impregnated vinyl sheet complete with ¼" (6 mm) foamed elastomeric. Extend 6" (150 mm) beyond fan flexible connection backing and secure in place with ½" (15 mm) wide stainless steel banding.
- 3.5.3 Provide finished opening for electrical and lubrication openings.

**3.6 Block Insulation Finish**

- 3.6.1 Premium Finish (BCICA Premium 2 Standard):
  - .1 Over hard finish cement apply thermo canvas jacket using fabric adhesive. Finish fabric jacket with one coat of fabric coating.
- 3.6.2 Custom Finish:
  - .1 No further finish required on hard finish cement.

**3.7 Flexible Sheet Finish**

- 3.7.1 Insulated flexible sheet insulation shall be painted with heavy brush coating of foam plastic, white insulation coating.

**3.8 Acoustic Lagging Material**

- 3.8.1 Material shall be glued, foam side to underside of heat pumps and all exterior surfaces of heat pumps.
- 3.8.2 Where access/doors panels are involved, the complete surface area to be treated shall be first cut from a single piece of lagging material, the access area marked out, plus a minimum ½" (15 mm) around

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perimeter, cut and then glued (foam side to metal) to the door/panel. Do not apply glue to the minimum ½" (15 mm) perimeter overhand section of the material. The main section can then be glued to the main surface being treated. Holes may be punched in the material to allow access to access bolts and material may be cut around hinges and handles.

- 3.8.3 Glue shall be an inexpensive contact adhesive such as LePages Contact Cement compatible with foam insulation. A liberal coat shall be applied to the metal surface but only a thin coat to the foam side of the lagging material. Put surfaces together **before** adhesive goes tack dry so that it can be manipulated neatly into place.
- 3.8.4 Use a non-hard setting caulk to caulk panel corners to ensure that the polyester decoupling layer is not visible.
- 3.8.5 Butt joints may be covered using any fire-rated film/PSA tape.
- 3.8.6 Where a number of identical units are involved, material shall be die-cut.
- 3.8.7 Scope of Acoustics Lagging:
  - .1 All water to air heat pump units suspended in ceiling.
  - .2 All fan coil units suspended in ceiling.
  - .3 Exposed in-line booster or exhaust fans suspended above occupied areas.

**END OF SECTION**

## 1. GENERAL

### 1.1 Related Work

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

### 1.2 General

- 1.2.1 Provide thermal insulation on piping, valves, fittings and radiant ceiling panels, as called for and as scheduled. Note items listed that do not require insulation.
- 1.2.2 Journeyman insulation applicators with red seal or TQ designation in the heat and frost trade shall supervise the insulation work. This project requires the Mechanical Insulation Contractor to provide a BCICA Quality Insurance Certificate (QAC). The Mechanical Insulation Contractor shall register with BCICA and shall be in full compliance with the requirements of the QAC Program. Materials must be installed by tradespersons with a Red Seal or TQ Designation in the Heat and Frost Trade as detailed in the QAC Program.
- 1.2.3 Provide mechanical contractor wall and pipe spacing requirements before project begins and follow up with pipe installer about the proper pipe spacing.
- 1.2.4 Minimum insulation thickness and insulating values shall be in accordance with **ASHRAE Std 90.1** or as per the schedule in this section, whichever is most stringent.
- 1.2.5 Install insulation and related materials and accessories in accordance with the suppliers and manufacturers recommended installation instructions.

### 1.3 Regulatory Requirements

- 1.3.1 Flame spread ratings and smoke developed classifications shall be as required by British Columbia Building Code, CAN/ULC-S102 and NFPA 90A. Generally, the flame spread rating throughout the material shall not exceed 25 and the smoke developed classification shall not exceed 50. Materials shall not flame, smoulder, glow, or smoke at temperature they are exposed to at service.
- 1.3.2 Fibreglass pipe insulation shall comply with:
- .1 CAN/ULC-S102.
  - .2 CCG F1-304 (plain only).
  - .3 CBSB 51-GP-9M.
  - .4 CGSB 51-GP52M (jacket).

- .5 ASTM C 547, Type I, Type IV.
  - .6 STM C 585 – Standard for inner and outer diameters.
  - .7 ASTM C 795 – Insulation in contact with austenitic stainless steel.
  - .8 ASTM C 1136 (jackets; Type I, II, III, IV).
  - .9 ASTM E-84, Surface Burning Characteristics, 25/50 Flame/Smoke.
  - .10 CAN/ULC-S102 “Test for Surface Burning Characteristics of Building Materials”.
- 1.3.3 PVC Fittings and Jacketing shall comply with:
- .1 CAN/CGSB – 51.53-95.
  - .2 CAN/ULC-S102.
- 1.3.4 Vapour Barriers
- .1 ASTM C755-20.
- 1.3.5 All insulation products shall be formaldehyde-free.

#### **1.4 Qualifications and Samples**

- 1.4.1 Submit Manufacturer’s documentation (and samples when requested) for materials, applications and finishing methods to establish they satisfy this specification and meet applicable code requirements, before commencing work.
- 1.4.2 Refer to Section 23 05 05 Firestopping for firestop requirements.

#### **1.5 Quality Assurance**

- 1.5.1 Installer qualifications: Skilled mechanics who are registered apprentices or have successfully completed an apprenticeship program or another craft training program.
- 1.5.2 Surface-Burning Characteristics: For insulation and related materials, UL/ULC Classified per UL723 or meeting ASTM E 84, by testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesives, mastic, tapes and cement material containers, with appropriate markings of applicable testing agency.
- .1 Insulation installed indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - .2 Insulation installed outdoors: Flame spread index of 75 or less, and smoke-developed index of 150 or less.
- 1.5.3 Formaldehyde free: Third party certified with UL Environment Validation.
- 1.5.4 Recycled content: A minimum 50 percent recycled glass content.
- 1.5.5 Bio soluble: As determined by research conducted by the International Agency for Research on Cancer (IARC) supported by

revised reports from the National Toxicology Program (NTP) and the California Office of Environmental Health Hazard Assessment. Certified by European Certification Board for Mineral Wool Products (EUCEB).

- 1.5.6 Low emitting materials: For all thermal and acoustical applications of Glass Mineral Wool Insulation Products, provide materials complying with the testing and products requirements of UL Greenguard Gold Certification.
- 1.5.7 EPD Submittals: As certified by UL Environment.
- 1.5.8 Products shall contain no polybrominated diphenyl ethers (PBDE) such as Penta-BDE, Octa-BDE or Deca-BDE fire retardants, whenever possible.

## **1.6 Definitions**

- 1.6.1 "CONCEALED" means insulated mechanical services in trenches, chases, furred spaces, shafts and hung ceilings (services in tunnels **are are not** considered to be concealed).
- 1.6.2 "EXPOSED" will mean not concealed, to include line of sight elements above 'cloud ceilings' and include piping in parkades, inside the building in unheated zones, and on roof or outside the walls.

## **1.7 Connections to Existing Piping**

- 1.7.1 Make good existing insulation disturbed or removed to facilitate alterations and additions to existing piping.

## **1.8 Heat Traced Piping**

- 1.8.1 Piping subject to freezing is specified to be heat traced. Insulation shall cover heat tracing, allow for oversized insulation as required for heat trace element thickness.

# **2. PRODUCTS**

## **2.1 Materials**

- 2.1.1 Products shall not contain formaldehyde, asbestos, lead, mercury or mercury compounds, if possible. They shall be UL Greenguard Gold or Indoor Advantage Gold, if possible.
- 2.1.2 Products shall be validated by UL/E to be formaldehyde free.
- 2.1.3 Products shall contain no less than 50% recycled content.
- 2.1.4 Insulation materials applied to carbon steel shall be Mass Load Corrosion Rate (MLCR) tested per ASTM 1617.
- 2.1.5 Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C-795.

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## 2.2 Pre-Formed Pipe Covering

### 2.2.1 Mineral Fibre - Low and Medium Temperature:

- .1 Type I (849°F (454°C)) or Type IV (982°F (528°C)); Thermal conductivity at 75°F – 0.019 BTU/hr/ft/°F (24°C – 0.033 W/M/°C)
- .2 Glass mineral wool bonded with a bio-based thermosetting resin.
- .3 UL/ULC classified for Earthwool, FHC 25/50 per ASTM E84 for Redi-Klad. Living building challenge-declare red list free for Rediklad pipe or unjacketed earthwool pipe only.
- .4 Comply with ASTM C585, ASTM C411, ASTM C795 and ASTM C547, Type I and Type IV, **factory-applied ASJ+SSL+ or ASJ-SSL**.
- .5 Products shall be validated by UL/E to be formaldehyde free and have an EPD.
- .6 With integral vapour barrier jacketed and longitudinal lap.
- .7 Acceptable products: Subject to compliance with requirements, provide Knauf Insulation; Earthwool 1000 degree pipe insulation with COSE technology or Earthwool Redi-Klad 1000 degree pipe insulation with ECOSE technology or comparable product by one of the following:
  - .1 Manson Alley K, Owens Corning ASJ/SSL-II, Johns Manville Micro-Lok AP-T Plus.

### 2.2.2 Calcium Silicate - High Temperature:

- .1 Without integral jacket.
- .2 Thermal Conductivity at 199°F – 0.034 BTU/hr/ft/°F (93°C - 0.059 W/m/°C).
- .3 Acceptable Products:
  - .1 IIG Thermo-12 Gold.

### 2.2.3 Perlite Insulation - High Temperature (over 662°F (350°C)):

- .1 Without integral jacket.
- .2 Thermal Conductivity at 194°F – 0.041 BTU/hr/ft/°F (90°C - 0.071 W/m/°C).
- .3 Acceptable Products
  - .1 IIG, Howred Goodtemp.

### 2.2.4 Rock Mineral Wool - High Temperature (over 662°F (350°C)):

- .1 With integral vapour barrier jacket and longitudinal lap.
- .2 Thermal conductivity at 199°F – 0.023 BTU/hr/ft/°F (93° C - 0.040 W/m/°C).
- .3 Acceptable Products:



- .1 Roxul ASJ/SL, ESLIN (Energy Savings Layered Insulation) by Visionary Industrial Insulation, Thermafiber, IIG.

2.2.5 Flexible Foamed Elastomeric:

- .1 Thermal conductivity at 75°F – 0.023 BTU/hr/ft/°F (24° C - 0.040 W/m/°C).
- .2 Acceptable Products:
  - .1 AP Armacell, K-Flex USA, Aerocell.

2.2.6 Flexible Closed Cell:

- .1 Thermal conductivity at 75°F – 0.021 BTU/hr/ft/°F (24° C - 0.036 W/m/°C).
- .2 Acceptable Products:
  - .1 Therma-Cel.

2.2.7 Phenolic Closed Cell - Rigid:

- .1 With integral vapour barrier jacket and longitudinal lap.
- .2 Thermal conductivity at 75°F – 0.011 BTU/hr/ft/°F (24° C - 0.019 W/m/°C).
- .3 Acceptable Products:
  - .1 Kingspan Kooltherm.

2.2.8 Polyiso Closed Cell – Rigid:

- .1 With integral vapor barrier jacket and longitudinal lap.
- .2 Thermal conductivity at 24°C - 0.019 W/m/°C.
- .3 Acceptable Products:
  - .1 Shur-Fit polysio with Mylar SSL (self-seal lap) vapor barrier.

**2.3 Firestopping and Smoke Seal Materials**

- 2.3.1 Refer to Section 23 05 05 Firestopping for firestop requirements.

**2.4 Accessories**

2.4.1 Insulation Fastenings:

- .1 16 ga (1.61mm) galvanized wire or 16 ga (1.61 mm) thick copper wire as commercially available.

2.4.2 Jacket Fastenings:

- .1 Thermocanvas and All Service:
  - .1 Staples (flare type), compatible jacket finishing tape, contact adhesives recommended by the jacket manufacture.
- .2 Metal Jackets
  - .1 Sheet metal screws, pop rivets, bands.

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- .3 PVC Jacket and Fitting Covers:
    - .1 PVC self-adhesive tape, plastic pop rivets, bonding cement.
  - 2.4.3 Adhesives:
    - .1 Flexible elastomeric and flexible closed cell insulation adhesive:
      - .1 Armstrong 520, Thermacell 1590, Rubatex R-373, Zipcoat 8A.
    - .2 Vapour barrier jacket adhesive:
      - .1 Bakelite 230-39, Childers CP-82, Epolux Cadoprene 400, Foster 85-20.
    - .3 Fabric adhesive, to insulation pipe covering:
      - .1 Bakelite 120-18, Childers CP-52, Epolux Cadalag 336, Foster 30-36, Robson White Lag.
  - 2.4.4 Coatings:
    - .1 Vapour barrier coating on reinforcing membrane or on insulating cement to achieve minimum 0.05 perm permeance of assembly:
      - .1 Bakor 120-09, Childers Chil-Out CP33/Chil-Perm CP35; Epolux Cadalag 336; Foster Vapour out 30-33/Vapor-Fas 30-65.
      - .2 Childers CP-30 (refrigeration suction lines only).
    - .2 Flexible elastomeric and flexible closed cell insulation finish coating to achieve minimum 0.05 perm permeance of assembly:
      - .1 Armstrong, Bakelite 120-13, Rubatex, Zipcoat.
  - 2.4.5 Finish Jackets:
    - .1 Thermocanvas Jacket:
      - .1 Fattal's Thermocanvas, Robson Flamex FR Canvas or Tai-Can Canvas.
    - .2 All Service Jacket (with 0.0019" (0.3 mm) minimum thick foil):
      - .1 Fattal's Fat-Lock ASJ, Fibreglass ASJ, Knauf ASJ+, Kingspan ASJ, Manson SPT, Johns Manville AP-T Plus, Owens Corning ASJ, Roxul ASJ.
    - .3 PVC Finishing Jacket (minimum 0.015" (0.38 mm) thick) with factory applied self seal lap:
      - .1 Shur-Fit Products SSL PVC Jacket, Proto PVC, Speedline PVC, Zeston PVC.
    - .4 Aluminum Jacket:
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- .1 26 ga (0.51 mm) thick stucco embossed or smooth aluminum jacketing with longitudinal slip joints and 0.0019" (0.3 mm) end laps with factory applied protective liner on interior surface.
    - .1 Shur-Fit Aluminum Jacket, ITW, Ideal products or other as commercially available.
    - .2 Pacific Pressed fitting covers (available from Shur-Fit Products) for the following:
      - .1 Grooved pipe fittings
      - .2 Insulated and clad refrigerant lines
  - 2.4.6 Reinforcing Membrane:
    - .1 Glass reinforcing membrane as commercially available: Foster Mast-A-Fab; Childers Chil-Glas #10; Pittsburgh Corning PC-79
  - 2.4.7 Insulating Cement:
    - .1 Ryder Thermokote MW high temperature, or as commercially available.
  - 2.4.8 Finishing Cement:
    - .1 Ryder Thermokote 1 FW.
  - 2.4.9 Pre-Formed Fitting Covers:
    - .1 Aluminum Fitting Covers:
      - .1 26 ga (0.51 mm) thick, die shaped components with factory applied protective liner on interior surface.
        - .1 Pacific Pressed Fitting Covers (Available from Shur-Fit Products), Childers Ell-Jacs, Ideal Weatherjacs, Shield-Ells or other as commercially available.
    - .2 PVC Fitting Covers:
      - .1 0.02" (0.50 mm) thick pre-moulded one-piece covers.
        - .1 Childers, Proto PVC, Speedline PVC, Zeston PVC, Fattal PVC.
  - 2.4.10 Pre-Formed Insulation Fittings:
    - .1 Shur-Fit, Keen Insulated Fittings, Moulded Acoustic Production or from insulation fabricators/manufacturers.
    - .2 Provide pre-molded elbows and fittings molded in two matching half sections of full thickness insulation as adjoining piping insulation. As an alternative, provide mitred sections of equivalent insulation in thickness, composition and density to that on straight pipe runs.
    - .3 Gouging out or thinning insulation thickness is not acceptable. Inserts, blanket or FSK duct wrap insulation is not acceptable and will be removed and replaced.
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- .4 PVC and or aluminum coverings are to be molded to match fittings – alternatively oversized fittings and end caps may be used with mitred insulation sections, PVC and aluminum fitting covers are not considered to be vapour barriers unless completely vapour sealed.
  - .5 Canvas and mastic finish is required where codes do not allow PVC.
  - .6 KEEN Insulated fittings (available from Shur-Fit Products) for hot, cold, chilled, & HT fire protection systems for all grooved type pipe fittings and no further finish required in exposed indoor areas satisfy the above requirements.
  - .7 KEEN Insulated Fittings with Pacific Pressed fitting covers (available from Shur-Fit Products) for all outdoor applications of insulated grooved pipe satisfy the above requirements.
  - .8 KEEN Insulated Valve Covers (available from Shur-Fit Products) for all indoor insulated chilled water or domestic cold water systems satisfy the above requirements.
- 2.4.11 Pre-Insulated pipe supports:
- .1 Specified in section 23 05 29 Hangers and Supports for HVAC Piping and Equipment to be provided by mechanical contractor. Ensure mechanical contractor is aware of requirement for them to supply and install to avoid problems on site.
  - .2 Install Seismic Pro-Pipe insulated pipe (available from Shur-Fit Products) on all insulated lines requiring sway bracing or horizontal/vertical anchoring.
- 2.4.12 Insulated Victaulic, or other similar pipe system fittings:
- .1 KEEN Insulated Fittings (available from Shur-Fit Products) satisfy the above requirements.
- 2.4.13 Insulated balancing valves, strainers, or shut-off valves on DCW and CHWS/R lines:
- .1 KEEN Insulated Fitting service covers (available from Shur-Fit Products) satisfy the above requirements.
- 2.4.14 Insulated refrigerant lines or other outdoor piping or in areas exposed to physical abuse:
- .1 Pacific Pressed fitting cover (22ga (0.64mm)) Aluminum jacket. (Available from Shur-Fit Products)
  - .2 3M VentureClad Insulation Jacketing System classified as zero permeability. Installation shall be as per manufacturer's guidelines.

## **2.5 Scope of Insulation**

### **2.5.1 Heating Piping, Fittings and Valves:**

- .1 Insulate the following systems, unless otherwise noted:
  - .1 Hot water heating supply and return piping.
  - .2 Steam piping.
  - .3 Condensate piping.
  - .4 Boiler feed water piping.
  - .5 Antifreeze heating supply and return piping.
  - .6 Condenser water piping, outside building.
  - .7 Cooling tower sump, spray water, drain, overflow and chemical feed piping, outside building.
  - .8 Geo-exchange source side metal piping and components inside the building.
  - .9 Flexible branch connections to ceiling radiant heat panels.
  - .10 Hot gas piping.
  - .11 Trace heated drain lines from freezer and cold rooms.
- .2 DO NOT insulate the following, unless otherwise noted:
  - .1 Piping located within perimeter heating enclosures.
  - .2 Relief piping.
  - .3 Drain lines.
  - .4 Small branch risers to terminal heating elements just above floor level, from 6" (150 mm) below floor slab up to heating element.
  - .5 Flexible interconnections between ceiling radiant heating panels.
  - .6 Condenser water piping inside building.
  - .7 HDPE plastic geo-exchange piping inside the building.
- .3 Insulate the following valves and fittings if pipe is insulated using pre-formed fitting insulation sections, molded or mitred insulation to the full thickness insulation requirements. Duct wrap, fiber flexible insulation or inserts that do not match the same density and installed thickness of the pipe insulation schedule are not acceptable.:
  - .1 Elbows, tees, reducers.
  - .2 Valve bodies on the valves and check valves.
  - .3 Flanges.
  - .4 Strainers.
- .4 The following hot pipe fittings that operate at greater than 140°F (60°C) shall be coated with Thermolite - SG as per Manufacturer's specification to prevent skin burns:

- .1 Valves, NPS 2½" (65 mm) and smaller.
- .2 Valve bonnets.
- .3 Unions.
- .4 Drip legs.
- .5 Steam pressure reducing valves.
- .6 Steam traps.
- .7 Flexible connections.
- .8 Expansion Joints.
- .9 Check valve covers.

2.5.2 Chilled water piping, refrigerant piping, fittings and valves:

- .1 Insulate and vapour seal the following systems including the provision of vapour dams as indicated in Part 3 of this section, unless otherwise noted:
  - .1 Chilled water supply and return, including pump bodies, valve bodies and meters.
    - .1 Provide KEEN Insulated Valve Covers (available from Shur-Fit Products) or approved alternate w/removable port cover on all CHWS balancing valves.
  - .2 All refrigerant piping for comfort cooling.
  - .3 Refrigerant suction piping for product refrigeration.
  - .4 Antifreeze heat recovery piping.
- .2 DO NOT insulate the following, unless otherwise noted:
  - .1 Drain lines for sumps 60°F (15.6°C) and over.
- .3 Insulate and vapour seal the following fittings, if pipe is insulated. Duct wrap, fiber flexible insulation or inserts that do not match the same density and installed thickness of the pipe insulation schedule is not acceptable:
  - .1 Elbows, tees, reducers.
  - .2 Valves, (bodies and bonnets) except check valve covers.
  - .3 Strainers.
  - .4 Flanges
  - .5 Unions
  - .6 Chilled water pump bodies.

2.5.3 Plumbing pipes, fire protection pipes, fittings, valves:

- .1 Insulate the following systems, unless otherwise noted:

- .1 Domestic cold water system including meter body and booster pump bodies and including traps on handicapped lavatories.
- .2 Domestic hot water supply and recirculation piping.
- .3 Domestic tempered water supply and return.
- .4 Rainwater leaders and cast-iron fittings **for the full length from the roof drain body to connection to below grade storm sewer**, using preformed fibreglass pipe insulation complete with continuous vapour barrier. Roof drain bodies shall be insulated to same thickness as pipe.
- .5 All drains, lines, stacks, fire standpipes and sprinkler mains in unheated areas (insulation shall cover heat tracing cables).
- .6 Water valves, flanges, PRVs strainers, check valves.
- .7 Sprinkler/standpipe system from domestic water connection point to 16'-0" (4.8 m) downstream or to inlet alarm valve, whichever is less, using preformed fiberglass pipe insulation complete with continuous vapour barrier.
- .8 Interior irrigation/hose bibb supply piping.
- .2 DO NOT insulate the following, unless otherwise noted:
  - .1 Piping used exclusively for fire protection (unless in unheated spaces).
  - .2 Soil stacks, vents, etc.
  - .3 All special service piping, e.g., gas, compressed air, etc.
  - .4 Unions.
  - .5 Flexible connections or expansion joints (unless noted on drawings).
  - .6 Check valve covers.
  - .7 Strainer leg and basket covers.
  - .8 Flexible fixture connections.
- 2.5.4 Pipe penetrations through walls and floors:
  - .1 Material for stuffing, sealing and caulking of pipe penetrations shall be supplied and installed under this section.

## 2.6 **Pipe Insulation Schedule and Thickness Table**

- 2.6.1 'Inside' means within the heated building envelope. Everywhere else is considered outside and unheated space.

Service	Design Operating Temperature	PIPE SIZE				
		≤NPS 1 (25 mm)	NPS 1¼ (32 mm) to NPS 2 (50 mm)	NPS 2½ (65 mm) to NPS 4 (100 mm)	NPS 6 (150 mm) to NPS 8 (200 mm)	>NPS 8 (200 mm)
Chilled Water	≥40°F (≥4.4°C)	1" (25 mm)	1" (25 mm)	1" (25 mm)	1" (25 mm)	1" (25 mm)
Condenser Water Inside Building	86°F (30°C) – 105°F (41°C)	None	None	None	None	None
Condenser Water Outside Building	86°F (30°C) - 105°F (41°C)	1½" (40 mm)	1½" (40 mm)	1½" (40 mm)	1½" (40 mm)	1½" (40 mm)
Cooling Tower Sump Spray Water Piping, Drain, Overflow, Chemical Feed (Outside Building)	90°F (32.2°C)	1½" (40 mm)	1½" (40 mm)	1½" (40 mm)	1½" (40 mm)	1½" (40 mm)
Refrigerant Suction and Hot Gas	<41°F (5°C)	1" (25 mm)	1½" (40 mm)	1½" (40 mm)	1½" (40 mm)	1½" (40 mm)
Glycol Heat Recovery	50°F (10°C)	1" (25 mm)	1" (25 mm)	1½" (40 mm)	1½" (40 mm)	1½" (40 mm)
Hot Water/Glycol Heating	105°F (40°C) -140°F (60°C)	1" (25 mm)	1½" (40 mm)	1½" (40 mm)	1½" (40 mm)	1½" (40 mm)
	141°F (60°C) -200°F (93°C)	1½" (40 mm)	2" (50 mm)	2" (50 mm)	2" (50 mm)	2" (50 mm)
Hot Water/Glycol Heating	201°F (94°C) -250°F (120°C)	2½" (65 mm)	2½" (65 mm)	2½" (65 mm)	3" (80 mm)	3" (80 mm)
Heat Pump Water (inside building) (including geo- exchange side condenser water piping "Source Side")	15°F (-10°C) min to 55°F (13°C) max	1" (25 mm)	1½" (40 mm)	1½" (40 mm)	1½" (40 mm)	1½" (40 mm)
Heat Pump Water (outside building) (where exposed and not buried)	30°F (-1°C) to 90°F (32°C)	1½" (40 mm)	1½" (40 mm)	1½" (40 mm)	1½" (40 mm)	1½" (40 mm)
Steam	up to 15 psi (103 kPa)	2½" (65 mm)	3" (80 mm)	3" (80 mm)	3" (80 mm)	3" (80 mm)



Service	Design Operating Temperature	PIPE SIZE				
		≤NPS 1 (25 mm)	NPS 1¼ (32 mm) to NPS 2 (50 mm)	NPS 2½ (65 mm) to NPS 4 (100 mm)	NPS 6 (150 mm) to NPS 8 (200 mm)	>NPS 8 (200 mm)
	(250°F (121°C))					
Steam	16 psi (110 kPa) to 120 psi (827 kPa) (350°F (176°C))	3" (80 mm)	4" (100 mm)	4½" (115 mm)	4½" (115 mm)	4½" (115 mm)
Steam Condensate (gravity)	212°F (100°C)	2½" (65 mm)	2½" (65 mm)	2½" (65 mm)	3" (80 mm)	3" (80 mm)
Steam Condensate (pumped)	180°F (82°C)	1½" (40 mm)	1½" (40 mm)	2" (50 mm)	2" (50 mm)	2" (50 mm)
Generator Exhaust Pipe and Silencer	900°F (482°C)	3" (80 mm)	3" (80 mm)	3" (80 mm)	3" (80 mm)	3" (80 mm)
Generator Glycol Coolant Piping (inside building)	392°F (200°C)	2½" (65 mm)	2½" (65 mm)	2½" (65 mm)	2½" (65 mm)	2-½" (65 mm)
Continuous Cold Water Drainage	40°F (5°C)	½" (15 mm)	½" (15 mm)	½" (15 mm)	½" (15 mm)	½" (15 mm)
Drip Pan Drains - Unit Coolers	34°F (1°C) and above	None	None	None	None	None
Drip Pan Drains - Freezers	below 34°F (1°C)	½" (15 mm)	½" (15 mm)	½" (15 mm)	½" (15 mm)	½" (15 mm)
Drip Pan Drains - Freezers	heat traced	1" (25 mm)	1" (25 mm)	1" (25 mm)	1" (25 mm)	1" (25 mm)
Evaporator Drip Pan Drains	51°F (11°C) and above	None	None	None	None	None
Evaporator Drip Pan Drains, and Chilled Water Coil Drains	50°F (10°C) and lower	½" (15 mm)	½" (15 mm)	½" (15 mm)	½" (15 mm)	½" (15 mm)
Domestic Cold Water	Below 65°F (18°C)	½" (15 mm)	½" (15 mm)	½" (15 mm)	½" (15 mm)	½" (15 mm)
Domestic Hot and Tempered Water	105°F (40°C) - 140°F (60°C)	1" (25 mm)	1½" (40 mm)	1½" (40 mm)	1½" (40 mm)	1½" (40 mm)

Service	Design Operating Temperature	PIPE SIZE				
		≤NPS 1 (25 mm)	NPS 1¼ (32 mm) to NPS 2 (50 mm)	NPS 2½ (65 mm) to NPS 4 (100 mm)	NPS 6 (150 mm) to NPS 8 (200 mm)	>NPS 8 (200 mm)
Supply and Recirculation	141°F (61°C) - 180°F (82°C)	1½" (40 mm)	2" (50 mm)	2" (50 mm)	2" (50 mm)	2" (50 mm)
Self-Regulated Heat Traced DHW Piping <sup>1</sup>	105°F (40°C) - 140°F (60°C)	1½" (40 mm)	2" (50 mm)	2" (50 mm)	2" (50 mm)	2" (50 mm)
Buried and Exterior Rainwater Storm Drainage	90°F (32.2°C)	None	None	None	None	None
Above Grade Interior Rainwater Storm Drainage including interior roof drain body.	Below 65°F (18°C)	1" (25 mm)	1" (25 mm)	1" (25 mm)	1" (25 mm)	1" (25 mm)

Note 1: Insulation for self-regulated heat traced DHW piping shall comply with this table or manufacturer's recommendation (whichever is more stringent).

Note 2: All piping forming part of the HVAC and plumbing systems and located outside the building envelope shall be insulated at a minimum of 2x thickness above. (This includes parkades and all/any unheated spaces within the building.)

### 3. EXECUTION

#### 3.1 Application

- 3.1.1 Apply insulation to piping only after tests have been made and systems accepted.
- 3.1.2 Apply insulation and insulation finish so finished product is smooth in finish, with the longitudinal seams concealed from view. Apply piping insulation materials, accessories and finishes in accordance with Manufacturer's recommendations. Pre-formed or molded pipe fitting insulation sections shall be used on all elbows, tees and pipe joint/flange fittings. Where pre-formed or molded insulation sections cannot be used or sourced, insulate to BCICA standards, including oversize insulation at mechanical pipe joints or mitred elbows.
  - .1 Provide KEEN Fabricated Fittings (available from Shur-Fit Products) for grooved pipe fittings where available.
- 3.1.3 On piping NPS 1 (25 mm) and larger with insulation and vapour barrier, install high density insulation above hanger shield. Insert to

be slightly longer than length of shield. Maintain integrity of vapour barrier over full length of pipe without interruption at sleeves, fittings and supports. Refer to Section 23 05 29.

- .1 Provide Pro-Pipe supports (available from Shur-Fit Products).
  - .2 Insulator shall back insulate supporting hardware 4X insulation thickness and vapor seal when pipe support penetrates the vapour barrier.
- 3.1.4 Insulation and vapour barrier shall be continuous through both rated and non-rated separations.
- 3.1.5 Mechanical to provide valve stem extensions on all insulated pipe so insulator can provide pipe covering or molded fittings to full thickness.
- 3.1.6 Provide high density insulation and shields at all riser clamps/seismic sway bracing connection locations for all cold piping with continuous vapour barrier.
- .1 Provide Seismic Pro-Pipe supports (available from Shur-Fit Products).

### **3.2 Insulation Termination Points**

- 3.2.1 Cold Application: All fittings shall be insulated. Terminate insulation 3" (80 mm) back from uninsulated connections to provide working clearance for serviceable locations and terminate insulation at 90° and finish with reinforced scrim cloth vapour barrier mastic system/sealer system extending over ASL and pipe/equipment connections. Cover onto pipe and over the insulation vapour barrier.
- 3.2.2 Hot Applications: As above or a breathable type mastic or sealer is acceptable.
- 3.2.3 Cut back insulation at 45° and finish with silicone caulking sealant around base of thermometer wells, pressure gauges, flow switches and pressure and control sensors.

### **3.3 Vertical Risers**

- 3.3.1 On vertical pipe over 3" (80 mm) provide insulation supports welded or bolted to pipe, directly above lowest pipe fitting. Thereafter, locate on 15'-0" (4.5 m) centres.

### **3.4 Hot Application 80°F (26.7°C) and Over**

- 3.4.1 Piping:
- .1 Install medium temperature pipe insulation with integral jacket to pipe and hold in place by stapling flap, with spreading staples at 3" (80 mm) centres. Pipe insulation with integral self-sealing jacket will not require additional fastening.

- .2 Install strips of vapour barrier jacket over butt joints and secure with reinforcing tape and mastic.
- 3.4.2 Fittings:
  - .1 Insulate fittings, to thickness of adjacent pipe insulation, with sections of pipe insulation mitred to fit tightly, or with pre-formed insulation fittings (Shur-Fit) or from insulation fabricator.
  - .2 Provide KEEN Insulated Fittings (available from Shur-Fit Products) for insulated grooved pipe fittings.
- 3.4.3 Valves, Strainers:
  - .1 Insulate valve bodies and strainers with fitted pipe insulation, or mitred blocks to thickness of adjacent pipe insulation or insulate with pre-formed insulation fittings (Shur-Fit) or from insulation fabricator. Valves, if not integral, shall be provided with stem extension to allow for proper insulation thickness by Mechanical Contractor. Stem extension to stay stationary to ensure vapor barrier seal is not broken when valve is exercised. Drains, blow-off plugs and caps shall be left uncovered.
  - .2 Provide KEEN Insulated Fittings (available from Shur-Fit Products) for insulated pipe fittings.
- 3.4.4 Flanges and Victaulic Fittings:
  - .1 Do not insulate flanges or grooved couplings on condenser/heat pump water piping inside building.
  - .2 Insulate flanges on condenser/heat pump water piping outside building.
  - .3 Insulate flanges with oversized pipe insulation or mitred blocks to thickness of adjacent pipe insulation. Insulation to overlap adjoining insulation at least 3" (80 mm).
  - .4 Insulate using pre-formed fitting, molded or mitred to the full thickness insulation requirements. Duct wrap, fiber flexible insulation or inserts that do not match the same density and installed thickness of the pipe insulation schedule is not acceptable.

### **3.5 Cold Application 50°F (10°C) and Less**

- 3.5.1 Piping:
  - .1 Install low/medium temperature pipe insulation with integral vapour barrier jacket to pipe and hold in place by securing jacket flap. Seal flaps with vapour barrier adhesive. Pipe insulation with integral self-sealing vapour barrier jacket does not require additional fastening.
  - .2 Install strips of vapour barrier jacket over butt joints with vapour barrier adhesive. Over wrap butt strips by 50% for

insulation OD 12" (300 mm) and above apply strip on 10" (250 mm) centres for additional securement. (Note: accessory items such as, but not limited to, thermometers, probes, valves, etc. shall be insulated and sealed. Hangers in contact with the pipe shall be back insulated from where they carry the pipe to 4 times the insulation thickness and vapour sealed).

- .3 Install vapour dams on chilled water piping over 2½" (65 mm) as indicated in the NAIMA Chilled Water Installation Guide 2015. Mastic coat insulation ends at every fourth section of insulation on straight pipe and allow to dry before piping is insulated and vapour sealed. Extend the mastic onto the pipe and extend the mastic up and onto the ASJ jacket. Apply 1" (25 mm) wide blue tape to indicate location of vapour dams. Vapour barrier tape shall provide minimum .02 perm vapour seal.

#### 3.5.2 Fittings:

- .1 Insulate fittings to thickness of adjacent pipe insulation with section of pipe insulation mitred to fit tightly, or pre-formed or moulded insulation fittings (Shur-Fit), apply reinforcing membrane embedded barrier coating and apply finish vapour barrier coating.
- .2 Provide KEEN Insulated (available from Shur-Fit products) fittings for insulated grooved pipe fittings.
- .3 Flexible insulation such as blanket inserts, flexible fibre or duct wrap will not be acceptable on cold piping.
- .4 Install vapour dams on chilled water fittings as indicated in the NAIMA Chilled Water Installation Guide 2015. Mastic coat insulation ends at all sides of all fittings and allow to dry before fittings are insulated and vapour sealed. Extend the mastic onto the fitting and extend the mastic up and onto the ASJ jacket. Apply 1" (25 mm) wide blue tape to indicate location of vapour dams. Vapour barrier tape to provide minimum .02 perm vapour seal.
- .5 All heat traced sanitary, storm and drainage piping, to cold pipe insulation thickness schedule.

#### 3.5.3 Valves, Strainers:

- .1 Insulate pump bodies, valve bodies, bonnets and strainers with fitted pipe insulation or mitred blocks to the same thickness as adjacent pipe insulation, apply reinforcing membrane embedded in barrier coating or insulate with pre-formed insulation fittings (Shur-Fit) or from insulation fabricator complete with vapour barrier. Valves, if not integral, shall be provided with stem extension to allow for proper insulation thickness by Mechanical Contractor. Stem

extension to stay stationary to ensure vapor barrier seal is not broken when valve is exercised. Drains, blow-off plugs and caps shall be left uncovered.

3.5.4 Unions, Flange and Victaulic Fittings:

- .1 Insulate cold unions and flanges with oversized pipe insulation or mitred blocks to thickness of adjacent pipe covering, apply reinforcing membrane embedded in barrier coating and final coating of vapour barrier mastic.

**3.6 Anti-Sweat Coating**

3.6.1 Coat with anti-sweat coating - "No Sweat" by Robson Thermal Mfg. Ltd. or approved alternate, the following uninsulated cold surfaces:

- .1 Connect surfaces of thermometers, pressure gauges, flow switches, controllers, etc.

3.6.2 The coating thickness shall be recommended by coating Manufacturer for system operation conditions.

**3.7 Pipe Insulation Finishes**

3.7.1 "Concealed" insulation in horizontal and vertical service spaces will require no further finish.

3.7.2 "Concealed" pipe insulation in damp locations, e.g., pipe trenches, shall have vapour barrier jacket, vapour sealed.

3.7.3 "Exposed" flexible insulation shall be painted with heavy brush coating of foam plastic white insulation coating.

3.7.4 Where KEEN Elastomeric Fittings and valve covers (available from Shur-Fit Products) have been used, no further finish is required.

3.7.5 "Exposed" insulation inside building shall be finished as follows:

- .1 Premium Finish (PVC Covers) PF-5 BCICA Standard:
  - .1 Over factory applied integral all-service type jacket on pipe insulation, apply PVC jacket.
  - .2 Over insulated fittings apply PVC fitting covers. Over insulated valve bodies, valves bonnets, strainers and flanges apply purchased PVC covers or field fabricate from PVC sheeting secured with solvent bonding cement.
- .2 Premium Finish with Canvas Wrap: BCICA PF-2 standard finish fabric with two coats of fabric coating. Canvas re-covering shall be applied with a minimum overlap of 1" (25 mm), and finished with two coats of flexible fabric paint, white.
- .3 Economy Finish (PF-3 BCICA Standard):
  - .1 Apply pipe insulation with integral all-service type jacket. Cover longitudinal and circumferential joints with

jacket finishing tape neatly applied. Alternately, secure jacketing longitudinal joint using integral self-sealing lap. Cover circumferential joints with jacket finishing butt strips. Over wrap strips by 50%. For insulation OD 12" (300 mm) apply trips on 10" (250 mm) centres for additional securement. PVC 0.02" (0.50 mm) thick should not be used as vapour barrier alone. Should have 'ASJ' or mastic system under it. Over insulation on short pipe runs and piping adjacent to fittings, valves, etc., jacket to be field applied.

- .2 Over insulated fittings apply tack coat of vapour barrier mastic and embed reinforcing membrane and cover with same mastic. Over insulated valve bodies, valve bonnets, strainers and flanges, apply all-service jacketing using necessary fastenings and jacket finishing tape and with reinforced mastic system on irregular surfaced. Alternatively install plain aluminum foil tape with a perm rating of .002 or better.

3.7.6 "Exposed" outdoor insulation **including in the parking garage** shall be finished as follows:

- .1 Insulation shall have vapour barrier jacket.
- .2 Over pipe insulation jacket apply aluminum weather protecting jacket. The longitudinal seam shall be located to shed water. Secure the jacket using necessary metal banding on approximately 10" (250 mm) centres and at the overlaps. Screws are not permitted on cold operating systems.
- .3 Over insulated fittings, valve bodies, valve bonnets, strainers and flanges, apply metal jacket or pre-formed metal fittings to provide complete jacket system. Secure with necessary fastenings.
- .4 Seal outdoor jacketing watertight.

3.7.7 Provide Pacific Pressed fitting covers (available from Shur-Fit Products) for insulated grooved pipe. On outdoor insulated pipe fittings PVC is not acceptable due to exposure to weather and UV rays.

3.7.8 Provide Pacific Pressed fitting covers (available from Shut-Fit Products) on outdoor insulated refrigerant lines. On outdoor insulated pipe fittings PVC is not acceptable due to exposure to weather and UV rays.

### **3.8 Refrigeration Suction Piping Outside Building**

3.8.1 Install flexible foamed elastomeric or flexible closed cell pre-formed piping insulation. Secure longitudinal and butt joints with adhesive.

Insulate fittings and components. To obtain the specified thickness, apply in layers with staggered joints.

3.8.2 Finish with flexible elastomeric or flexible closed cell insulation coating.

3.8.3 Re-cover outdoor exposed insulation with Aluminum jacket (Pacific Pressed (available from Shur-Fit Products) fitting covers.

**3.9 Firestopping and Smoke Seals**

3.9.1 Refer to Section 23 05 05 Firestopping for firestop requirements.

**3.10 Insulation Packing of Pipe Sleeves**

3.10.1 Tightly pack space between pipe sleeves and pipe or between pipe sleeve and pipe insulation with mineral wool insulation - Thermal Ceramics "Cerafibre" or Carborundum "Fibrefrac" to full depth of sleeve to prevent transmission of sound and/or passage of smoke.

**3.11 Insulation for Radiant Ceiling Panels**

3.11.1 Provide and install 3" (80 mm) thick 0.75 lb/ft<sup>3</sup> (12 kg/m<sup>3</sup>) flexible glass mineral wool insulation on top of hot water ceiling radiant heating panels. Insulation shall be faced on both sides with FSK (Foil, Scrim, Kraft) facing with edges sealed.

3.11.2 Application:

- .1 Cut insulation to fit dimension of back of panel and lay insulation on top of panel.
- .2 Insulation shall extend from edge to edge.
- .3 Insulation shall cover small piping located directly above the panel

**END OF SECTION**



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1. **GENERAL**

1.1 **Related Work**

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

1.2 **Quality Assurance**

- 1.2.1 Commissioning shall be executed in accordance with intent of ASHRAE Guideline 1.1 – 2007 “HVAC and R Technical Requirements for the Commissioning Process”.

1.3 **General**

- 1.3.1 Be responsible for the performance and commissioning of equipment supplied in Mechanical. Commissioning is process of advancing installation static completion to full working order in accordance with contract documents and design intent. It is activation of completed installation.
- 1.3.2 In consultation with General Contractor, ensure sufficient time is allowed and fully identified on construction schedule for proper commissioning of mechanical systems.

2. **PRODUCTS: NOT USED**

3. **EXECUTION**

3.1 **Commissioning and Demonstration**

- 3.1.1 Submit schedule for commissioning phase of work. Schedule shall show:
- .1 Equipment start-up schedule.
  - .2 Submission dates for documents required prior to substantial completion.
  - .3 Timing of various phases of commissioning, testing, balancing and demonstration process.
- 3.1.2 Commissioning is concluded when air and water systems have been balanced and installation is in working order and acceptable for use. Work will include the following:
- .1 Balancing of air systems as specified in Section 23 05 93.
  - .2 Balancing of liquid systems as specified in Section 23 05 93.
  - .3 Adjust vibration isolators and earthquake restraints for optimum performance.

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- .4 Verification and certifications of sealing of HVAC penetrations through fire separations (rated and non-rated) and sound separations.
  - .5 Verification of water tightness of roof and exterior wall penetrations.
  - .6 Verification that coil drain pans operate.
  - .7 Set up automatic control valves/dampers and automatic temperature control devices.
  - .8 Testing and debugging of DDC System.
  - .9 Set up and test alarm and protective devices.
  - .10 Power failure test with emergency generator start-up.
  - .11 Calibration and adjustment of smoke venting and pressurization systems.
  - .12 BAS Trend Logging of temperature and humidity in specified areas.
- 3.1.3 At conclusion of commissioning, demonstrate operation of systems to Consultant and to Owner's Operating Staff. For demonstration and instruction to Operating Staff requirements, refer to following clause and Controls Systems Specification.
- 3.1.4 The verification process shall include the demonstration of the following:
- .1 Ease of access provided for servicing coils, motors, drives, fusible link fire dampers, smoke dampers, control dampers and damper operators.
  - .2 Location of and opening and closing of access panels.
  - .3 Operation of automatic controls dampers and automatic temperature control devices.
  - .4 Operation of alarm and protective devices.
  - .5 Proper response of mixing boxes and air valves to thermostats and volume adjustment controls.
  - .6 Operation of smoke dampers and smoke pressurization and removal provisions.
  - .7 Operability of randomly selected fire dampers.
  - .8 Noise level from typical mixing boxes and air valves under extreme operating conditions.
  - .9 Operation of equipment and systems under each mode of operating, and failure, including:
    - .1 DDC control features.
    - .2 Automatic controls including air compressors.
    - .3 Boilers and associated gas/oil fuel systems.
    - .4 Chiller(s) and cooling tower(s).

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- .5 Packaged air conditioners.
  - .6 Refrigeration systems.
  - .7 Heat recovery systems.
  - .8 Heat exchangers/immersion heaters.
  - .9 Pumps.
  - .10 Cabinet unit heaters.
  - .11 Unit heaters.
  - .12 Fans.
  - .13 Coils.
  - .14 Humidifiers.
  - .15 Tanks - domestic hot water, blowdown, condensate and expansion.
  - .16 Steam pressure reducing stations.
  - .17 Deaerator.
  - .18 Condensate return units.
  - .10 Energy meters for natural gas sub-metering, hydronic energy meters, water sub-meters, and electrical sub-meters to be tested, calibrated and verified in accordance with the Manufacturer's requirements and Government of Canada Weights and Measures Requirements.
- 3.1.5 At completion of the commissioning, testing, balancing and demonstration, submit the following to Consultant:
- .1 Letter certifying that work specified is complete, clean and operating in accordance with specification and drawings.
  - .2 Completed copies of commissioning check sheets, copies of start-up reports from specialty Contractors and Vendors and functional performance test sheets.
  - .3 Record drawings as specified.
  - .4 TSSA Boiler Inspection Department approval of boiler, pressure vessels and pressure piping installation.
  - .5 Fire Commissioner's approval of fuel oil installations.
  - .6 TSSA Gas Inspection Department approval of boiler and gas firing.
  - .7 List of alarm and protective devices tested, with the final operating settings.

### **3.2 Commissioning and Demonstration**

- 3.2.1 Provide services of approved independent specialist firm to coordinate commissioning process specified under this division and those items of other Divisions which interact with work of this Division, including complete life safety and fire protection system.

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- 3.2.2 Cooperation of all trades is essential for efficient and planned process. Team comprising the following is recommended:
- .1 Commissioning Coordinator.
  - .2 General Contractor.
  - .3 Mechanical Contractor's Supervisor.
  - .4 Mechanical Consultant.
  - .5 Building Owner's Representative.
  - .6 Mechanical Trades, especially Controls Contractor and Balancing Agency.
  - .7 Electrical.
- 3.2.3 Prepare commissioning statement for each of four phases indicated. Phases are as follows:
- .1 PHASE 1 - System readiness.
  - .2 PHASE 2 - System start-up, testing, balancing, etc.
  - .3 PHASE 3 - Verification of system performance.
  - .4 PHASE 4 - Demonstration and instruction.
- 3.2.4 Each phase is applicable to each major and/or separate system making up work in Mechanical plus Electrical interface as applicable.
- 3.2.5 Regular meetings shall be held during commissioning process. Minutes of meetings shall be issued to Contractors involved, Consultant and Owner's Representative.
- 3.2.6 Plan work to be specific in respect of personnel, schedule, review and laboratory tests.
- .1 Personnel: Assign direct overall charge of commissioning to commissioning coordinator fully qualified through practical experience and comprehensive knowledge of interactive nature of building systems and controls to understand complete system and to be available to carry project through to total completion. Person shall be responsible for Commissioning, Demonstration to Consultant and Owner and Certifications of Substantial and Total Performance.
  - .2 Schedule: Submit schedule, as part of construction schedule, for commissioning phase of work. Schedule shall show:
    - .1 Equipment start-up schedule.
    - .2 Submission dates for various documents required prior to substantial completion.
    - .3 Timing of various phases of commissioning, testing, balancing and demonstration process.
  - .3 Review: Within three months of commencing project work, person having direct overall charge of commissioning shall

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review design intent and intended commissioning procedures with Consultant. Six months prior to date of scheduled substantial completion, submit detailed plan that addresses entire approach to commissioning process. Plan should be prepared specifically for project. Plan should include the following components:

- .1 Name and qualifications of commissioning coordinator/agent.
- .2 Itemized check lists for readiness, start-up and operational verification of equipment and systems.
- .3 Outline of proposed method of notification and correction of interim operational deficiencies operational deficiencies.
- .4 Outline of proposed demonstration and operator training program.
- .4 Troubleshooting: Where problems become apparent during commissioning, work at identification and resolution of these problems. Basic functions in trouble shooting are:
  - .1 What - Identification and definition of problem.
  - .2 Why - Determination and evaluation of causes.
  - .3 When - Determine time available to resolve problem.
  - .4 Involve Consultant in review of problem and proposed resolution.
  - .5 Coordinate remedial action with appropriate parties.
  - .6 Evaluate effectiveness of remedial action.

**END OF SECTION**

## **1. GENERAL**

### **1.1 Related Work**

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.
- 1.1.2 Refer to Section 23 05 49 for required seismic restraint of piping.

### **1.2 Reference Standards**

- 1.2.1 Carry out piping system work in accordance with ASME/ANSI B31.9 code and CSA B51.
- 1.2.2 Grooved joint piping components shall conform to CSA B242 code.

### **1.3 Regulatory Requirements**

- 1.3.1 Components, products and fabrication techniques shall be provided in compliance with Regulations and Requirements of Ontario Regulation Boiler and Pressure Vessels, under the Technical Standards and Safety Act.
- 1.3.2 Installation, repair or alternations to pressure piping systems shall be performed by licensed Contractors Welders, certified for work in accordance with Regulations and Requirements of Ontario Regulation Boiler and Pressure Vessels, under the Technical Standards and Safety Act.
- 1.3.3 Field welding to be in accordance with procedures of CSA-W117.2 and current edition of ASME/ANSI B31.1 or B31.9 Code.

### **1.4 System Pressure Ratings**

- 1.4.1 Pipe Fittings:
  - .1 Piping system 125 psi (860 kPa) or less operating pressure – 125 psi (860 kPa) rating.
  - .2 Piping systems 126 psi (870 kPa) to 250 psi (1,725 kPa) operating pressure – 250 psi (1,725 kPa) rating.
- 1.4.2 Valves:
  - .1 Suitable for maximum system operating temperature and pressure.
  - .2 Triple duty valves (combination 3 in 1) at pump stations are prohibited.

### **1.5 Shop Drawings**

- 1.5.1 Submit detailed shop drawings of valves in accordance with Section 23 05 00. Shop drawings shall indicate make, model, location, type, size and pressure rating and Provincial CRN number.

- 1.5.2 Grooved joint couplings and fittings shall be shown on drawing and product submittals and shall be specifically identified with the applicable style or series designation.

## 2. **PRODUCTS**

### 2.1 **General**

- 2.1.1 Products shall be registered with regulatory authority in accordance with CSA B51.

### 2.2 **Pipe**

#### 2.2.1 Steel Pipe:

- .1 To NPS 10 (250 mm), Schedule 40 to ASTM A53 Grade B.
- .2 NPS 12 (300 mm) and over,  $\frac{3}{8}$ " (9.5 mm) wall thickness to ASTM A53 Grade B.
- .3 For the following system:
  - .1 Hot water heating.
  - .2 Glycol heating.
  - .3 Glycol heat recovery.
  - .4 Chilled water.
  - .5 Chemical feed.
  - .6 Heat pump water.
  - .7 Relief valve vents.
  - .8 Condenser water.
  - .9 Pressure drains.

#### 2.2.2 Stainless Steel Pipe: Schedule 10S to ASTM A312, Type 304/304L, suitable for and approved for use with Vic-Press 304™, Viega MegaPress or grooved.

- .1 . For the following system:
  - .1 Hot water heating.
  - .2 Glycol heating.
  - .3 Glycol heat recovery.
  - .4 Chilled water.
  - .5 Chemical feed.
  - .6 Heat pump water.
  - .7 Relief valve vents.
  - .8 Condenser water.
  - .9 Pressure drains.

- .10 Condensate drain lines.
- 2.2.3 Copper Pipe: to ASTM B88M-86, Type K, or L hard drawn copper tubing.
  - .1 Type L, hard drawn:
    - .1 Pressure drains to NPS 2 (50 mm).
    - .2 Domestic hot water pre-heat.
  - .2 Type L hard drawn may be used as an alternative to steel piping for the following systems:
    - .1 Hot water heating.
    - .2 Chilled water.
    - .3 Condenser water – open or closed circuit.
  - .3 Type K, hard drawn:
    - .1 Air vent overflow.
- 2.2.4 PVC Pipe: ASTM D1785, Schedule 40, and Schedule 80 for sizes 8" (200 mm) and larger or ASTM D2241, SDR 21 or 26:
  - .1 Fittings: ASTM D2466 or ASTM D2467, PVC.
  - .2 Joints: ASTM D2855, solvent weld.
  - .3 Grooved: Victaulic PGS-300 couplings and fittings.
  - .4 Materials in contact with PVC pipe and fittings shall comply with Manufacturers compatibility documentation.

## 2.3 **Pipe Joints – Steel Piping**

- 2.3.1 NPS 2 (50 mm) and under: screwed fittings, except where otherwise noted, with Teflon tape and RectorSeal Teflon paste or pipe dope, Viega MegaPress in applicable applications.
- 2.3.2 NPS 2 (50 mm) and under: plain end pipe, QuickVic™ SD Installation-Ready™ Fittings for Carbon Steel Pipe. Pipe end preparation and installation training will be provided by manufacturer's rep.
- 2.3.3 NPS 2½ (65 mm) and over: welding fittings and flanges to CSA W47.1.
- 2.3.4 Flanges: raised face, steel weld neck, lap or back-welded slip on type. Use flat face for attachment to cast iron valves.
- 2.3.5 Victaulic Vic-Press and Viega MegaPress fittings with EPDM O-rings may be used on closed-circuit hot water heating up to 230°F (110°C) working temperature, and 200 psi (1,380) working pressure, glycol heating, glycol heat recovery, chilled water, heat pump water, condenser water-closed circuit systems.
- 2.3.6 Couplings to be installation-ready complete with pre-lubricated centre leg gaskets. Rigid couplings NPS 2 (50 mm) through NPS 12 (300 mm) to have shift limiting slant pad design, with torque



absorber, one-touch bolt tightening and bolt pad to bolt pad assembly. Couplings to have wide width Flush Seal Gaskets NPS 14 (350 mm) and larger with coupling housings that have lead-in chamfer on housing key section to mate with wedge-shaped grooves. Couplings will have two (2) symmetrical halves with no other loose parts. Couplings will have bolts of equal length and diameter.

- .1 Rigid Type NPS 2 (50 mm) to NPS 12 (300 mm): Installation-Ready, for installation without field disassembly, with grade EHP gasket rated to 250°F (120°C). Victaulic Style 107.
  - .2 Flexible Type: For use in locations where vibration attenuation and stress relief are required. Three flexible couplings may be used in lieu of flexible connector provided it meets vibration isolation requirements. The couplings shall be placed in close proximity to the source of the vibration. Victaulic Installation-Ready Style 177 to 250°F (120°C) for NPS 2 (50 mm) to NPS 8 (200 mm) or Victaulic Style 77 to 230°F (110°C) for NPS 10 (250 mm) to NPS 12 (300 mm) .
  - .3 NPS 14 (350 mm) and Larger: Victaulic AGS two-segment coupling series with lead-in chamfer on housing key and wide width Grade "E" FlushSeal® gasket.
    - .1 Rigid Type: Housing key shall fill the wedge shaped AGS groove and provide rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9. Victaulic Style W07.
    - .2 Flexible Type: Housing key shall fit into the wedge shaped AGS groove and allow for linear and angular pipe movement. Victaulic Style W77.
  - .4 Flange Adapter: Flat face, ductile iron housings with elastomer pressure responsive gasket, for direct connection to ANSI Class 125 or 150 flanged components. Victaulic Style 741/W741.
    - .1 For connections to Class 300 flanged components in sizes to NPS 12 (300 mm), Victaulic Style 743.
- 2.3.7 Flange Bolts and Nuts, carbon steel: to ANSI B18.2.1 and ANSI B18.2.2.
- 2.3.8 Flange Gaskets:
- .1 Up to 125 psi (860 kPa) system pressure – non-asbestos gaskets for mating surfaces.
  - .2 Over 125 psi (860 kPa) system pressure – stainless steel spiral wound non-asbestos gaskets.

## **2.4 Pipe Fittings – Steel Pipe**

- 2.4.1 Pipe fittings, screwed, flanged or welded:

- .1 Cast-iron pipe flanges: Class 125 to ANSI B16.1.
  - .2 Cast-iron screwed fittings: Class 125 to ANSI B16.3.
  - .3 Steel pipe flanges and flanged fittings: to ANSI B16.5.
  - .4 Steel butt-welding fittings: to ANSI B16.9a.
  - .5 Unions, malleable iron ground joint type: Class 150 to ANSI B16.3
- 2.4.2 Fittings for roll grooved piping: Ductile iron to ASTM A536; wrought steel to ASTM A234 Grade WPB; or factory fabricated from steel pipe conforming to ASTM A53.
- .1 All grooved joint couplings, fittings, valves, and specialties shall be Victaulic.
  - .2 Grooving tools shall be of the same Manufacturer as the grooved components.
  - .3 All gasket coupling housings, fittings, valve bodies and discs shall be date stamped for quality assurance and traceability.
  - .4 Where grooved or press products are used, all products and valves shall be by the same manufacturer.

## **2.5 Pipe Joints – Stainless Steel Pipe**

- 2.5.1 Victaulic Vic-Press 304™ fittings with HNBR O-rings may be used on hot water heating up to 210°F (98°C) working temperature, domestic water, glycol heating, glycol heat recovery, chilled water, heat pump water, condenser water-closed circuit systems. Vic-Press system shall be rated to 500 psi (3,450 kPa).
- 2.5.2 Shop t-drill fittings are acceptable with headers having final design pressure and name permanently marked on each header.
- 2.5.3 No in-position welding of stainless steel pipe.

## **2.6 Pipe Joints – Copper Pipe**

- 2.6.1 All sizes soldered or brazed as specified in Part 3 Execution of this Section.
- 2.6.2 CTS 2 to CTS 8 – Victaulic Style 607 installation-ready rigid couplings with pre-lubricated center leg gaskets and housings with angle bolt pads to provide rigid joint and grade “EHP” gasket for temperature range -30°F (-34°C) to 250°F (120°C) may be used on hot water heating, heat pump, chilled water, and condenser water systems.
- .1 Couplings shall be manufactured to copper-tube dimensions. (Flaring of tube or fitting ends to accommodate alternate sized couplings is not permitted.)

## **2.7 Pipe Fittings – Copper Pipe**

- 2.7.1 Cast bronze: to ANSI B16.18.

- 2.7.2 Wrought copper bronze: to ANSI B16.22.
- 2.7.3 Roll grooved (non-flared) fittings by Victaulic.

## **2.8 Flanges – Copper Pipe**

- 2.8.1 Brass or bronze: to ANSI B16.15.
- 2.8.2 Cast-iron: to ANSI B16.4.
- 2.8.3 Victaulic Style 641 Flange Adapter.

## **2.9 Valves General**

- 2.9.1 Valves shall be of one Manufacturer where possible.
- 2.9.2 Provide valves with Manufacturer's name and pressure rating clearly marked on outside of body. Valves shall be suitable for service used.
- 2.9.3 All castings used for valve bodies shall be date stamped for quality assurance and traceability.
- 2.9.4 Valves shall have current Provincial CRN number.
- 2.9.5 Valves to be provided with stem extension to allow for proper insulation thickness. Stem extension to stay stationary to ensure vapor barrier seal is not broken when valve is exercised.
- 2.9.6 Include lock shield handles where shown or noted.
- 2.9.7 Provide valves located over 7'-0" (2.1 m) from floor in equipment room areas with chain operated sheaves. Extend chains to 6'-0" (1.8 m) above floor and hook to clips arranged to clear walking aisles.
- 2.9.8 Use non-rising stem valves where there is insufficient clearance for stem to rise.
- 2.9.9 Butterfly valves installed to permit removal of equipment, shall be threaded full lug type or grooved. Wafer type if additional pair of flanges is installed. The stem on butterfly valves shall be offset from the disc centerline to provide full 360-degree circumferential seating.
- 2.9.10 Isolation valves with rubber encapsulated discs or body will not be accepted for Hydronic water applications.

## **2.10 Gate Valves**

- 2.10.1 NPS 2 (50 mm) and Under, Screwed:
  - .1 Bronze body, rising stem, solid wedge disc, union or screwed bonnet.
  - .2 Acceptable Products:
    - .1 125 psi (860 kPa) – Crane 1700, Kitz 24, Nibco T-134, Toyo 293.
- 2.10.2 NPS 2 (50 mm) and Under, Soldered:

- .1 Bronze body, rising stem, solid wedge disc, screwed bonnet.
  - .2 Acceptable Products:
    - .1 200 psi (1,380 kPa) WOG – Crane 1700S, Kitz 44, Nibco S-134, Toyo 299.
- 2.10.3 NPS 2½ (65 mm) and Over, Flanged:
- .1 Cast-iron body, rising stem, OS and Y, solid wedge disc, bronze trim, bolted bonnet.
  - .2 Acceptable Products:
    - .1 125 psi (860 kPa) – Crane 465-½, Kitz 72, Nibco F-617-0, Toyo 421A.

## 2.11 **Globe Valves**

- 2.11.1 NPS 2 (50 mm) and Under, Screwed:
- .1 Bronze body, rising stem, renewable composition or bronze disc, union bonnet.
  - .2 Acceptable Products:
    - .1 125 psi (860 kPa) – Crane 1703, Kitz 03, Nibco T-235-Y, Toyo 220.
- 2.11.2 NPS 2 (50 mm) and Under, Soldered:
- .1 Bronze body, rising stem, renewable composition or bronze disc, screwed bonnet.
  - .2 Acceptable Products:
    - .1 200 psi (1,380 kPa) W.O.G. – Crane 1703S, Kitz 10, Toyo 212.

## 2.12 **Butterfly Valves**

- 2.12.1 NPS 2½ (65 mm) and Over - Flanged:
- .1 Ductile iron body with ductile iron plated or bronze disc, stainless steel stem and extended neck to clear minimum of 2" (50 mm) thick insulation.
  - .2 Threaded full lug type or wafer type (with or without integral flanges).
  - .3 Resilient EPT or EPDM seat.
  - .4 Operators (unless otherwise specified in Controls Section):
    - .1 NPS 6 (150 mm) and under – lever handle with minimum 10 position ratchet and disc position indicator.
    - .2 NPS 8 (200 mm) and over – worm gear operator.
  - .5 Acceptable Products:

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- .1 150 psi (2,070 kPa) WOG – Crane, Demco, Keystone, Kitz, Toyo, Nibco WD-2100 or LD-2100, MA Stewart 'D' Series, RWV 918 Series.
- 2.12.2 NPS 2 (50 mm) and Over – Steel Roll Grooved Piping:
- .1 Ductile iron body.
  - .2 Disc:
    - .1 Ductile Iron with Electroless nickel coating for NPS 2 (50 mm) through NPS 12 (300 mm).
    - .2 Aluminum bronze for NPS 2 (50 mm) through NPS 6 (150 mm).
    - .3 Stainless steel for NPS 2 (50 mm) through NPS 12 (300 mm).
    - .4 Ductile Iron with black PPS coated for NPS 14 (350 mm) through NPS 24 (600 mm).
  - .3 Seal:
    - .1 NPS 12 (300 mm) and Smaller: Pressure-responsive Grade 'E' – EPDM.
    - .2 NPS 14 (350 mm) and Larger: Disc-mounted Grade 'E' – EPDM.
  - .4 Stainless steel stem. (Stem shall be offset from the disc centreline to provide full 360-degree circumferential seating.)
  - .5 Grooved ends.
  - .6 Operators (unless otherwise specified in the Controls Section):
    - .1 NPS 8 (200 mm) and under – lever handle with minimum 10 position ratchet and disc position indicator.
    - .2 NPS 10 (250 mm) and over – worm gear operator.
  - .7 Acceptable Products:
    - .1 300 psi (2,070 kPa) WOG –
      - .1 NPS 12 (300 mm) and Smaller: Victaulic MasterSeal™.
      - .2 NPS 14 (350 mm) and Larger: Victaulic AGS-Vic300.
- 2.12.3 NPS 2-½ (65 mm) through NPS 6 (150 mm) – Copper roll grooved (non-flared) piping:
- .1 Cast brass body.
  - .2 Disc: Aluminum-bronze.
  - .3 Stem: Stainless steel, offset from the disc centerline to provide complete 360-degree circumferential seating.
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- .4 Seat: Pressure-responsive elastomer (grade to suit the intended service).
- .5 Copper-tube dimensioned grooved ends.
- .6 Operator: lever handle with minimum 10 position ratchet and disc position indicator.
- .7 Acceptable Products:
  - .1 300 psi (4,140 kPa) CWP – Victaulic Series 608N.

## 2.13 **Ball Valves**

### 2.13.1 NPS 2 (50 mm) and Under, Screwed or QuickVic SD:

- .1 Forged brass or bronze body, double O-Ring design or Teflon packing, threaded cap, chrome plated solid bronze ball, PTFE seats, blow-out proof stem.
- .2 Ball valves for isolation service shall have large/full port.
- .3 Ball valves for balancing service shall have reduced port and memory stop valve handle.
- .4 Acceptable Products:
  - .1 600 psi (4,140 kPa) WOG – Crane F9202, Grinnell 3700, Kitz 58, Nibco T-585-70, Toyo 5044A.
  - .2 Victaulic Series P89 / P569.
  - .3 Red-White 5020 EZ Press for Type K or L copper when Pressfit fittings are used.

### 2.13.2 NPS 2 (50 mm) and Under, Soldered:

- .1 Forged brass or bronze body, double O-Ring design or Teflon packing, threaded cap, chrome plated solid bronze ball, PTFE seats.
- .2 Ball valves for isolation service shall have large/full port.
- .3 Ball valves for balancing service shall have reduced port and memory stop valve handle.
- .4 Acceptable Products:
  - .1 500 psi (3,450 kPa) WOG – Crane F9222, Kitz 59, Nibco S-585-70, Toyo 5049A, MAS B4.

## 2.14 **Balance Fittings and Valves**

### 2.14.1 NPS 1¼ (32 mm) and Under:

- .1 Bronze body and bronze trim, rising stem, renewable composition disc, globe type with memory stop, Lockshield, male or female union connections, angle and straight type.
- .2 Acceptable Products:
  - .1 100 psi (690 kPa) – Dahl 13000-M series, Toyo 250 or 251, Caleffi.

.2 Victaulic – Tour & Andersson - Style 786, 787.

2.14.2 NPS 1½ (40 mm) and Over:

- .1 Screwed connections up to NPS 2 (50 mm).
- .2 Flanged or grooved connections NPS 2½ (65 mm) and over.
- .3 Cast-iron body, non-lubricated eccentric plug with resilient coating EPT or RS 55, suitable for 250°F (120°C) operating temperature, stainless steel bearings, adjustable memory stop, plug type suitable for wrench adjustment.
- .4 Acceptable Products:
  - .1 175 psi (1,210 kPa) WOG – DeZurik 400, Keystone Ballcentric, Caleffi.
  - .2 Victaulic – Tour & Andersson - Style 786, 787, 789.

2.14.3 NPS 3 (80 mm) and Over:

- .1 Victaulic Vic-Plug Valve Series 377
- .2 Xylem Circuit Setter
- .3 Armstrong CBV
- .4 Victaulic – Tour & Andersson - Style 786, 787.
- .5 Wheatley GS
- .6 Oventrop
- .7 Danfoss
- .8 Red-White 9574

**2.15 Automatic Flow Control Valves and Coil Kits**

2.15.1 General: Devices shall automatically control required flow quantity between differential pressure ranges of 1 psi (7 kPa) to 87 psi (600 kPa) (pressure independent type auto-flow valves).

2.15.2 NPS 2 (50 mm) and Smaller:

- .1 Body forged brass ASTM B283 600 WOG, 250°F (120°C).
- .2 Return from coil: (downstream side of Temperature Control Valve) Combination assembly including:
  - .1 Body fitted with ball shut-off valve, hard chrome-plated, Teflon Ball Seals and EPDM or Viton O-Rings.
  - .2 Flow Cartridge shall be accessible, non-clogging 304SS piston type with + 5% accuracy.
  - .3 Two P/T Plugs, union for accepting temperature control valve (by Controls Contractor).
- .3 Return from Coil: (upstream side of Temperature Control Valve) Combination assembly including:
  - .1 Full port union with manual air vent and P/T test plug.
- .4 Supply to coil: Combination assembly including:

- .1 Ball valve, strainer P/T test plug and blow down drain valve.

2.15.3 NPS 2½ (65 mm) and Larger:

- .1 Body epoxy coated ductile iron ASTM A536 250 psi (1,725 kPa) 250°F (120°C).
- .2 Flow cartridges 304 SS moving parts in brass housing, 2 psi (14 kPa) to 87 psi (600 kPa), 25 USgpm (1.9 L/s) to 2,280 USgpm (144 L/s).
- .3 P/T Plugs, thermometer well and drain.

2.15.4 Provide dual hose temperature/pressure meter kit with flow conversion chart and carrying case.

2.15.5 Packaged coil components consisting of required coil valving, strainers, unions, hoses, etc., may be supplied. Victaulic Koil-Kit Series 799 or 79V, with Series 78U Union Port Fitting, Series 78Y Strainer/Ball Valve, Series 78T Union/Ball Valve, required 24" (600 mm) long braided hoses, and Series 793/794 Differential Pressure Controllers. The coil package shall be provided with a meter to be left with the Owner after installation.

2.15.6 Acceptable Products: Nexus, Griswold, Victaulic Series 76; Caleffi; Oventrop; Cocon-Q; RWV 9500/9520 Series and CK Series; Hays, Danfoss.

**2.16 Circuit Balancing Valves and Coil Kits**

2.16.1 NPS 2 (50 mm) and under: DZR Brass (Ametal) copper alloy body, screwed, 'Y' pattern globe.

2.16.2 NPS 2½ (65 mm) and over: Ductile-iron body, flanged or grooved, 'Y' pattern globe.

2.16.3 Maximum pressure 250 psi (1,725 kPa) and maximum temperature 250°F (120°C). To be selected and sized for a nominal pressure drop of 5 ft (1.5 m) head, typically one pipe size smaller than piping size.

2.16.4 Calibrated balancing valve with memory, positive shut-off, inlet and outlet pressure measuring connections with integral shutoffs and drains.

2.16.5 Calibration charts and adjustment tools to be included.

2.16.6 Provide differential pressure meter kit of same brand and Manufacture as balancing valves suitable for direct read-out complete with connection hoses suitable for system pressure. Meter to remain with Owner after installation.

2.16.7 Packaged coil components consisting of required coil valving, strainers, unions, hoses, etc., may be supplied. Victaulic Koil-Kit Series 799 or 79V, with Series 78U Union Port Fitting, Series 78Y Strainer/Ball Valve, Series 78T Union/Ball Valve, required 24" (600



mm) long braided hoses, and Series 793/794 Differential Pressure Controllers. The coil package shall be provided with a meter to be left with the Owner after installation.

2.16.8 Acceptable Products:

- .1 Bell and Gossett – Circuit Setter
- .2 ESBE – Circuit Setter
- .3 Victaulic / Tour and Andersson – Series 786H/787H/788/789 and Series 78KH
- .4 Armstrong – CBV
- .5 Wheatley – GS
- .6 Nexus
- .7 Caleffi
- .8 RWV 9500/9520 Series and CK series
- .9 Oventrop
- .10 Danfoss

**2.17 Swing Check Valves**

2.17.1 NPS 2 (50 mm) and under, screwed:

- .1 Bronze body, bronze swing disc, screw in cap, regrindable seat.
- .2 Acceptable Products:
  - .1 125 psi (860 kPa) – Crane 1707, Grinnell 3300, Kitz 22, Nibco T-413-B, Toyo 236.

2.17.2 NPS 2 (50 mm) and Under, Soldered:

- .1 Bronze body, bronze swing disc, screw in cap, regrindable.
- .2 Acceptable Products:
  - .1 Class 200 psi (1,380 kPa) WOG – Crane 1707S, Kitz 23, Nibco-S-413-B, Toyo 237.

2.17.3 NPS 1½ (40 mm) and Over, Grooved:

- .1 Ductile iron body, Grade 'E' – EPDM seat, stainless steel swing disc, coupled cap.
- .2 Acceptable Products:
  - .1 Class 300 psi (2,070 kPa) CWP – Victaulic Style 712, Mueller Steam.

2.17.4 NPS 2½ (65 mm) and Over, Flanged:

- .1 Cast-iron body, renewable or regrindable seat, bronze swing disc, bolted cap.
- .2 Acceptable Products:
  - .1 Class 125 psi (860 kPa) – Crane 373, Kitz 78, Nibco F-918, Toyo 435A.

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**2.18 Silent Check Valves (Spring Type)**

**2.18.1 NPS 2 (50 mm) and Under, Screwed:**

- .1 Bronze body, bronze trim, stainless steel spring, (heavy duty spring in vertical down flow application).
- .2 Acceptable Products:
  - .1 Class 125 psi (860 kPa) – Conbraco 61-500, Durabla, Grinnell 3600, Muessco 203BP, Mueller Steam.

**2.18.2 NPS 2½ (65 mm) and Over:**

- .1 Cast steel, wafer style bronze trim, stainless steel spring (heavy duty spring in vertical down flow application).
- .2 Cast ductile iron, grooved end type, stainless steel spring and shaft, for use in horizontal or vertical applications.
- .3 Acceptable Products:
  - .1 125 psi (860 kPa) wafer style – Apco, Durabla, Duo-Chek II, Nibco W-910, M & G, Mueller.
  - .2 300 psi (2,070 kPa) with Grooved Ends: Victaulic 716, or 779 with venturi taps.
    - .1 For sizes NPS 14 (350mm) and over, Class 230 psi (1,586 kPa) with AGS grooved ends, Victaulic Series W715.

**2.19 Needle Valves**

- 2.19.1 Bronze body, screwed, globe type with cadmium plated steel stem.
- 2.19.2 Acceptable Products: Class 400 psi (2,760 kPa) – Crane 88/89, RP and C 60-100.
- 2.19.3 Application: Install needle valves where petcocks or manual vents are indicated.

**2.20 Radiator Valves**

- 2.20.1 Screwed bronze body with bronze trim, wheel handle, rising stem, renewable composition disc, male union connections, angle and straight type.
- 2.20.2 Acceptable Products: Class 100 psi (690 kPa) – Dahl 11041 or 11042, Dunham Bush 200B or 246B, Kitz 100 series, Sarco Type R or RP, Toyo 252 or 253, Oventrop.

**2.21 Thermostatic Radiator Valves**

- 2.21.1 Screwed nickel plated brass body, stainless steel spindle, EPDM rubber valve disc, straight and angle type.
- 2.21.2 Valves complete with sensors, operators and capillary tubing.
- 2.21.3 Remote sensors/operators to have 25'-0" (7.5 m) capillary tube.

- 2.21.4 Capillary tubing to be run concealed in walls and ceilings, sheathed in  $\frac{3}{4}$ " (20 mm) diameter plastic tubing.
- 2.21.5 Valves in public areas to have valve mounted operators with remote wall mounted sensors.
- 2.21.6 Valves on convector units to have valve mounted operators and sensors.
- 2.21.7 Acceptable Products: Danfoss.

**2.22 Drain Valves**

- 2.22.1 Globe type, bronze body with bronze trim and composition disc.
- 2.22.2 Acceptable Products: Crane 1703, Dahl 2343, Kitz 03, Nibco T-235-Y, Toyo 220, Caleffi.

**2.23 Hose Bibbs for Hydronic System Service**

- 2.23.1 Brass ball valve with forged brass cap and chain, NPS  $\frac{3}{4}$  (20mm) male, threaded hose end, Lockshield in public areas. Working pressure 250 psi (1,725 kPa) to 250°F (120 °C).
- 2.23.2 Acceptable Products: Crane F9202CC, Dahl #50-430 Dahl #50.430LS, Kitz 58CC, Red-White/Toyo 5046.

**2.24 Low-Loss Headers (Hydraulic Separators)**

- 2.24.1 Low loss headers (hydraulic separators) shall be equal to Viessmann models 80/20 and 400/200 to suit flow.
- 2.24.2 Acceptable products: Caleffi Hydro Cal.

**2.25 Heating Water Piping, Pre-Insulated Buried**

- 2.25.1 Steel Pipe: ASTM A53, Schedule 40 wall for all sizes up to 12" (300 mm) and over, black with factory applied AWWA C105 polyethylene jacket, and minimum 2" (50 mm) of factory applied rigid expanded foam insulation.
  - .1 Fittings: ASTM A234, forged steel welding type.
  - .2 Joints: AWS D1.1, welded.
  - .3 Casing: Polyurethane insulation with high density polyethylene jacket and heat shrink sleeves.
  - .4 Standard of Acceptance: Logstor Rohr, Perma-Pipe: Xtru-Therm
- 2.25.2 Copper Tubing: ASTM B88, Type [K,] [L,] annealed.
  - .1 Fittings: ASME B16.22, wrought copper.
  - .2 Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430°F to 535°F (220°C to 280°C).

- .3 Casing: Minimum 2" (50 mm) polyurethane insulation with high density polyethylene jacket and heat shrink sleeves.

## **2.26 Chilled Water Piping, Buried**

- 2.26.1 Steel Pipe: ASTM A53, Schedule 40 wall for sizes up to 12" (300 mm) and over, black with factory applied AWWA C105 polyethylene jacket, and minimum 2" (50 mm) of factory applied rigid expanded foam insulation.
  - .1 Fittings: ASTM A234, forged steel welding type.
  - .2 Joints: AWS D1.1, welded.
  - .3 Casing: Polyurethane insulation with high density polyethylene jacket and heat shrink sleeves.
  - .4 Standard of Acceptance: Logstor Rohr, Perma-Pipe: Xtru-Therm.
- 2.26.2 Copper Tubing: ASTM B88, Type [K] [L] annealed.
  - .1 Fittings: ASME B16.22, wrought copper.
  - .2 Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430°F to 535°F (220°C to 280°C)
  - .3 Casing: Polyurethane insulation with high density polyethylene jacket and heat shrink sleeves.
- 2.26.3 Ductile Iron Pipe: AWWA C151.
  - .1 Fittings: AWWA C110, ductile iron, standard thickness.
  - .2 Joints: AWWA C111, rubber gasket with ¾" (19 mm) diameter rods.
- 2.26.4 PVC Pipe: ASTM D1785, Schedule 40, and Schedule 80 for sizes 8" (200 mm) and larger, or ASTM D2241, SDR 21 or 26.
  - .1 Fittings: ASTM D2466, or ASTM D2467, PVC.
  - .2 Joints: ASTM D2855, solvent weld.
  - .3 Materials in contact with PVC pipe and fittings shall comply with Manufacturers compatibility documentation.
- 2.26.5 PEX Piping System: Equal to Uponor EcoFlex jacketed pre-insulated piping system.
  - .1 Fittings and connectors to be same brand/supplier as piping system, nominally Uponor Wipex fittings.

## **2.27 Condenser Water Piping, Buried**

- 2.27.1 Steel Pipe: ASTM A53, Schedule 40 wall for sizes up to 12" (300 mm) and over, black with factory applied AWWA C105 polyethylene jacket, and minimum 2" (50 mm) of factory applied rigid expanded foam insulation.
  - .1 Fittings: ASTM A234, forged steel welding type.

- .2 Joints: AWS D1.1, welded.
  - .3 Casing: Polyurethane insulation with high density polyethylene jacket and heat shrink sleeves.
  - .4 Standard of Acceptance: Logstor Rohr, Perma-Pipe: Xtru-Therm.
- 2.27.2 Copper Tubing: ASTM B88, Type [K,] [L,] annealed.
- .1 Fittings: ASME B16.22, wrought copper.
  - .2 Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430°F to 535°F (220°C to 280°C).
- 2.27.3 Ductile Iron Pipe: AWWA C151.
- .1 Fittings: AWWA C110, ductile iron, standard thickness.
  - .2 Joints: AWWA C111, rubber gasket with  $\frac{3}{4}$ " (20 mm) diameter rods.
- 2.27.4 PVC Pipe: ASTM D1785, Schedule 40 for pipes up to 4" (100 mm), and Schedule 80 for sizes over 4" (100 mm) diameter, or ASTM D2241, SDR 21 or 26.
- .1 Fittings: ASTM D2466 or ASTM D2467, PVC.
  - .2 Joints: ASTM D2855, solvent weld.
  - .3 Materials in contact with PVC pipe and fittings shall comply with Manufacturers compatibility documentation.
- 2.27.5 PEX Piping System: Equal to Uponor EcoFlex jacketed pre-insulated piping system.
- .1 Fittings and connectors to be same brand/supplier as piping system, nominally Uponor Wipex fittings.

### 3. **EXECUTION**

#### 3.1 **Piping**

- 3.1.1 Ream pipe ends. Clean scale and dirt, inside and outside before and after assembly. Remove welding slag or other foreign material from piping.
- 3.1.2 During construction, protect openings in piping and equipment, by capping or plugging to prevent entry of dirt.
- 3.1.3 Provide proper pipe spacing before project begins. Be responsible for ensuring that sufficient space is provided for proper installation of insulation materials.
- 3.1.4 Screw, weld, QVSD or groove (unless otherwise specified) piping systems up to NPS 2 (50 mm) .
- 3.1.5 Weld or groove (unless otherwise specified) all piping systems NPS 2½ (65 mm) and over.

- 3.1.6 Install piping to conserve headroom and space. Run exposed piping parallel to walls. Group piping wherever practical.
- 3.1.7 Avoid piping in exterior walls unless otherwise directed. If required, install this piping protected from outside by building insulation and vapour barrier.
- 3.1.8 Maintain minimum of 1" (25 mm) space between adjacent flanges or pipe insulation, whichever has larger diameter.
- 3.1.9 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.
- 3.1.10 Saddle type branch fittings may be used on mains, if branch line is half size or smaller than main. Whole saw or drill and ream main to maintain full inside diameter of branch line prior to welding saddle. Use correct hole saw size for Victaulic 920 Mechanical tees.
- 3.1.11 If welding, use long radius elbows.
- 3.1.12 Install thermometer wells and immersion sensor wells specified under Controls Section. Where wells restrict flow in small diameter pipes (NPS 1½ (40 mm) and smaller) install section of oversized pipe at least NPS 2 (50 mm) .
- 3.1.13 Remake leaking joints using new materials, do not caulk or cement leaking threaded joints.
- 3.1.14 Use eccentric reducers at pipe size changes, flush on top side, to permit positive venting and drainage.
- 3.1.15 Do not use thread protection couplings, close nipples, running nipples or street elbows.
- 3.1.16 Install di-electric type unions or flanges or Victaulic Style 647 Di-electric Waterways to "OPEN" type systems, where copper piping connects to steel.
- 3.1.17 Avoid locating water and drain piping over electrical equipment. Where unavoidable, provide galvanized drip pans under such pipe and weld piping and fittings. Provide drain and piping from drip pans to floor drain.
- 3.1.18 Bull head tees shall not be used for converging flows.

## **3.2 Pipe Grading**

- 3.2.1 Grade piping to provide positive drainage and venting. Slope as follows:
  - .1 Supply mains and branches – up in direction of flow, minimum 1:480 [1" (25 mm) in 40'-0" (12.2 m)].
  - .2 Return mains and branches – down in direction of flow, minimum 1:480 [1" (25 mm) in 40'-0" (12.2 m)].
  - .3 Reverse return supply and return mains – up in direction of flow, minimum 1:480 [1" (25 mm) in 40'-0" (12.2 m)].

- .4 Grade horizontal drainage and vent piping down in direction of flow, 2% minimum.
- .5 On closed system, equip low points with ¾" (20 mm) drain valves. Provide at high points on lines and equipment connections, collecting chambers and high capacity float operated air vents.

### **3.3 Grooved Joint Piping Systems**

- 3.3.1 Grooved joints shall be installed in accordance with Manufacturer's latest published installation instructions.
- 3.3.2 Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove.
- 3.3.3 Gaskets shall be elastomer grade suitable for intended service, and be molded and produced by coupling Manufacturer.
- 3.3.4 Grooved coupling Manufacturer's factory trained Representative shall provide on-site training for Contractor's field personnel in use of grooving tools and installation of grooved joint products.
- 3.3.5 Representative shall periodically visit jobsite and review Contractor is following best recommended practices in grooved product installation. (Distributor's Representative is not considered qualified to conduct training or jobsite visit(s).)

### **3.4 Soldering and Brazing**

- 3.4.1 Pressure fluid systems –SOLDER with 95/5 tin-antimony to ASTM B-32 Alloy Grade Sb5.
- 3.4.2 Non-pressure systems, (drains) SOLDER with 50/50 tin lead.
- 3.4.3 Piping connections to radiant ceiling panels, SOLDER with 95/5 tin-antimony to ASTM B-32 Alloy Grade Sb5.

### **3.5 Connections to Equipment and to Existing Piping**

- 3.5.1 Install unions, grooved couplings or flanges at connections to equipment and specialty components and at connecting points to existing systems which, for reasons of separation for testing, will require to be blind flanged or capped. Where dissimilar pipe and terminal connections are made (e.g. Pex Pipe to manifolds or terminal heating/cooling device) the entire connected assembly shall be warranted by the contractor.
- 3.5.2 Unions are not required in installations using grooved mechanical joint couplings. (Couplings shall serve as unions and disconnect points.)
- 3.5.3 Install removable sections of pipe with 12" (300 mm) spool pieces on suction side of end suction pumps and where required for ease of maintenance.

- 3.5.4 Connect to equipment in accordance with Manufacturer's instruction unless otherwise noted.
- 3.5.5 Arrange piping connections to allow ease of access and for removal of equipment.
- 3.5.6 Align and independently support piping connections adjacent to equipment to prevent piping stresses being transferred.
- 3.5.7 Do not reduce equipment connection sizes by bushing.
- 3.5.8 Branch connections to existing steel piping may be made using double strap service saddles – Smith Blair #313 or Dresser #91.

### **3.6 Drain Connections**

- 3.6.1 Pipe discharge from liquid relief valves, liquid safety valves, high capacity air vents, steam drip pan elbows, equipment blowdown, water columns, overflows and piping system drains to nearest building drain. Install brass, bronze or copper receiving funnel on drain where shown.
- 3.6.2 Drains for drain pans shall be DWV copper ASTM B306 1¼" (32 mm) minimum size.
- 3.6.3 Drain and vent piping shall be of same material as piping system connected, except where otherwise specified.
- 3.6.4 Where item being drained is under pressure, provide deep seal trap.

### **3.7 Expansion of Piping**

- 3.7.1 Install piping systems with due regard and provision for expansion, avoiding strain or damage to equipment and building. Provide adequate expansion and contraction for piping running across building expansion joints.
- 3.7.2 Only major expansion configuration and fittings have been indicated on drawings. Provide required additional compensators, loops and swing connections.
- 3.7.3 Where expansion loops are required, use Victaulic Style 177 and 77 couplings on the loops in accordance with Victaulic instructions and as approved by the Engineer is acceptable.
- 3.7.4 Provide anchors, where shown. Anchors shall be fabricated from mild steel plate and structural steel angle and channel sections, in accordance with ANSI B3.31.
- 3.7.5 Contractor and Engineer to confirm with Structural Engineer that structure is suitable for mounting of Anchors and load placed on structure before concrete is poured and prior to install.
- 3.7.6 Provide anchors on both sides of expansion devices, as indicated on drawings, and as required to control flexing of the piping system.
- 3.7.7 In welded systems where expansion loops are required use long radius elbows.



- 3.7.8 Install welded expansion loops, cold sprung 50% of calculated expansion.
- 3.7.9 Install at least three elbows in branch connections. Where space does not permit, install braided flexible pipe connectors in accordance with Manufacturer's recommendations. Three elbow branch connections shall have sufficient developed length to ensure excessive stresses are not generated in piping and in no case less than 36" (900 mm).

### **3.8 Valves**

- 3.8.1 Install valves with stems upright or angled 45° above horizontal unless approved otherwise.
- 3.8.2 Valves shall be provided with stem extension to allow for proper insulation thickness. Stem extension to stay stationary to ensure vapor barrier seal is not broken when valve is exercised.
- 3.8.3 Install control valves with stems upright unless approved otherwise and with adequate clearance for removal of actuators.
- 3.8.4 Use gate valves or ball valves NPS 2 (50 mm) and under to shut-off branch takeoffs and to isolate equipment.
- 3.8.5 Butterfly valves may be used as alternative to gate valves on glycol heating, hot water heating, chilled water, condenser water, heat pump and glycol heat recovery systems. Review glycol concentrations/service temperature with elastomers for compatibility.
- 3.8.6 Use globe valves to control flow in circuits except where balancing cocks are specifically specified.
- 3.8.7 Use plug type globe valves in control valve bypass connections.
- 3.8.8 Use plug cocks for balance valves in water return branch mains and branch connections to return mains and for shut-off and balancing on glycol circuits.
- 3.8.9 Install balance fittings or valves in return piping connections to each terminal heating and cooling unit, e.g. Radiators, unit heaters, fan coil units, heating and cooling coils. All balancing valves shall be sized on a nominal pressure drop of at least 5 ft (1.5 m) water column, typically one pipe size smaller than line size.
- 3.8.10 Install radiator valves in supply connections to each convection heating element.
- 3.8.11 Provide isolation valves in systems such that floor by floor for horizontal systems, risers in vertical system and zone areas on large horizontal system can be isolated.
- 3.8.12 Provide valves upstream of meters, gauges, automatic air vents, Flowtrex/Triple duty valves etc. for isolation purposes.

- 3.8.13 Use swing check valves, in horizontal and vertical upflow pipes and on discharge of pumps. Spring loaded water check valves shall be located 8 pipe diameters downstream of pumps or elbows.
- 3.8.14 Use silent check valves where specifically shown in vertical pipes with downward flow.

### **3.9 Drain Valves and Hose Bibbs**

- 3.9.1 Install drain valves and hose bibbs at each low point in piping system and at specific drain locations indicated on drawings.
- 3.9.2 Install NPS  $\frac{3}{4}$  (20 mm) hose bibbs at downfed terminal heating and/or cooling units.
- 3.9.3 Install NPS  $1\frac{1}{2}$  (40 mm) or NPS  $\frac{3}{4}$  (20 mm) on line sizes less than NPS  $1\frac{1}{2}$  (40 mm) drain valves/hose bibbs at low points in piping systems to facilitate draining.
- 3.9.4 Install drain valves in lieu of hose bibbs for systems operating at over 200°F (93°C).
- 3.9.5 Install hose end adaptor on discharge side of each drain valve or pipe to drain, where indicated.
- 3.9.6 Use NPS  $1\frac{1}{2}$  (40 mm) fire hose and connect to discharge side of drain valves to flush piping system during pipe cleaning process.
- 3.9.7 Install caps, with chains, on hose end adaptors, in public areas.

### **3.10 Piping Tests**

- 3.10.1 Notify Consultant and Inspection Authority Having Jurisdiction, 48 hours in advance of intended test dates.
- 3.10.2 Before testing piping, isolate equipment, which cannot withstand test pressure. Where dissimilar pipe and terminal equipment are connected (e.g. Pex Piping to manifolds or to perimeter heating/cooling elements), the Pex/dissimilar pipe connections shall be pressure tested prior to final component installation.
- 3.10.3 Do not insulate, backfill or conceal until tests have been completed and approved by inspection authorities.
- 3.10.4 Examine systems under test for leaks.
- 3.10.5 Joints shall remain dry during test. General sweating around weld shall be reason for rejection.
- 3.10.6 Remake leaking connections and joints.
- 3.10.7 Tests shall be limited to new piping and terminal units only.
- 3.10.8 New connections to existing piping shall be warranted.
- 3.10.9 Do not backfill any underground piping until it has been surveyed and documented by the [University] [Owner].
- 3.10.10 Initial Hydrostatic test:

- .1 150% of working pressure, but not less than 125 psi (860 kPa) for 1 working day.
- 3.10.11 Final Hydrostatic test:
  - .1 150% of working pressure, after piping connections to equipment are complete, maintain until entire piping system has been inspected.

### **3.11 Flushing and Cleaning**

- 3.11.1 Flushing and cleaning shall commence after piping tests are completed.
- 3.11.2 Install temporary bypass connections around terminal units before commencing chemical cleaning.
- 3.11.3 Chemically clean the following piping systems as recommended by approved professional chemical cleaning and treatment agency who shall supervise work:
  - .1 Heating hot water system(s).
  - .2 Glycol heating system(s).
  - .3 Chilled water system(s).
  - .4 Glycol heat recovery system(s).
  - .5 Heat pump water system(s).
  - .6 Condenser water system(s) (closed circuit).
- 3.11.4 Clean and flush out only with clean fresh water the following systems:
  - .1 Condenser water system(s) (open system).
- 3.11.5 Flush out traces of chemical with clean water after chemical cleaning is complete.
- 3.11.6 Install final connections to terminal units after flushing is complete.
- 3.11.7 Remove, clean and reinstall strainer baskets.
- 3.11.8 Submit report signed by principal of Agency, which certifies cleaning has been satisfactorily completed.

### **3.12 Chemical Treatment**

- 3.12.1 Chemically treat water systems in accordance with Section 23 25 00.

### **3.13 Testing and Balancing**

- 3.13.1 Test and balance piping systems in accordance with requirements of Section 23 05 93.

**END OF SECTION**

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## 1. GENERAL

### 1.1 Related Work

1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

### 1.2 Reference Standards

1.2.1 Provision of specialty components shall be in accordance with ANSI/ASME B31 Codes for Building Services Piping.

### 1.3 Regulatory Requirements

1.3.1 Water specialty components shall be provided in compliance with Regulations and Requirements of Province of Ontario Regulation Boiler and Pressure Vessels, under the Technical Standards and Safety Act.

### 1.4 System Pressure Ratings

1.4.1 Piping systems 125 psi (860 kPa) or less operating pressure - 125 psi (860 kPa) rating.

1.4.2 Piping systems 126 psi (870 kPa) to 250 psi (1,725 kPa) operating pressure – 250 psi (1,725 kPa) rating.

## 2. PRODUCTS

### 2.1 Air Vents Automatic – High Capacity Type

#### 2.1.1 Non-Serviceable Type:

- .1 Casing and internal parts suitable for system operating pressure and temperature.
- .2 Metal construction with outlet threaded to accept vent tubing connection.
- .3 Automatic float type.
- .4 Shraeder type venting valve.
- .5 Acceptable Products:
  - .1 50 psi (345 kPa) maximum operating pressure – Armstrong AW, Dole 75, Maid-O-Mist 6, Taco 426, Watson McDaniel AE 1800, Caleffi.
  - .2 75 psi (517 kPa) maximum operating pressure – Armstrong AW, Dole 75, Maid-O-Mist 6, Taco 426, Watson McDaniel AE 1800, Caleffi.

- .3 150 psi (1,034 kPa) maximum operating pressure – Armstrong AW, Maid-O-Mist 6, Taco 426, Watson McDaniel AE 1800, Caleffi.

## **2.2 Air Vents Manual – High Capacity**

### **2.2.1 Globe Type:**

- .1 Bronze Body, union bonnet, screwed, 450 Brinell hardened stainless steel trim and plug type disc.

### **2.2.2 Acceptable Products:**

- .1 Class 125 psi (860 kPa) – Crane 14-½ LP, Jenkins 2032, Lunkenheimer 73-PS, Toyo 214.
- .2 Class 200 psi (1,380 kPa) – Crane 212P, Jenkins 2050, Lunkenheimer 73-PS, Toyo 214.

## **2.3 Air Vents Manual – Radiator Type**

### **2.3.1 Needle Type:**

- .1 Bronze or steel body, screwed, needle valve.
- .2 Manual key operator.
- .3 125 psi (860 kPa) maximum operating pressure and 250°F (120°C) maximum operating temperature.
- .4 Acceptable Products:
  - .1 Maid-O-Mist 816, Caleffi.

### **2.3.2 Hydroscopic Type:**

- .1 Bronze or steel body, screwed hydroscopic discs.
- .2 Manual screwdriver or key operator.
- .3 Acceptable Products:
  - .1 50 psi (345 kPa) maximum operating pressure – Maid-O-Mist 72, Taco 417, Caleffi.
  - .2 75 psi (517 kPa) maximum operating pressure – Maid-O-Mist 72, Taco 417, Caleffi.

## **2.4 Air Separators**

- 2.4.1 Provide centrifugal, type with 125 psi (860 kPa) WSP steel tank, galvanized steel ¼" (6 mm) perforated strainer, perforated stainless steel air collector tube and drain connection.

- 2.4.2 Provide air and dirt separators including blow-down valve, skim valve, and automatic air vent. The separator must utilize an internal medium to aid in the separation of air and dirt entrained in the system. The separator must be constructed in accordance with the latest revision of the ASME Boiler and Pressure Vessel Code and stamped for the working pressure of the system.

- 2.4.3 Acceptable Manufacturers:

- .1 Armstrong, Bell + Gossett (Xylem), Spirotherm, Taco, Spirotech, Caleffi, Wessels.

## **2.5 Expansion Tanks – Diaphragm Type**

2.5.1 Expansion tanks with working pressure to 30 psi (207 kPa) and less than 24" (600 mm) in diameter.

- .1 Steel construction with sealed-in elastomer diaphragm suitable for up to 240°F (116°C).
- .2 Welding performed by certified, qualified welders.
- .3 Factory tested hydraulically to 75 psi (517 kPa).
- .4 Identification plate showing:
  - .1 Manufacturer's name.
  - .2 Expansion tank operating pressure, 30 psi (207 kPa).
  - .3 Hydraulic test pressure 75 psi (517 kPa).
  - .4 Date of manufacture.
- .5 Pre-charge via air charging valve to 12 psi (83 kPa).
- .6 Saddles for horizontal installation or base mount for vertical installation.
- .7 Acceptable Products: Armstrong, Watts, Amtrol/Extrol, Bell+Gossett (Xylem), Taco, Zilmet.

2.5.2 Expansion tanks with working pressure exceeding 30 psi (207 kPa) or with diameter exceeding 24" (600 mm).

- .1 Steel construction with sealed-in elastomer diaphragm suitable for up to 240°F (116°C).
- .2 Manufactured in accordance with requirements of ASME Section VIII, Pressure Vessels, Division 1, 125 psi (860 kPa) pressure rated.
- .3 Identification showing:
  - .1 Manufacturer's name:
  - .2 Capacity in litres.
  - .3 Hydraulic test pressure.
  - .4 Working pressure.
  - .5 Code stamping and ASME registered design.
- .4 Air pre-charged via air charging valve to 12 psi (83 kPa).
- .5 Saddles for horizontal installation or base amount for vertical installation.
- .6 Acceptable Products: Armstrong, Watts, Amtrol/Extrol, Bell+Gossett (Xylem), Taco, Flexcon, Wessels.

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**2.6 Buffer Tanks**

- .1 Steel construction with vertical internal baffle to encourage proper mixing of fluid.
- .2 Design to suit either chilled water or hot water application with inlet and discharge ports.
- .3 Manufactured in accordance with requirements of ASME Section VIII, Pressure Vessels, Division 1, 125 psi (860 kPa) pressure rated.
- .4 Five year limited warranty
- .5 Flanged Connections
- .6 Lifting lugs
- .7 Red Oxide paint
- .8 Integral Automatic Air Vent
- .9 Factory installed 2" blow down valve and brass flushing cock.
- .10 Temperature and pressure gauge on shell
- .11 Inspection openings/manholes
- .12 Identification showing:
  - .1 Manufacturer's name:
  - .2 Capacity in litres and US gallons
  - .3 Hydraulic test pressure.
  - .4 Working pressure.
  - .5 Code stamping and ASME registered design.
- .13 Acceptable Products: AO Smith, Bell & Gossett (Xylem), Taco, Armstrong.

**2.7 Flexible Hose Assemblies**

- 2.7.1 Scope: For connection to air valve reheat coils, fan coil units etc.
- 2.7.2 EPDM rubber inner core, installation or base mount for vertical installation.
- 2.7.3 End connections are male solid NPT one end and male swivel NPT on the other end.
- 2.7.4 Suitable for hot water applications up to 230°F (110°C).
- 2.7.5 Acceptable Products: Unisource Manufacturing Inc., Nexus, H-P Flex, Metraflex Elastoflex/SST.

**2.8 Pressure Reducing Station – Cold Water**

- 2.8.1 Screwed, bronze or cast-iron body, suitable to 200 psi (1,380 kPa), composition seat.
- 2.8.2 Each reducing station to include:

- .1 Gate valve, strainer, union, pressure reducing valve, union gate valve.
- .2 Bypass with globe valve.
- .3  $\frac{3}{4}$ " (20 mm) relief valve.

2.8.3 Acceptable Products: Cashco, Watts, Cash Acme.

## **2.9 Pressure Relief Valves – Water**

2.9.1 Screwed, bronze body or cast-iron body with expanded outlet.

2.9.2 ASME rated.

2.9.3 Acceptable Products:

- .1 Bronze body: Watts 174A, NPS  $\frac{3}{4}$  (20 mm) to NPS 2 (50 mm) , Cash Acme F-30 or F-82, Apollo.
- .2 Iron body: Watts 740, NPS  $\frac{3}{4}$  x 1 (20 mm x 25 mm) to NPS 2 x 2 $\frac{1}{2}$  (50 mm x 65 mm), Cash Acme F-95, Apollo.

## **2.10 Pressure Relief Valves – Pump Bypass**

2.10.1 Hydraulically operated, single seated globe valve, controlled by a direct acting spring valve and diaphragm pilot valve.

2.10.2 Main and Pilot Valve - cast-iron body, stainless steel seat and reinforced synthetic rubber diaphragm.

2.10.3 Suitable for system operating temperature and pressure.

2.10.4 Connections:

- .1 NPS 2 (50 mm) and under, screwed.
- .2 NPS 2 $\frac{1}{2}$  (65 mm) and over, flanged.

2.10.5 Refer to drawings and/or schedules for flow rates (min., normal, max.) and relief pressure range or setpoint.

2.10.6 Acceptable Products:

- .1 Singer Model 106-RPS.

## **2.11 Pressure Relief Valves – Pump Bypass**

2.11.1 Differential pressure overflow valve to control pump pressure.

2.11.2 Screwed, bronze body with stainless steel spring.

2.11.3 Acceptable Products:

- .1 Braukmann DU 146.

## **2.12 Separator – Liquid/Solids**

2.12.1 Centrifugal – action vortex separator.

2.12.2 Carbon Steel constructed in accordance with ASME, Section VIII, Division 1 for pressure vessels.

2.12.3 Solids Recovery vessel with indicator package for notice of separator bag cleaning.



- 2.12.4 Pressure gauges with petcock valves on inlet and outlet connections.
- 2.12.5 Isolation valve at purge outlet connections.
- 2.12.6 Connection spool piece.
- 2.12.7 Standard of Acceptance:
  - .1 Lakos model HTX-0130 [150 USgpm (9.5 L/s) at 5 psi (35 kPa)] [Alternate: Vortisand H2F] [Alternate: Bernoulli BSP (Plastic) or Bernoulli BSS (Stainless Steel body)].

### 2.13 **Strainers**

- 2.13.1 NPS 2 (50 mm) and under: bronze body, screwed connections.
- 2.13.2 NPS 2½ (65 mm) and over: cast-iron body, flanged connections.
- 2.13.3 NPS 2 (50 mm) and over: Y or T type strainer with grooved ends with ductile iron body or factory fabricated steel body.
- 2.13.4 Suitable for maximum system operating pressure. Where system pressure exceeds 125 psi (860 kPa), use 250 psi (1,725 kPa) strainer bodies.
- 2.13.5 Basket Screen:
  - .1 Bronze, stainless steel or monel perforated screen.
  - .2 225 holes/in<sup>2</sup> (35 holes/cm<sup>2</sup>), 3/64" (1.2 mm) diameter perforations, 36% open area.
- 2.13.6 Acceptable Products:
  - .1 Armstrong, Metraflex LPD, Muesco, Spirax/Sarco, Toyo, Victaulic Series 730, 732 or W730 for all grooved end strainers.

### 2.14 **Suction Guide**

- 2.14.1 Integrated long radius elbow, strainer and suction entrance guide vanes.
- 2.14.2 Suitable for 150 psi (1,034 kPa) and 250°F (120°C).
- 2.14.3 Cast ductile iron body, stainless steel strainer, stainless steel guide vanes **[stainless steel for open systems]**.
- 2.14.4 Connections:
  - .1 NPS 2 (50 mm) and under, screwed.
  - .2 NPS 2½ (65 mm) and over, flanged or grooved.
- 2.14.5 Select for system flow rate and allowable pressure drop.
- 2.14.6 Acceptable Products:
  - .1 Armstrong Suction Guide, Bell and Gossett Suction Diffusers, Mech-Line, Taco Suction Diffuser, Victaulic 731 / W731 Series Suction Diffuser, Metraflex Suction Guide.

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### 3. EXECUTION

#### 3.1 Air Vents – Automatic – High Capacity Type

- 3.1.1 Install automatic high capacity air vents at each high point in piping system and where indicated on drawings.
- 3.1.2 Install on tees and not on horizontal pipe runs or elbows.
- 3.1.3 Install ½" (15 mm) minimum isolating gate valve ahead of each air vent, unless air vent has integral shut-off valve.
- 3.1.4 Pipe air vent discharge connections (except for glycol) separately to nearest building drain using ¼" (6 mm) hard drawn copper tube. Label ends with permanent labels.
- 3.1.5 Pipe air vent discharge connections (except for glycol) separately to water-tight solder jointed 16 ga (1.61 mm) copper drain pan, using ¼" (6 mm) hard drawn copper tube where exposed and soft copper where concealed. Label ends with permanent labels.
- 3.1.6 Pipe air vent discharge connections from glycol circuit, separately back to glycol mixing tank, using ¼" (6 mm) hard drawn copper tube.

#### 3.2 Air Vents – Manual – High Capacity

- 3.2.1 Install manual air vents at high points in piping systems and where indicated on drawings.
- 3.2.2 Install on tees and not on horizontal pipe runs or elbows.
- 3.2.3 Install isolating gate valve ahead of each vent valve.
- 3.2.4 Pipe air vent discharge connections to nearest building drain.

#### 3.3 Air Vents Manual Radiator Type

- 3.3.1 Install manual/automatic low capacity air vents on return side of each water heating/cooling terminal element installed above connection to main piping.
- 3.3.2 Fit air vent on top of air collecting chamber of NPS ¾ (20 mm) pipe, 6" (150 mm) high.
- 3.3.3 Arrange air vents so screwdriver slots or key opening are easily accessible.
- 3.3.4 Drill access holes through radiation enclosures, where necessary.
- 3.3.5 DO NOT USE on glycol systems.

#### 3.4 Air Separator

- 3.4.1 Provide on suction side of system circulation pump.

#### 3.5 Air Scoop

- 3.5.1 Provide on suction side of system circulation pump.

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**3.6 Combination Balance/Check Valves**

- 3.6.1 Install combination stop/balance/check valves on discharge of centrifugal pumps as indicated on drawings and/or where scheduled.
- 3.6.2 Install in accordance with Manufacturer's recommendations.
- 3.6.3 Minimum 5 pipe diameters from pump connections.

**3.7 Expansion Tank – Diaphragm Type**

- 3.7.1 Install expansion/contraction tanks at each location indicated on drawings and as scheduled.
- 3.7.2 Install gate valve in system connection.
- 3.7.3 Install globe valve in tank drain connection.

**3.8 Flexible Hoses Heat Pumps**

- 3.8.1 Install flexible hoses on supply and return loop water connections to each heat pump.
- 3.8.2 Install union on one end.
- 3.8.3 Use flexible hoses to bypass heat pumps during pipe cleaning.

**3.9 Flexible Pipe Connectors**

- 3.9.1 Install convoluted and arched pipe connectors, for misalignment connections, where indicated on drawings or required.
- 3.9.2 Install in accordance with Manufacturer's recommendations.
- 3.9.3 Three Victaulic Style 177 flexible couplings may be used in lieu of flexible connectors for vibration attenuation and stress relieve. The couplings shall be placed in close proximity to the source of the vibration.

**3.10 Pressure Reducing Stations – Cold Water**

- 3.10.1 Install water make-up stations for each hot water, chilled water and other closed water systems where indicated on drawings.
- 3.10.2 Pipe relief valve to drain.

**3.11 Pressure Relief Valves – Water**

- 3.11.1 Install pressure relief valve(s) on each heat exchanger to prevent over pressuring.
- 3.11.2 Select relief valves to relieve full heat input of heat supply side.
- 3.11.3 Pipe relief valve to drain.
- 3.11.4 Where one line vents several relief valves, cross sectional area shall equal sum of individual vent areas.

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**3.12 Pressure Relief Valves – Pump Bypass**

3.12.1 Install pressure relief valves to relieve flow from supply main to return main where indicated on drawings.

**3.13 Separator – Liquids/Solids**

3.13.1 Provide straight run at inlet and outlet connections of at least 5 pipe diameters.

3.13.2 Install spool piece at outlet to permit internal service access.

**3.14 Strainers**

3.14.1 Install pipe line strainers where indicated on drawings.

3.14.2 Provide isolation valves on either side of strainer to permit cleaning without draining system.

3.14.3 Blowdown connections:

- .1 Strainers, NPS 2 (50 mm) and under – hot services: nipple and cap.
- .2 Strainers, NPS 2½ (65 mm) and over – hot services: nipple, globe valve and nipple.
- .3 Strainers, all sizes – cold services: plug.

**3.15 Suction Guide**

3.15.1 Install suction guides on suction of centrifugal pumps, where indicated on drawings and where scheduled in accordance with Manufacturer's recommendations.

3.15.2 "Start-up" strainer baskets must be removed prior to commissioning of systems.

**END OF SECTION**

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**1. GENERAL**

**1.1 Related Work**

1.1.1 This Specification Section forms part of Contract Documents and are to be read, interpreted and coordinated with other parts.

**1.2 Shop Drawings**

- 1.2.1 Submit shop drawings in accordance with Section 23 05 00.
- 1.2.2 Submit shop drawings of pump curves with operating points indicated. Include NPSH curve when applicable.
- 1.2.3 Submit motor efficiencies for motors 1 hp (0.746 KW) and over, refer to Section 23 05 13 for minimum efficiencies.

**1.3 Quality Assurance**

- 1.3.1 Ensure pumps operate at specified system fluid temperatures without binding and cavitation, are non-overloading in parallel or individual operation; operate within 25% of midpoint of published maximum efficiency curve.
- 1.3.2 Where pumps are operated in conjunction with others such as parallel pumps, show operating points on pump curve.
- 1.3.3 Under no circumstances use a triple duty flow/check valve (combination 3 in 1) on any pump station, provide a check valve, flow balancing valve and an isolation valve as separate pipeline installations.

**1.4 General**

- 1.4.1 Motors powered by variable speed drive controllers shall be EEMAC Class B with Type F insulation, have 1.15 service factor and be suitable to be driven by PWM variable speed drive controllers. Motor Manufacturer shall submit, in writing, confirmation motors are designed to withstand voltage peaks of 3.1 times the normal voltage and voltage rate of rise of 2000V/ $\mu$ s at frequency of 20 kHz.
- 1.4.2 Provide ECM motors complete with manual speed control switch, and 0-10V DC control signal terminal for variable speed control. See Section 23 05 13 for ECM motor requirements.
- 1.4.3 Acceptable Pump Products – General: Bell & Gossett, Armstrong, Taco, Grundfos.

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## 2. PRODUCTS

### 2.1 General

- 2.1.1 Statically dynamically balance rotating parts.
- 2.1.2 Construction shall permit complete servicing without breaking piping or motor connections.
- 2.1.3 Pumps shall operate at 1750 r/min unless specified otherwise.
- 2.1.4 Domestic water pumps shall be all bronze construction.

### 2.2 In-Line Circulator Pumps

- 2.2.1 Suitable for maximum working pressure of 125 psi (860 kPa) and maximum temperature of 225°F (107°C).
- 2.2.2 Casing: Cast-iron radially split, with flanged connections. Supplied with matching companion flanges.
- 2.2.3 Impeller: Corrosion resistant cadmium plated steel **stamped brass or bronze**.
- 2.2.4 Shaft: Alloy steel with bronze sleeve bearing, integral thrust collar.
- 2.2.5 Seal Assembly: Mechanical.
- 2.2.6 Coupling: Flexible self-aligning.
- 2.2.7 Motor: Resilient mounted, drip proof, sleeve bearing.

### 2.3 Vertical In-Line Centrifugal Pumps

- 2.3.1 Suitable for maximum working pressure of 175 psi (1,210 kPa) and maximum temperature of 225°F (107°C).
- 2.3.2 Casing: Cast-iron radially split, single stage, flanged suction and discharge connections, separate tapped opening for venting, draining and gauge connections.
- 2.3.3 Impeller: Bronze dynamically balanced, keyed drive with locking nut.
- 2.3.4 Shaft: Stainless steel on split coupled pumps and carbon steel with bronze sleeve on close coupled pumps.
- 2.3.5 Seal Assembly: Inside unbalanced mechanical seal with factory installed seal flushing line.
- 2.3.6 Coupling: Close coupled on motors less than 7.5 hp (5.6 KW) and split couplers for motors 7.5 hp (5.6 KW) and larger to permit removal of seal without disturbing motor.
- 2.3.7 Motor: EEMAC Class B, squirrel cage induction, continuous duty, drip proof, ball bearings.
- 2.3.8 Accessories: Strainer/suction guide, discharge flow meter/shutoff valve.
- 2.3.9 Mounts: Seismic inline pump stands c/w vibration isolation pads. Vibro Acoustics SIPS.

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**2.4 Base Mounted, Single Suction, Centrifugal Pumps**

- 2.4.1 Suitable for maximum working pressure of 175 psi (1,210 kPa) and maximum temperature of 225°F (107°C).
- 2.4.2 Casing: Cast-iron radially split, end suction, with back pull-out feature, flanged suction and discharge connections, tapped opening for venting, draining and gauge connections.
- 2.4.3 Impeller: Bronze enclosed type, keyed drive with locking nut.
- 2.4.4 Shaft: Carbon steel with stainless steel sleeve and grease/oil lubricated bearings.
- 2.4.5 Seal Assembly: Mechanical with factory installed seal flushing line.
- 2.4.6 Coupling: Flexible self-aligning. Coupling guard.
- 2.4.7 Motor: EEMAC Class B, squirrel cage induction, continuous duty, drip proof, ball bearings.
- 2.4.8 Base: Fabricated steel with drip tray under seal area and tapping for drain connection. Bases shall be stiff enough such that vibration isolators can be attached directly to base, without additional concrete inertia bases.
- 2.4.9 Accessories: In-line strainer on suction pipe, discharge flowmeter/shutoff valve.

**2.5 Boiler Feed Pumps**

- 2.5.1 Pump casing and flanges suitable for maximum working pressure of 580 psi (4,000 kPa).
- 2.5.2 Combination self-priming multi-stage turbine with initial centrifugal stage.
- 2.5.3 Low NPSH.
- 2.5.4 Cast-iron casting, bronze impellers, stainless steel shaft.
- 2.5.5 Grease lubricated ball bearing at drive end and sleeve bearing at suction end.
- 2.5.6 Packed stuffing box.
- 2.5.7 Direct drive with flexible coupling.
- 2.5.8 Steel base.

**2.6 Vertical Space Miser Split Coupled Centrifugal Pumps**

- 2.6.1 Suitable for a maximum working pressure of 125 psi (860 kPa) or 250 psi (1,720 kPa) depending on system pressure. Pumps shall have a balanced double volute design to reduce radial thrust and prolong seal and bearing life.
- 2.6.2 Casing: Ductile iron with top pull out capability and suction baffle to improve efficiency. Suction and discharge will be positioned to allow

for vertical piping without the need for elbows, guides or angle type valves.

- 2.6.3 Impeller: Cast bronze, enclosed, statistically, dynamically and hydraulically balanced and shall be factory trimmed to match the delivery conditions.
- 2.6.4 Shaft: One piece steel with bronze shaft sleeve.
- 2.6.5 Seal Assembly: Internal mechanical seal properly vented to the pump suction connection.
- 2.6.6 Coupling: Close coupled on motors less than 5.6 kW and split couplers for motors 5.6 kW and split rigid coupling, located onto the shafts via annular rings. Couplings relying on friction fit to tightening to maintain position on the shaft shall not be acceptable.
- 2.6.7 Motor: High efficiency drip proof, ball bearing.
- 2.6.8 Accessories.

## **2.7 Inline, Wet Rotor, Integrated VFD, Pipe Mounted Pump**

- 2.7.1 In-line pipe-mounted pumps with integrated VFD shall be Grundfos MAGNA® wet rotor, in-line, variable speed circulators.
- 2.7.2 The pump and motor shall be designed and built by the same manufacturer.
- 2.7.3 The Pumps shall be of quiet "Wet Rotor" design. Maximum noise level of the pump and motor shall be 54dB (A).
- 2.7.4 The pumps shall be able to operate at maximum 203°F (110°C) and minimum 59°F (15°C) water, continuously and at maximum 230°F (110°C) intermittently.
- 2.7.5 The head-capacity curve shall have a steady rise in head from maximum to minimum flow within the preferred operating region
- 2.7.6 The pump housing shall be Cast Iron, with laser welded stainless steel Impellers and Stainless Steel neck rings to minimize recirculation and maximise pump efficiency. Pumps shall have tungsten carbide sleeve bearings for extended life. Pumps for Domestic Hot Water application shall be of Stainless Steel housing.
- 2.7.7 The pump is to be connected directly to a single-phase 4- or 8-pole, synchronous, permanent-magnet motor (PM motor) and had to have been tested with the pump as one unit by the same manufacturer.
- 2.7.8 The Motor shall have a variable frequency drive integrated in the terminal box and a small control panel on the terminal box. The pump speed shall be controlled by the "Integrated Variable Frequency Drive". No additional devices (such as pressure transducer etc.) are to be required for control of the pumps.



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- 2.7.9 The motor shall be cooled by the pumped fluid and shall be self-ventilating. The stator housing shall have 8 drain holes to enable condensed water to escape
- 2.7.10 The terminal box shall be made of black composite material, shall have an Enclosure class of IP44 and shall have fiber optic indicator lights for operation indication and trouble shooting
- 2.7.11 The pump shaft shall be installed horizontally per manufacturer's recommendations. The required inlet pressure by the pump shall be available at the pump inlet
- 2.7.12 The following control modes are to be available:
- .1 Proportional Pressure control - The pump head is changed continuously in accordance with the water demand in the system.
  - .2 Constant Pressure control - A constant head is maintained, irrespective of water demand.
  - .3 AUTOADAPT - The differential pressure across the pump is automatically adjusted to match the flow requirements
- 2.7.13 The control panel on the terminal box should enable selection of the any of the above control modes without any external devices. The control panel should also enable setting desired Pressure set-point. The control panel should show an estimation of flow rate through the pump in 0-100% range.
- 2.7.14 The controller is to be capable of receiving a "Remote Start/Stop Signal" at a Digital Input for ON/OFF control by an external device (e.g. DDC or other BAS). The controller shall also have a Signal Relay that can be programmed for Fault or Operation indication to an external controller (e.g. DDC or other BAS)
- 2.7.15 The control shall have an optional Module that can receive 4-20mA speed signal for operation from an external device. The Module shall have the capability of connect two MAGNA pumps for Alternating between the pumps and for Duty/Standby operation.
- 2.7.16 Magna Communication Card
- .1 Supply complete with optional communication card – GENI MODULE that allows the following contact points:
    - .1 RS485 Connection for GENI BUS or other bus communication.
    - .2 0-10VDC External Analog Input:
      - .1 Via this input the pump can be controlled by an external controller using the following control modes:

- .1 Constant Curve: The external analog signal will control the pump SPEED within the range from the min speed to the upper limit selected speed.
- .2 Proportional or Constant Pressure Control: The external analog signal will influence the pressure setpoints set on the controller. 100% signal corresponds to Pressure Setpoint. Anything below 100% will reduce the setpoint to that percentage value.
- .3 External Signals for Forced Control to Minimum or Maximum Duty
- .4 Control of Twin-Head Pumps or Two Magna Pumps
  - .1 This allows connecting two MAGNA pumps so that they operate as a twin-head pumps in Master-Slave configuration.
  - .2 The pumps can be set to one of the following operating modes:
    - .1 Alternating Operation. Pump operation alternates every 24 hours. If the duty pump stops due to a fault, the other pump will start.
    - .2 Standby Operation. One pump is operating continuously. In order to prevent seizing-up, the other pump will start at a fixed frequency. If the duty pump stops due to a fault, the other pump will start.
    - .3 The operating modes are to be selected by means of a mechanical contact in each module.

## **2.8 Pump Integrated Variable Frequency Drive Motors**

- 2.8.1 Each motor shall be of the Integrated Variable Frequency Drive design consisting of a motor and a Variable Frequency Drive (VFD) built and tested as one unit by the same manufacturer.
- 2.8.2 The VFD shall be of the PWM (Pulse Width Modulation) design using current IGBT (Insulated Gate Bipolar Transistor) technology.
- 2.8.3 The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of motor. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump control and to eliminate the need for motor de-rating.

- 2.8.4 The VFD shall utilize an energy optimization algorithm to minimize energy consumption. The output voltage shall be adjusted in response to the load, independent of speed.
- 2.8.5 The VFD shall automatically reduce the switching frequency and/or the output voltage and frequency to the motor during periods of sustained ambient temperatures that are higher than the normal operating range. The switching frequency shall be reduced before motor speed is reduced.
- 2.8.6 An integral RFI filter shall be standard in the VFD.
- 2.8.7 The VFD shall have a minimum of two skip frequency bands which can be field adjustable.
- 2.8.8 The VFD shall have internal solid-state overload protection designed to trip within the range of 125-150% of rated current.
- 2.8.9 The integrated VFD motor shall include protection against input transients, phase imbalance, loss of AC line phase, over-voltage, under-voltage, VFD over-temperature, and motor over-temperature. Three-phase integrated VFD motors shall be capable of providing full output voltage and frequency with a voltage imbalance of up to 10%.
- 2.8.10 The integrated VFD motor shall have, as a minimum, the following input/output capabilities:
  - .1 Speed Reference Signal: 0-10 VDC, 4-20mA
  - .2 Digital remote on/off
  - .3 Fault Signal Relay (NC or NO)
  - .4 Fieldbus communication port (RS485)
- 2.8.11 The motor shall be Totally Enclosed Fan Cooled (TEFC) with a standard NEMA C-Face, Class F insulation with a temperature rise no higher than Class B.
- 2.8.12 The cooling design of the motor and VFD shall be such that a Class B motor temperature rise is not exceeded at full rated load and speed at a minimum switching frequency of 9.0 kHz.
- 2.8.13 Motor drive end bearings shall be adequately sized so that the minimum L10 bearing life is 17,500 hours at the minimum allowable continuous flow rate for the pump at full rated speed.

## **2.9 Pump Discharge Flow Meter**

- 2.9.1 Provide a Bell & Gossett (Xylem) Venturi Balance and Flow Measurement Valve with Integral Ball/Butterfly Valve.
  - .1 Acceptable Products: Taco Accu-flo; IMI Flow design UA or AF; Armstrong APV.

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### 3 . **EXECUTION**

#### 3.1 **General**

- 3.1.1 Ensure pumps are installed so no piping or equipment loads are imposed on pump body. Provide stanchions or hangers for this purpose. Refer to Manufacturer's installation instructions for details.
- 3.1.2 Pumps shall be aligned by qualified millwright and alignment certified.
- 3.1.3 Check pump rotation.
- 3.1.4 Pipe drain tapping to floor drain.
- 3.1.5 "Start-up" strainer baskets in strainer/suction guides must be removed prior to commissioning of systems.
- 3.1.6 Provide air cock and drain connection on horizontal pump casings.
- 3.1.7 Provide line sized gate or butterfly valve and strainer or suction diffuser on suction side of pump. Provide line sized soft seated check valve and gate or butterfly valve on discharge side of pump.
- 3.1.8 Provide discharge flow meter/shutoff valve or way of measuring flow rate on pump discharge pipe.
- 3.1.9 Decrease from line size, with long radius reducing elbows or reducers.
- 3.1.10 Shave or replace pump impellers to meet actual operating conditions.
- 3.1.11 Where remote control panels are used, Contractor shall allow for wiring from panel to pumps.
- 3.1.12 Provide seismic restraints for pumps.
- 3.1.13 Secure control panels for seismic loads.
- 3.1.14 Where pumps are controlled by a variable speed drive, the minimum speed of the pump shall be set at  $\pm 40\%$  of rated RPM, or as directed by the pump supplier based on pump curve and minimum system flows and pressure requirements.

#### 3.2 **In-line Circulators**

- 3.2.1 Install as indicated by flow arrows.
- 3.2.2 Support at flanges on inlets and outlets of unit.
- 3.2.3 Install with bearing lubrication points accessible.

#### 3.3 **Base Mounted Type**

- 3.3.1 Place level, shim unit and grout.
- 3.3.2 Align coupling in accordance with Manufacturer's recommended tolerance.

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**END OF SECTION**

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## 1. **GENERAL**

### 1.1 **Related Work**

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

### 1.2 **Scope**

- 1.2.1 Provide for cleaning and degreasing of systems that use glycol or water as heat transfer medium.
- 1.2.2 Provide for cleaning and disinfection of domestic hot and cold systems.
- 1.2.3 Provide temporary strainers, connections and by-pass lines as required.
- 1.2.4 Provide equipment to add chemicals to systems as specified herein.
- 1.2.5 Provide equipment to operate and control system as specified herein. Provide appropriate protection so capped off unused piping does not corrode.
- 1.2.6 Provide corrosion coupons for closed and open loop circulation systems as specified herein, to include testing and analysis at least twice in the first year of warranty
- 1.2.7 Piping systems to be chemically treated include the following systems:
- .1 Chilled water system(s).
  - .2 Hot water heating system(s).
  - .3 Heat pump water system(s).
  - .4 Glycol system(s).
- 1.2.8 Provide complete start-up and commissioning, including the amounts of chemicals and filter media change-outs sufficient to calibrate the system and provide supplies for the first year of warranty.

### 1.3 **Quality Assurance**

- 1.3.1 Water treatment chemicals and treatment process shall be supplied and performed by Contractor. Work shall be supervised by Water Treatment Specialist who, upon completion, shall certify process is satisfactory and submit report outlining cleaning operation and treatment process. Contractor shall provide name and supplier of chemical treatment specialist as part of post-tender submittals and progress claim breakdown.

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**1.4 Reference Standards**

- 1.4.1 Provide HVAC water treatment in accordance with ASME Boiler Code Section VII, and requirements and standards of regulating authorities, except where specified otherwise.

**1.5 Submittals**

- 1.5.1 Submit shop drawings including proposed chemicals, quantities, procedures and equipment to be supplied. Provide written operating instructions and system schematics including MSDS data, and safe disposal instructions. Provide samples of testing record sheets with recommended water treatment testing schedule for the proposed treatment.
- 1.5.2 Provide written report containing log and procedure of system cleaning, giving times, dates, problems encountered and condition of water.
- 1.5.3 Submit written report containing test results and list of chemicals added every 14 days from time of commissioning to acceptance.
- 1.5.4 Notify Consultant 48 hours prior to chemical cleaning so work may be verified and reviewed.

**1.6 Water Treatment Service**

- 1.6.1 Water Treatment Specialist shall provide supervision of installations, set-up and adjustments and shall submit written report on system operations.
- 1.6.2 Chemicals, feed systems and test equipment shall be provided by Water Treatment Specialist.
- 1.6.3 Treatment chemicals shall not contain hydrazine.
- 1.6.4 Treatment chemicals shall be non-foaming.
- 1.6.5 Water Treatment Specialist shall instruct maintenance personnel before substantial completion. Written instructions of treatment, dosages, control charts and test procedures shall be included in maintenance manuals.
- 1.6.6 Water Treatment Specialist shall provide monthly visits to check chemical treatment, take water samples and recommend any changes to treatment, and provide written report for period of one year after substantial completion. Provide sufficient chemicals to treat system from time of commissioning to acceptance of building. Provide a stock of chemicals, filters and corrosion coupons suitable for 12 months normal operation or minimum **[5,000]** hours of operation for system volume.
- 1.6.7 Provide test kit suitable for chemical treatments used. Test kit shall be made available for on-site tests and provide Myron 3 range TDS meter to check conductivity. Hand kit over to Building Operator at project completion; obtain receipt.

- 1.6.8 Provide one mild steel and one copper corrosion coupon package to monitor corrosion rate for each open and closed systems.

## 2. PRODUCTS

### 2.1 Materials

#### 2.1.1 System Cleaner:

- .1 Sodium Metasilicate, Sodium Nitrite or acceptable equal and wetting agent compound, which in solution removes grease and petroleum products. Concentration level to be determined by Water Treatment Specialist (PACE Chemicals Ltd. – PURGEX L-24 or PURGEX L-27 for aluminium safe boilers or acceptable equal).

#### 2.1.2 Closed System Treatment (Hot Water, Chilled Water):

- .1 Borated Nitrite based corrosion inhibitor. Maintain levels at 60 – 100 ppm for organic PACE Chemicals Ltd. – BAR COR CWS-105, or at 700 – 1000 ppm of BAR COR CWS-55 (non-organic product) or acceptable equal (use WT-580/780 for aluminium safe boilers). The use of Nitrite only, or Sulphite only will not be accepted.

#### 2.1.3 Glycol System:

- .1 Charge hot water and/or heat recovery system(s) and chilled water system(s) with a **[40%]** solution (by volume) in water of inhibited propylene glycol equivalent to DOWFROST.

### 2.2 Equipment

#### 2.2.1 Chemical Feed System – Closed Systems (hot water heating, chilled water, heat pump and closed circuit condenser water):

- .1 Bypass Pot Feeder: Closed water systems shall have bypass chemical pot feeder with 2 gal (7.6 L) capacity, constructed of heavy-duty cast-iron or welded steel (suitable for 200 psi (1,380 kPa) working pressure), with quick opening cap and complete with NPS ¾ (20 mm) connections. Install isolating valves on inlet, outlet and drain.
- .2 Side Stream Filters: Closed systems shall have side stream filters. 304 L stainless steel or polypropylene plastic filter housing to accept 30 micron – 2½” (65 mm) x 10” (250 mm) long filter cartridges and complete with swing bolt lid. Minimum flow rate of 9 USgpm” (35 L/min). A Flow Indicator with stainless steel impeller shall be installed as per Manufacturer’s instructions. Include 10 filter replacement cartridges for each side stream filter unit.
- .3 Chemical Feed Piping shall be Schedule 40 black steel.



- .4 Provide make-up water meter equal to Neptune T-10, Neptune Trident 8 or Rockwell Hersey complete with electronic output for analogue flow monitoring by building automation system.
- .5 Corrosion Coupon and Holder Assembly:
  - .1 Mild steel **[copper]** corrosion coupon.
  - .2 Holder, NPS ¾ (20 mm) or NPS 1 (25 mm) connection.
  - .3 Provide malleable or cast-iron cross, NPS ¾ (20 mm) or NPS 1 (25 mm) connection.

#### 2.2.2 Glycol Feed System:

- .1 Automatic feed system with manual override, (Neptune Model G-50-1A, Axiom Model SF-100, or acceptable equal), comprising the following:
  - .1 Pump: 2 USgpm (7.5 L/min) at 100 psi (690 kPa), bronze gears, stainless steel shaft and carbon bearings, Buna N lip seals. Motor, 1725 rpm, 1/3 HP, 115/1/60 VAC. (Albany Model CEP93-3).
  - .2 Tank: 45 gal cylindrical, polyethylene tank with hinged poly cover, steel support stand with bottom mount pump shelf, required connections and agitator bracket.
  - .3 Agitator: Direct drive, 1725 rpm, ¼ HP, 115/1/60 VAC complete with bracket mount and stainless steel shaft and propeller (Neptune Model A-2).
  - .4 Pressure Switch: Glycol addition shall be controlled by adjustable pressure switch with high and low setpoints. When pressure in loop reaches low setpoint, pump shall start and feed glycol until high setpoint pressure is achieved and pump stops.
  - .5 Control Panel: NEMA 4X enclosure, 115/1/60 VAC and shall consist of the following:
    - .1 Power supply cord with moulded plug.
    - .2 H-O-A switch for pump motor.
    - .3 Pump "ON" indication.
    - .4 "LOW" tank level indication with audible alarm.
    - .5 Push button to silence.
    - .6 Contacts for remote connection.
  - .6 Accessories:
    - .1 Float switch for low level cut off of pump.
    - .2 Pressure switch.
    - .3 Relief valve piped back to tank.
  - .7 Provide pressure gauge located in discharge piping.

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- .8 Specific gravity hydrometer, Taylor Instruments Standard quality, Model H4130, scale range 1.000 – 1.200, divisions at 0.002 length 12" (300 mm).
  - .9 Provide chart showing specific gravity of specified solution by volume, at specified temperature.
- 2.2.3 Glycol Feed System (Secondary Antifreeze Heating, Heat Recovery Systems):
- .1 Manual feed system including the following:
    - .1 Tank: 45 gal (170 L) cylindrical, polyethylene tank or direct from drum with hinged poly cover and steel support stand with agitator bracket. (Neptune Model TM 50PT or acceptable equal).
    - .2 Agitator: Direct drive, 1725 rpm, ¼ HP, 115/1/60 VAC complete with stainless steel shaft and propeller (Neptune Model A-2 or acceptable equal). Mixer mounts to bracket supplied as part of tank stand.
    - .3 Pump: Hand operated fill pump, diaphragm style, 36 psi (250 kPa) minimum head, NPS ¾ (20 mm) connections, equivalent to Monarch L-30A.
    - .4 Provide pressure gauge located in discharge piping.
    - .5 Specific gravity hydrometer, Taylor Scientific Standard quality, Model 13-1715-00, scale range 1.000 – 1.200, divisions at 0.002, length 12" (300 mm).
    - .6 Provide chart showing specific gravity of specified solution by volume, at specified temperature.
- 2.2.4 Glycol Feed System for Solar Closed Loop
- .1 Glycol Feed System for Solar: Automatic Feed System (Axiom Model MF300-S).
    - .1 Pump: 0.6 USGpm (2.4 liter/min) at 50 psi (345 kPa), 115/1/60 VAC, with thermal cut-out, plug, and cord, capable of running dry without damage.
      - .1 Tank: 65 litre cylindrical, polyethylene tank with cover, pump suction hose with strainer, low level pump cut-out, diverter valve for air purging and agitation, and all required connections.
      - .2 Pressure Regulating Valve: Glycol addition shall be controlled by an adjustable pressure reducing valve, range 10 (115 kPa) - 255 psi (170kPa), complete with pressure gauge, strainer, check valve, union connection and ½" (15 mm) x 35" (875 mm) flexible outlet hose with check valve.
      - .3 Low Pressure Alarm: Low level alarm panel (Axiom R1A10-1 SAA), complete with remote monitoring contacts and selectable audio alarm.

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**3 . EXECUTION**

**3.1 Glycol Antifreeze System**

- 3.1.1 Label drain valves with "GLYCOL – DO NOT DRAIN".
- 3.1.2 Pre-mix solution in mixing tank, demonstrate specific gravity of solution to Consultant at sample points and charge system(s) using feed pump. After system filled, check specific gravity of solution in each system. Leave mixing tank filled with specified glycol solution.

**3.2 Eye Wash Station**

- 3.2.1 Provide a self-contained eye wash station in the immediate area of chemical treatment storage and tanks. Secured to wall, equal to Haws model 7501 portable gravity fed eyewash.
- 3.2.2 Provide a plumbed eye wash station in the immediate area of chemical treatment storage and tanks. Wall mounted, equal to Guardian model G1814BC, complete with thermostatic mixing valve.

**END OF SECTION**

## **1. GENERAL**

### **1.1 Related Work**

1.1.1 This Specification Section forms part of Contract Document and is to be read, interpreted and coordinated with other parts.

### **1.2 Submittals**

1.2.1 Submit a schedule indicating the ductwork standards to be used, including metal gauges, joints and reinforcement, before construction of any ductwork.

### **1.3 Reference Standards**

1.3.1 The construction and installation of ductwork and plenums shall be in accordance with the following referenced SMACNA manuals and ASHRAE handbooks:

- .1 SMACNA - HVAC Duct Construction Standards.
- .2 SMACNA - HVAC Air Duct Leakage Test Manual.
- .3 ASHRAE - Handbook - Equipment Volume.

### **1.4 General**

- 1.4.1 Duct sizes on drawings indicate clear inside dimensions. For acoustically lined or internally insulated ducts, maintain inside duct dimensions.
- 1.4.2 Where duct sizes are shown in nominal metric sizes, round and oval duct sizes may be supplied in nearest available sizes in equivalent imperial units.
- 1.4.3 Provide for openings in correct locations through slabs and walls. Openings shall be planned to include installation of fire dampers at rated fire separations.
- 1.4.4 Where ducts penetrate roofs, provide roof curbs with flashing and counter flashing.
- 1.4.5 Arrange for 4" (100 mm) high by 4" (100 mm) wide concrete curbs around duct penetrations through floor slabs outside of duct shafts.
- 1.4.6 Project drawings are diagrammatic and efforts have been made to provide information regarding number of offsets and transitions, but all are not necessarily shown. Changes may be required in duct routings, elevation and duct shape to eliminate interference with structure and other services. Required adjustments shall be established when coordinating and field measuring work prior to fabrication and must be provided as part of contract and association costs must be considered and included.

- 1.4.7 Ductwork shall be clean and free from scale, corrosion and deposits. Ductwork shall be degreased and wiped clean of oil and other surface films with appropriate solvents prior to installation.
- 1.4.8 Ductwork shall be delivered clean to site and maintained in clean condition. Dirty ductwork shall be removed from site.
- 1.4.9 Where welding ductwork, welding shall be continuous with Everdur welding. Tack welding is unacceptable, except as specifically noted. Paint damaged areas with zinc coating after welding.
- 1.4.10 Where a combustible structure and/or there is a combustible ceiling plenum, that plenum shall not be used as an open plenum and all transfer air/return air shall be fully ducted, unless otherwise noted.

## 2. PRODUCTS

### 2.1 Galvanized Steel

- 2.1.1 Galvanized steel shall have 0.9 oz/ft<sup>2</sup> (275 g/m<sup>2</sup>) galvanizing coat both sides to ASTM A653-13.

### 2.2 Ductwork and Plenum Pressures

- 2.2.1 Provide ductwork and plenums of galvanized steel for static pressure categories listed below.

- .1 10" w.g. (2,500 Pa) static pressure:

- .1 Built up supply air plenums between inlet automatic control dampers and discharge automatic control dampers:

.1	INLET DAMPERS	DISCHARGE
	DAMPERS	

.2	CD	and	CD-
----	----	-----	-----

.3	CD	and	CD-
----	----	-----	-----

.4	CD	and	CD-
----	----	-----	-----

.5	CD	and	CD-
----	----	-----	-----

.6	CD	and	CD-
----	----	-----	-----

- .2 6" w.g. (1,500 Pa) static pressure:

- .1 Stair, vestibule and elevator pressurization ducts.

- .2 Smoke evacuation ducts.

- .3 Kitchen exhaust ducts.

- .4 Supply ductwork and plenums downstream from the discharge automatic control dampers listed below, up to the furthest smoke/fire dampers at the ends of supply duct risers ( emerging from duct shafts) or to supply duct smoke dampers in the walls of mechanical rooms.

.1	DISCHARGE DAMPERS
----	-------------------

.2	CD-
----	-----

- .3 CD-
- .4 CD-
- .5 CD-
- .6 CD-
- .3 4" w.g. (1,000 Pa) static pressure:
  - .1 Supply air ductwork downstream from supply air handling units discharge, to the upstream side of mixing boxes/air valves.
  - .2 Exhaust and return air ductwork downstream from return/exhaust air valves to return/exhaust fans and downstream from return/exhaust fans to air handling units and/or outdoor relief.
  - .3 Outdoor intake plenums in mechanical room(s).
- .4 2" w.g. (500 Pa) static pressure:
  - .1 Supply ductwork downstream from mixing boxes/air valves to terminal air outlets.
  - .2 Supply ductwork and plenums on systems without mixing boxes/air valves.
  - .3 Return air ductwork and plenums, except where otherwise specified.
  - .4 Exhaust and relief air ductwork and plenums, except where otherwise specified (welding/sawdust exhaust).
  - .5 Outdoor air ductwork and plenums, except as otherwise specified.

## 2.3 **Ductwork – Under 2" w.g. (500 Pa) Static Pressure**

- 2.3.1 Provide galvanized steel duct work for system operating pressures 2" w.g. (500 Pa) and less. Ductwork shall be constructed, reinforced, sealed and installed to withstand 1-½ times working static pressure.
- 2.3.2 Construct rectangular ductwork in accordance with SMACNA Duct Construction Standards Third Edition - 2005.
- 2.3.3 Nomasco "Ductmate System, Lockformer TDC" or Exanno "Nexus System" may be used for rectangular duct joints.
- 2.3.4 At least two opposite faces of rectangular ductwork shall be joined together using joint which cannot pull apart.
- 2.3.5 Construct rectangular duct fittings in accordance with Section 2 and 4, including Figures 4-1 to 4-9 of SMACNA Duct Construction Standards Third Edition - 2005, but excluding beaded crimp joints and snaplock seams.
- 2.3.6 Construct round ductwork in accordance with Section III, including Tables 3-1 to 3-15 and Figures 3-1 to 3-11, of SMACNA Duct

Construction Standards Third Edition - 2005, but excluding beaded crimp joints and snaplock seams.

- 2.3.7 Construct flat oval ductwork in accordance with Section 3.3 of SMACNA Duct Construction Standards Third Edition - 2005. Joints and seams shall be similar to those indicated for round ducts. Flat oval duct to be used for positive pressure application only.
- 2.3.8 Construct round and flat oval duct fittings in accordance with Section III of SMACNA Duct Construction Standards Third Edition - 2005. Round elbows shall have centreline radius of 1.0 times duct diameter. Sheet metal gauge of fittings and elbows shall have centreline radius of 1.0 times duct diameter. Sheet metal gauge of fittings and elbows shall not be less than thickness specified for longitudinal seam straight duct. Adjustable elbows are not permitted.
- 2.3.9 Cast-in slab ductwork shall be ECCODUCT® product, sizes as noted on the drawings.
  - .1 Acceptable Products: DDK – “In-Slab Duct System” – Reinforced Type, PacAire – “In-Slab Vent Duct System”.

## **2.4 Ductwork – 2” w.g. (500 Pa) and Greater Static Pressure**

- 2.4.1 Provide galvanized steel duct work for system operating pressures 2” w.g. (500 Pa) and over. Ductwork shall be constructed, reinforced, sealed and installed to withstand 1-½ times working static pressure.
- 2.4.2 Construct rectangular ductwork in accordance with SMACNA Duct Construction Standards Third Edition - 2005.
- 2.4.3 Nomasco “Ductmate System”, Exanno “Nexus System” or “Lockformer TDC, TDF system” may be used for rectangular duct joints.
- 2.4.4 Construct rectangular duct fittings in accordance with Section 2 and 4 of SMACNA Duct Construction Standards – Third Edition - 2005.
- 2.4.5 Construct round ductwork in accordance with Section III, including Tables 3-1 to 3-15 and Figures 3-1 to 3-11 of SMACNA Duct Construction Standards Third Edition - 2005.
- 2.4.6 Construct flat oval ductwork in accordance with Section 3.3, of SMACNA Duct Construction Standards Third Edition - 2005. Joints and seams shall be similar to those indicated for round duct. Flat oval duct to be used for positive pressure application only.
- 2.4.7 Construct round and flat oval duct fittings in accordance with Section III of SMACNA Duct Construction Standards Third Edition - 2005. Round elbows shall have centreline radius of 1.5 times duct diameter. Construct 90° elbows of not less than 5 tapered section. Seams and joints in round or oval duct fittings and elbows shall be spot welded lap seams at not more than 2” (50 mm) spacing and

inside seams sealed with approved duct sealant. If zinc coating is burned the steel during welding, joints shall be painted to prevent corrosion. Sheet metal gauges of fittings and elbows shall not be less than thickness specified for longitudinal seam straight duct, but suitably thick for welding methods used.

**2.5 Plenums – Under 2” w.g. (500 Pa) Static Pressure**

- 2.5.1 Provide galvanized steel low pressure plenums, suitable for 2” w.g. (500 Pa) positive or negative pressure, for central plant ventilating and air conditioning equipment.
- 2.5.2 Construct plenums in accordance with Chapter 9 of SMACNA Duct Construction Standards Third Edition - 2005.
- 2.5.3 Where building structure does not form bottom surface of walk-in plenum, fabricate plenum floor panels of 14 ga (1.99 mm) galvanized steel, with angle iron reinforcing to limit deflection of floor panels to ¼” (6 mm) under concentrated load of 250 lb (115 kg) at mid span.
- 2.5.4 Where plenum floors are internally lined, install 16 ga (1.61 mm) thick galvanized steel panel on top of insulation.
- 2.5.5 Apply silicone sealant CGE Silpruf 2000 series or Dow Corning 781/732 between plenum base angles and concrete or curbs before bolting together.
- 2.5.6 Reinforce openings in plenum walls with 1½” (40 mm) x 1½” (40 mm) x ⅜” (4.5 mm) angle iron, secured to main vertical and horizontal reinforcing angles.
- 2.5.7 Construct access door and casing around door as per SMACNA Standards, casing access doors, with angle iron frame sized to suit plenum wall. Doors constructed of 16 ga (1.61 mm) metal.
- 2.5.8 Arrange access doors to open against airflow and static pressure.
- 2.5.9 Weld joints on condensate drains pans. Construct pans of 16 ga (1.61 mm) thick stainless steel Type #302 or #304. Install 1¼” (40 mm) piping connection, complete with water seal at least 4” (100 mm) deep, from pan drain connection to nearest building drain. Install drain connections to completely drain pans.
- 2.5.10 Seal piping penetrations through plenum walls, with gland seals as detailed in SMACNA Duct Construction Standards - 2005.
- 2.5.11 Bulkheads mounting air filters and air coils shall be airtight to prevent air bypass around filters and/or coils.

**2.6 Plenums – 2” w.g. (500 Pa) and Greater Static Pressure**

- 2.6.1 Provide medium/high pressure galvanized steel plenums, suitable for specified pressures.



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- 2.6.2 Construct plenums in accordance with Chapter 9 of the SMACNA Duct Construction Standards Third Edition - 2005. If requested, pressure test plenums to specified static pressure (positive or negative) to demonstrate structural integrity.
- 2.6.3 Where building structure does not form bottom surface of walk-in plenum, fabricate plenum floor panels of 14 ga (1.99 mm) galvanized steel, with angle iron reinforcing to limit deflection of floor panels to 1/4" (6 mm) under concentrated load of 250 lb (115 kg) at mid span.
- 2.6.4 Where plenum floors are internally lined, install 16 ga (1.61 mm) thick galvanized steel panel on top of insulation.
- 2.6.5 Apply silicone sealant CGE Silpruf 2000 series or Dow Corning 781/732 between plenum base angles and concrete or curbs before bolting together.
- 2.6.6 Reinforce openings in plenum walls with 2" (50 mm) x 2" (50 mm) x 1/4" (6 mm) angle iron, secured to main vertical and horizontal reinforcing angles.
- 2.6.7 Construct access door and casing around door as per SMACNA Standards, casing access doors, with angle iron frame sized to suit plenum wall. Doors constructed of 16 gauge metal.
- 2.6.8 Arrange access doors to open against airflow and static pressure.
- 2.6.9 Weld joints on condensate drains pans. Construct pans of 16 ga (1.61 mm) thick stainless steel Type #302 or #304. Install 1 1/4" (32 mm) piping connection, complete with water seal, from pan drain connection to nearest building drain. Install drain connections to completely drain pans.
- 2.6.10 Water Seal Depth:
- .1 4" (100 mm) for 2" w.g. (500 Pa) systems.
  - .2 5" (125 mm) for 3" w.g. (750 Pa) systems.
  - .3 6" (150 mm) for 4" w.g. (1,000 Pa) systems.
  - .4 8" (200 mm) for 6" w.g. (1,500 Pa) systems.
  - .5 12" (300 mm) for 10" w.g. (2,500 Pa) systems.
- 2.6.11 Seal piping penetrations through plenum walls with gland seals as detailed in the SMACNA Duct Construction Standards Third Edition - 2005.
- 2.6.12 Bulkheads mounting air filters and air coils shall be airtight to prevent air bypass around filters and/or coils.

## **2.7 Ductwork – Aluminum**

- 2.7.1 The following ductwork shall be fabricated from aluminum:
- .1 Exhaust ductwork from showers/baths, as indicated in drawings.

- .2 Discharge ductwork through roof, where indicated on drawings.
- .3 Swimming pool/spa hot tub ductwork.
- 2.7.2 Low Pressure Aluminum ductwork shall be constructed in accordance with clause 2.2 "Ductwork - 2" w.g. (500 Pa) Static Pressure."
- 2.7.3 For round and rectangular aluminum ductwork, use four gauges heavier than scheduled in the SMACNA Duct Construction Standards, Third Edition (SMACNA 006-2006) for galvanized ductwork.
- 2.7.4 Aluminum shall be utility grade.
- 2.7.5 Support aluminum ductwork using aluminum straps, cadmium plated threaded rods, aluminum flat bar or aluminum angle hangers. Support shall be similar to specified for galvanized iron ductwork.

## **2.8 Ductwork – Stainless Steel – Rectangular**

- 2.8.1 The following rectangular ductwork shall be fabricated from stainless steel:
  - .1 Exhaust ducts carrying moisture such as Dishwasher, Cartwasher, Washer/Sanitizer. Exhaust duct from unit to discharge point.
  - .2 Duct sections containing duct mounted humidifiers.
  - .3 Where indicated on drawings.
- 2.8.2 Low pressure stainless steel ductwork shall be suitable for system operating pressures under 2" w.g. (500 Pa).
- 2.8.3 Material: 18 ga (1.27 mm), #304 stainless steel or #316L for fume hood exhaust ducts, with No. 2B finish where concealed and No. 4 finish exposed. Exposed areas shall include finished occupied areas of building but not mechanical rooms.
- 2.8.4 Do not cross break duct panels. Grade to drain as indicated.
- 2.8.5 Weld longitudinal seams and lateral joints and finish exposed seams and lateral joints by grinding smooth and buffing to finish of sheet. Do not penetrate stainless steel with screws, bolts and rivets.
- 2.8.6 Provide gasketed companion flange connections where necessary to connect to equipment. Flanged connections shall be made by slipping formed 14 ga (1.98 mm) thick matching stainless steel welded angle frame over end of duct, leaving space for continuously welding frame to duct on inside.
- 2.8.7 Provide escutcheon trim bands around duct ceiling penetrations.
- 2.8.8 Provide gasketed cleanouts (not smaller than 18" (450 mm) x 12" (300 mm), with formed 14 ga (1.98 mm) thick matching stainless steel welded angle reinforcing frames, inside of ductwork and not more than 20'-0" (6 m) intervals, changes in direction and base of

risers. Cleanouts shall be fastened with wing nuts at 6" (150 mm) centres. Cleanout openings shall terminate not less than 1½" (40 mm) from bottom of duct.

2.8.9 Gaskets shall be ⅛" (3 mm) thick Teflon or approved alternate.

2.8.10 Support exposed ductwork with 2" (50 mm) x 14 ga (1.98 mm) matching stainless steel (No. 4 finish) U-strap hangers on 8'-0" (2.4 m) centres.

2.8.11 Support concealed ductwork with 2" (50 mm) x 14 ga (1.98 mm) galvanized steel, U-strap hangers at 8'-0" (2.4 m) centres.

## **2.9 Ductwork – Stainless Steel – Round**

2.9.1 The following round ductwork shall be fabricated from stainless steel:

- .1 Exhaust ducts carrying moisture such as Dishwasher, Cartwasher, Washer/Sanitizer. Exhaust duct from unit to discharge point.
- .2 Duct sections containing duct mounted humidifiers.
- .3 Where indicated on drawings.

2.9.2 Material:

- .1 18 ga (1.27 mm), #316L stainless steel for fume hoods, #304 for other applications with No. 2B finish where concealed and No. 4 finish where exposed to room (except mechanical rooms) or exposed outdoors.

2.9.3 Fabrication:

- .1 Fume Hood exhaust ducts shall be constructed of 316L stainless steel to SMACNA Seal Class B Standards minimum. Joints on duct and fittings shall be butt seams continuously MIG welded. Lap type joints are not acceptable. Welded joint in exposed locations must be ground and polished.
- .2 Provide gasketed companion flanged joints and any required transitions for fume hood duct connections.
- .3 Provide escutcheon trim bands around duct ceiling penetrations.
- .4 Provide gasketed cleanouts (not smaller than 18" (450 mm) x 12" (300 mm), with formed 14 ga (1.98 mm) thick matching stainless steel welded angle reinforcing frames, inside of ductwork and not more than 20'-0" (6 m) intervals, changes in direction and base of risers. Cleanouts shall be fastened with wing nuts at 6" (150 mm) centres. Cleanout openings shall terminate not less than 1½" (40 mm) from bottom of duct.

2.9.4 Elbows:

- .1 Round duct elbows shall be made of mitred, welded matching stainless steel or stamped elbows of same material. Welded elbow thickness shall be 18 ga (1.27 mm). 90° elbows shall have minimum of five sections. Centreline radius shall be 1.5 times duct diameter.

2.9.5 Support:

- .1 Support exposed ductwork with 2" (50 mm) x 14 ga (1.98 mm) stainless steel (No. 4 finish), U-strap hangers at 8'-0" (2.4 m) centres.
- .2 Support concealed ductwork with 2" (50 mm) x 14 ga (1.98 mm) galvanized steel, U-strap hangers at 8'-0" (2.4 m) centres.

**2.10 Ductwork – Acoustically Lined**

- 2.10.1 Where rectangular ductwork is indicated acoustically insulated with flexible acoustic duct liner, it shall be installed in accordance with instructions, SMACNA Duct Construction Standards Third Edition – 2005. Duct sizes shown are inside duct liner.
- 2.10.2 Where round ductwork is indicated acoustically insulated, it shall consist of two concentric round ducts with 1" (25 mm) thick flexible fibrous glass duct liner between ducts. Inner duct shall be perforated and correspond to duct diameter noted on drawings. Outer duct shall be suitable for static pressure and shall be sealed airtight where it joins adjacent ductwork.

**2.11 Ductwork – Outdoors**

- 2.11.1 Internally or externally insulated supply, return and exhaust ducts (downstream of heat recovery coils) including silencers, located outdoors on roof, shall be constructed watertight.
- 2.11.2 Joints shall be caulked with water impervious sealant. TDC clips should be continuous on top and sides of ducts.
- 2.11.3 Top of finished product (waterproof membrane) shall be pitched to avoid pooling of water.
- 2.11.4 After pressure testing, exterior of ducts and duct silencers shall be wrapped with waterproof membrane. Membrane shall consist of SBS rubberized asphalt compound, integrally laminated to reinforced aluminum foil, providing waterproof membrane. Product similar to Bakor Foilskin.

**2.12 Plenum Insulation Covering**

2.12.1 Sheet Metal:

- .1 Provide 22 ga (0.85 mm) galvanized sheet metal covering on acoustically lined plenum walls for distance of 4'-0" (1.2 m) downstream from cooling coils.

2.12.2 Perforated Metal:

- .1 Provide 22 ga (0.85 mm) thick perforated galvanized sheet metal covering on acoustically lined plenum walls (except immediately adjacent to downstream side of cooling coils where it should not be perforated).

**2.13    Air Distribution Plates**

- 2.13.1 Provide perforated air distribution plates at discharge of supply fans if required to provide a balance flow of air through downstream filters and coils.
- 2.13.2 Modify and reposition plates as necessary to balance airflow through downstream filters and coils to  $\pm 10\%$

**2.14    Coil End Covers**

- 2.14.1 Provide coil end casings to eliminate coil frame air leakage.
- 2.14.2 Provide for cooling coil ends to drop condensate to coil drain pan. Insulate and vapour seal inside of coil end casing to prevent casing condensation and provide closure panels to retain insulation.

**2.15    Wire Mesh Screens**

- 2.15.1 Provide wire mesh screens in air intake openings.
- 2.15.2 Screens shall be constructed from aluminum wire 16 ga (1.29 mm) diameter.
- 2.15.3 Screen mesh shall be  $\frac{1}{2}$ " (15 mm).
- 2.15.4 Mount screens in 20 ga (0.81 mm) thick folded aluminum frames.

**2.16    Counter Flashings**

- 2.16.1 Counter flashings - galvanized sheet steel of 22 ga (0.85 mm) minimum thickness.
- 2.16.2 Counter flashings are attached to mechanical equipment and lap base flashings on roof curbs.
- 2.16.3 Joints in counter flashings shall be flattened and solder double seam. Storm collars shall be adjustable to draw tight to pipe with bolts. Caulk around top edge. Storm collars shall be used above roof jacks.
- 2.16.4 Vertical flange section of roof jacks shall be screwed to face of curb.

**3 .    EXECUTION**

**3.1    Ductwork and Plenum Installation**

- 3.1.1 Where duct contains a fire or smoke damper, construct duct so free area is maintained through damper.

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- 3.1.2 Where duct is internally insulated, enlarge duct to not reduce free area.
  - 3.1.3 Make taper of diverging transitions less than 20° and taper of converging transitions less than 30° in accordance with SMACNA Duct Construction Standards Third Edition - 2005. Maximum divergence upstream of equipment to be 30° and 45° convergence downstream.
  - 3.1.4 Make inside radius of rectangular duct elbow at least equal to duct width, measured in direction of radius. If space conditions do not permit full radius elbow, use square elbows with multi-blade turning vanes.
  - 3.1.5 Turning vanes shall be single wall type. Vanes in galvanized sheet metal ducts shall be constructed from galvanized steel, minimum thickness 22 ga (0.85 mm). Vanes shall be spaced at 1½" (40 mm) centres and shall turn through 90° with radius of 2" (50 mm). Vanes shall not include straight trailing edge. Vanes and runners in aluminum ducts shall be constructed from aluminum. Aluminum vanes shall be 18 ga (1.02 mm).
  - 3.1.6 For under 2" w.g. (500 Pa) pressure systems, install tie rods to limit maximum unsupported vane length to 36" (900 mm). Refer to Figure 2-4 of the SMACNA Duct Construction Standards Third Edition – 2005.
  - 3.1.7 For 2" w.g. (500 Pa) and greater pressure systems, install tie rods to limit maximum unsupported vane length to 18" (450 mm). Refer to Figure 2-4 of SMACNA Duct Construction Standards Third Edition - 2005
  - 3.1.8 Install duct necks before grilles, registers and diffusers and cushion heads after diffuser take-offs to suit site conditions.
  - 3.1.9 Where indicated, install adjustable air turning devices, where full radius take-off fittings cannot be installed, in accordance with SMACNA Duct Construction Standards Third Edition - 2005. Adjustment shall be accessible outside duct with lockable quadrant operator or through grille or register with key-operated worm gear mechanism.
  - 3.1.10 Cross-break or bead metal duct panels unless otherwise noted.
  - 3.1.11 Do not cross-break duct panels on 2" w.g. (500 Pa) and greater static pressure systems.
  - 3.1.12 Do not cross-break bottom duct panels when ductwork is handling moisture.
  - 3.1.13 Roof mounted ducts shall have standing seams and shall be sealed weather tight.
  - 3.1.14 Grade ductwork handling moist/humid air, minimum of 1" (25 mm) in 10'-0" (3.0m) back to source. At low points in ductwork, provide

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- 6" (150 mm) deep drain sump and 1¼" (32 mm) diameter drain connection with deep seal trap and pipe to drain.
- 3.1.15 Construct ductwork handling moisture with three sided bottom sections and separate top panel. Install three sided bottom sections and internally seal transverse joints with CGE Silicone Sealant "Silpruf". Then install top panels and seal top panel seams and joints.
- 3.1.16 Provide floor drains in outside air and humidifier sections with deep seal traps.
- 3.1.17 Provide moisture collection sections inside louvres for outside air and exhaust air.
- 3.1.18 Support ductwork using galvanized steel straps, cadmium plated threaded rods, flat bar or angle hangers. Attachments to structure shall be compatible with structure and selected for load of ductwork. Install ductwork hangers in accordance with Chapter 5 of SMACNA Duct Construction Standards Third Edition - 2005.
- 3.1.19 Support duct risers at base and each floor and not greater than 12'-0" (3.6 m) intervals.
- 3.1.20 Prior to fabrication of ductwork, coordinate and field measure to ensure complete installation respecting other services. Provide necessary fittings, offsets, and alternate construction methods to facilitate installation.
- 3.1.21 Arrange ductwork and plenums so duct and plenum mounted equipment can be removed.
- 3.1.22 Arrange access doors to open against airflow and static pressure.
- 3.1.23 Provide necessary baffling in manufactured or built-up mixed air plenums to ensure good mixed air temperature with variations of not more than  $\pm 9^{\circ}\text{F}$  ( $5.5^{\circ}\text{C}$ ) under operating conditions.
- 3.1.24 Ducts passing through non-rated fire separations, sound insulated walls and through non-rated walls and floors shall be tightly fitted and sealed on both sides of separation with silicon sealant to prevent passage of smoke and/or transmission of sound (ULC approved fire stop sealant is not required). Where ducts are insulated, provide 24 ga (0.70 mm) thick galvanized steel band tightly fitted around insulation and caulk to band.
- 3.1.25 During construction, protect openings in ductwork from dust infiltration by covering with polyethylene and protect floor outlet duct openings with metal caps.
- 3.1.26 Where ductwork passes through open web steel joists, coordinate with joist fabricator before fabricating ductwork.
- 3.1.27 Where ducts penetrate roofs, install sleeves and roof curb complete with flashing and counter flashing. Pack sleeves in roof with fibreglass insulation.
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- 3.1.28 Provide drip pans under piping and shields for protection of electrical panels and equipment.
- 3.1.29 Unless noted otherwise, line builder's shafts and air plenums used as ducts and plenums with sheet metal.
- 3.1.30 In-slab ducts shall be sealed at all joints and fittings with two coats of low pressure duct sealer. Support cast-in-place ductwork on chairs and/or from rebar such that duct is at least 2" (50 mm) above bottom of slab, or as directed by the Structural Consultant. Grade duct to outside as much as possible and as far as possible. Avoid dips that create places for condensation to accumulate.

### **3.2 Ductwork and Plenum Cleaning**

#### **3.2.1 Responsibility:**

- .1 This Contractor shall be responsible for all ductwork installed under this contract being internally CLEAN, when handed over to Owner. This responsibility includes entire systems from outdoor air intakes to air terminals and from air terminals to relief outlets. It includes ductwork, lined and unlined, plenums and equipment within or connected to ducts and plenums.
- .2 Surfaces shall be considered clean when foreign materials capable of particulating and visible to naked eye are removed.

#### **3.2.2 Installation Procedure:**

- .1 Ductwork shall be wiped clean prior to installation.
- .2 LEED® Requirement: Oil film on sheet metal shall be removed before shipment to Work Site. Ducts shall be inspected to confirm that no oil film is present.
- .3 Close dampers immediately following installation, checking operation and retarding movement of contaminants through system.
- .4 Seal opening at end of each day and other times as site conditions dictate.
- .5 Floor opening to be capped with sheet metal or floor grilles plus 6 mils (0.15 mm) thick poly sheet.
- .6 Other openings to be covered with 6 mils (0.15 mm) thick poly sheet taped to be air tight.

#### **3.2.3 Cleaning Procedure:**

- .1 On completion of duct and plenum installation and prior to installation of air terminals and prior to balancing of air systems, but not until areas are substantially clean (floors have been swept and vacuumed) and "dirty" construction has been completed, employ an approved Cleaning Agency to vacuum clean the following:



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- .1 Air handling units.
  - .2 Plenums.
  - .3 Supply and return air ducts.
  - .4 Exhaust air ducts.
  - .2 Components within each system shall be thoroughly cleaned and include, but not be limited to, the following: coils, fans and motors, silencers, air terminals and mixing boxes/air valves.
  - .3 When connection to existing supply ductwork, clean existing supply ducts upstream from connection back to filters. Clean existing supply ductwork downstream from new connections to outlets.
  - .4 Cleaning shall generally be by high capacity power vacuum. High pressure compressed air, wire brushing and/or non-toxic solvent cleaning shall be used where dirt or scale cannot be removed otherwise. Coils shall be de-scaled.
  - .5 Cleaning Contractor shall be responsible for removing and replacing filter media. This Contractor will remove temporary filters and replace with new after cleaning system.
  - .6 Cleaning Contractor shall mark balancing damper positions before cleaning and return them to original position when cleaning completed unless system is still to be balanced.
  - .7 Reinstall grilles, registers and diffusers, removed for cleaning purposes.
  - .8 After duct systems have been cleaned, reseal if they are not being used. Provide filter media on return air terminals if return air fans are run after cleaning completed.
  - .9 Cleaning Agency shall perform full inspection of duct interior. Utilizing fibre optic borescope with dedicated light source, inspect interior ductwork surfaces, and ductwork accessories, including terminal units, mixing boxes/air valves, ductwork liners, duct-mounted coils, filters, dampers, humidifiers and other appurtenances within ductwork system.
  - .10 Spot checks will be made by Consultant during cleaning process to verify required standard is being met. When substantial completion is claimed, final spot checks will be made to verify ducts are clean. Make available to Consultant, fibre optic borescope with dedicated light source. If any ducts are found to be dirty, they shall be recleaned.
  - .11 Ducts serving very clean areas, served with 85% NBS or HEPA filters, shall be reviewed by Consultant utilizing equivalent of white glove wipe technique.

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- .12      Submit report from cleaning agency that certifies specified air systems have been cleaned.

**END OF SECTION**

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## 1. GENERAL

### 1.1 Related Work

- 1.1.1 This Specification Section forms part of contract Documents and is to be read, interpreted and coordinated with other parts.

### 1.2 Quality Assurance

- 1.2.1 Catalogued or published ratings shall be obtained from tests carried out by Manufacturer or from independent testing agency signifying adherence to codes and standards.
- 1.2.2 Flame and smoke spread ratings less than 25/50 and tested in accordance with CAN/ULC-S102 "Test for Surface Burning Characteristics of Building Materials".

## 2. PRODUCTS

### 2.1 Air Blenders

#### 2.1.1 Minimum Requirements:

- .1 Units factory built and tested.
- .2 Completely fixed devices, no moving parts.
- .3 12 ga (2.05 mm) thick aluminum, welded construction.
- .4 Blender mounted on discharge side of supply fans shall function as diffuser to maintain even velocity over entire face of final filters and coils.
- .5 Factory engineered and fabricated discharge cone/transition/diffuser assembly. Unit shall be built with flanges to fit fan discharge and outlet equipped with mounting plate to fit plenum walls.

#### 2.1.2 Standard of Acceptance:

- .1 Blender Products Inc.

### 2.2 Biosafety Cabinets – Manual Isolation Valves

#### 2.2.1 Minimum Requirements:

- .1 304 stainless steel - manual butterfly control valve.
- .2 Lockable handle with pointer to indicate percent open.
- .3 Valve plate with silicone gasket to ensure airtight shutoff.
- .4 Size to suit exhaust duct.

#### 2.2.2 Standard of Acceptance:

- .1 NuAire Model NU-940.

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**2.3 Backdraft Dampers – Light Duty**

2.3.1 Minimum Requirements:

- .1 16 ga (1.61 mm) thick galvanized steel or 16 ga (1.61 mm) aluminum channel frame.
- .2 24 ga (0.51 mm) thick embossed aluminum blades.
- .3 Full blade length shafts, brass bearings.
- .4 Felt or neoprene anti-chatter blade strips.
- .5 Maximum blade height per section, 24" (600 mm), use multiples for larger dimensions.
- .6 Maximum blade length of 18" (450 mm), use multiples for larger dimensions.
- .7 Manufacturer's label.
- .8 Where balanced backdraft damper (BBD) is indicated, damper shall incorporate adjustable counter balance weight and lever.
- .9 Maximum pressure drop across damper at 800 ft/m (4 m/s) shall be 0.14" w.g. (35 Pa).

2.3.2 Standard of Acceptance:

- .1 EH Price CBD, Nailor, Ruskin, Westvent.

**2.4 Backdraft Dampers – Medium Duty**

2.4.1 Minimum Requirements:

- .1 16 ga (1.61 mm) galvanized steel or 16 ga (1.61 mm) aluminum channel frame.
- .2 14 ga (1.63 mm) aluminum blades, complete with stiffening ribs/bends.
- .3 Full blade length shafts, brass ball or nylon bearings.
- .4 Felt or neoprene anti-chatter blade strips.
- .5 Blade connecting linkage with eyelet and pin bearings.
- .6 Maximum blade length of 30" (750 mm), use multiples for larger dimensions.
- .7 Manufacturer's label.
- .8 Where balanced backdraft damper (BBD) is indicated, damper shall incorporate adjustable counter balance weight and lever.
- .9 Maximum pressure drop across damper at 800 ft/m (4 m/s) shall be 0.18" w.g. (45 Pa).

2.4.2 Standard of Acceptance:

- .1 Airolite 625, Penn CBD-6.

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## 2.5 Balancing Dampers

2.5.1 Construction in accordance with SMACNA Duct Standards. PIN type balancing dampers are not permitted.

2.5.2 Minimum Requirements:

- .1 Rectangular ducts:
  - .1 Up to 12" (300 mm) deep - single blade (butterfly type).
  - .2 13" (325 mm) to 16" (400 mm) deep - two opposed blades, mechanically interlocked with pivots at quarter points.
  - .3 17" (425 mm) deep and over - multiple opposed blades, mechanically interlocked with blades not greater than 8" (200 mm) deep and pivots equally spaced.
- .2 Round Ducts:
  - .1 Single Blade (butterfly type).
- .3 Material:
  - .1 Minimum 16 ga (1.61 mm) thick galvanized steel blades on butterfly dampers.
  - .2 Minimum 16 ga (1.61 mm) thick galvanized steel blades on multi-blade dampers with rigidly constructed galvanized steel frame (no frame required on single blade dampers).
  - .3 Minimum 18 ga (1.27 mm) thick stainless steel blades for fume exhaust ducts.
- .4 Bearings:
  - .1 End bearings on low pressure single blade dampers above 12" (300 mm) diameter.
  - .2 Bearings on multiple blade dampers shall be bronze iolite type.
- .5 Operating Mechanism:
  - .1 Lockable quadrant type with end bearing on accessible rectangular ducts up to 16" (400 mm) deep and on accessible round ducts.
  - .2 Wide pitch screw mechanism type with crank operator on accessible rectangular ducts 17" (425 mm) and over in depth and on inaccessible rectangular and round ducts.
  - .3 Override limiting stops.
  - .4 No blade movement in set position.
- .6 Concealed Regulators:
  - .1 For drywall ceilings with no access panels, provide concealed balancing damper regulators embedded in

finished ceiling, mounted behind grilles, on or inside plenum slot diffusers and various other types of diffusers. Concealed damper regulator to be connected to balancing damper by means of flexible Bowden cable and installed flush with ceiling. Cover plate held in place with 2 screws and easily removed for damper adjustment. Concealed damper regulator similar to Young Regulator Co. Model No. 270-301. Provide necessary hardware, including Young Regulator balance damper model 5020-CC, Bowden cable and Young Regulator Model 030-12 wrench.

- .2 Drawing designation: D (CR).

## **2.6 Duct and Plenum Access**

### **2.6.1 Dimensions:**

#### **.1 Doors:**

- .1 20" (500 mm) wide x 54" (1,300 mm) high.
- .2 Head of door 70" (1,750 mm) above floor.

#### **.2 Panels:**

- .1 15" (375 mm) x 20" (500 mm).
- .2 Where far corners of the duct are closer than 20" (500 mm) and equipment within duct is closer than 12" (300 mm) size may be reduced to 16" (400 mm) x 12" (300 mm) or 18" (450 mm) x 10" (250 mm) elliptical.
- .3 Where space will not permit above dimensions they should be matched as closely as possible and additional access provided as required.

### **2.6.2 Products:**

- .1 Doors - construct in accordance with SMACNA Duct Standards Figure 6-12 except for latch type. 1½" (40mm) thick insulation.
- .2 Panels - Nailor Hart, Ventlok, 1" (25 mm) thick insulation.
- .3 Gaskets - neoprene or foam rubber.

### **2.6.3 Hardware:**

- .1 Panels up to 16" (400 mm) x 12" (300 mm) - 2 sash locks.
- .2 Panels – 15" (375 mm) x 20" (500 mm) - 4 sash locks.
- .3 Doors - piano hinge and Ventlok 310 latches complete with front and inside handles and front door pull.

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## 2.7 Duct Connectors – Thermal Breaks

- 2.7.1 Provide flexible duct connections to provide thermal breaks in sheet metal ducts and plenums passing through or terminating at exterior of building. Install inside building.
- 2.7.2 Minimum Requirements:
- .1 Pre-assembled 3" (80 mm) long thermal barrier with 3" (80 mm) long, 24 ga (0.70 mm) galvanized steel duct connectors on each side of thermal break.
  - .2 Thermal break - heavy fibreglass fabric with elastomer coating.
- 2.7.3 Standard of Acceptance:
- .1 Duro Dyne "Durolon," Ventfabrics "Ventlon."

## 2.8 Duct Connectors – Vibration Isolation

- 2.8.1 Provide flexible duct connections to provide vibration isolation at duct and plenum connections to fan and air handling units. See Figure 2-19 SMACNA Duct Standards.
- 2.8.2 Minimum Requirements:
- .1 Pre-assembled 3" (80 mm) minimum long flexible connection with 3" (80 mm) long 24 ga (0.70 mm) galvanized steel duct connectors on each side of flexible connection. Flexible connector - fibre glass fabric with elastomer coating.
- 2.8.3 Centrifugal fans with 36" (900 mm) diameter and larger fan wheels, use 6" (150 mm) long flexible connection.
- 2.8.4 Do not install connectors on perchloric acid fume exhaust systems.
- 2.8.5 Standard of Acceptance:
- .1 Duro Dyne "Durolon," Dynair "Hypalon," Ventfabrics "Ventlon".

## 2.9 Ductwork – Flexible – Plain

- 2.9.1 Provide factory fabricated plain, flexible air ductwork for the following applications:
- .1 Connections to air terminals.
  - .2 Connections to downstream side of mixing boxes/air valves.
  - .3 Connections to round fire dampers (up to 12" (300 mm) diameter) min. 10" (250 mm) long to a maximum of 14" (350 mm) long. To act as fire damper access section.
- 2.9.2 Minimum Requirements:
- .1 Non-corrosive spirals wire reinforcing flexible vinyl coated fibreglass cloth membrane.
  - .2 Suitable for up to 10" w.g. (2,500 Pa) positive static pressure and 1" w.g. (250 Pa) negative static pressure.

- .3 UL or ULC labelled, Class 1, duct connector.
- .4 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.9.3 Standard of Acceptance:

- .1 Flexmaster FAB4, Thermaflex SLP10, ATPC UPC#017 Class 'O'.

**2.10 Ductwork – Flexible – Insulated**

2.10.1 Provide factory fabricated insulated flexible ductwork for the following application:

- .1 Connections to downstream side of variable volume and consistent volume mixing boxes, where indicated.
- .2 Connections to air terminals where indicated.

2.10.2 Minimum Requirements:

- .1 Flexible vinyl coated steel helix bonded to inner duct liner. Fibrous glass thermal insulation.
- .2 Outer jacket of metalized fire-resistant vapour barrier.
- .3 Suitable for up to 2" w.g. (500 Pa) positive static pressure and/or 1" w.g. (250 Pa) negative static pressure.
- .4 UL or ULC labelled, Class 1, duct connector.
- .5 Acoustically rated.

2.10.3 Standard of Acceptance:

- .1 Gladd-Flex ABL-181, Thermaflex M-KE, Wiremold WK, ATCO UPC #070.

**2.11 Ductwork and Plenum Sealers**

2.11.1 Provide water-based duct sealing compounds for use in fabrication of ductwork and plenum joints.

2.11.2 Low Pressure Systems - SMACNA Seal Classification B. Medium and High Pressure Systems - SMACNA Seal Classification A.

2.11.3 Standard of Acceptance:

- .1 Foster 32-19, Hardcast Versa Grip, Hardcast Foil Grip 1402, Robson's Duct Seal-WB, United Duct Sealer, Trans Continental Multi-Purpose.

2.11.4 Where accessible, apply sealer to inside of joints on ducts and plenums under positive pressure - e.g. discharge side of fans.

2.11.5 Apply sealer to outside of joints on ducts and plenums under negative pressure - e.g. suction side of fans.

**2.12 Fire Dampers**

2.12.1 Minimum Requirements:



- .1 Fire dampers shall be ULC or Warnock Hersey tested and shall bear testing agency's label.
- .2 Fire dampers shall meet requirements of National Building Code and authorities having jurisdiction.
- .3 Fire dampers shall be "dynamic," rated to close under airflow, where the air system runs during a fire alarm condition.
- .4 Fire dampers may be static type in applications where there is no airflow/air system is off in a fire alarm condition.
- .5 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire separation.
- .6 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type in horizontal position with vertical airflow.
- .7 Fire dampers in low-pressure ductwork may be multi blade or curtain type.
- .8 Fire dampers in medium and high pressure ductwork shall be curtain type.
- .9 Curtain fire dampers shall be blades retained in recess so free area of connecting ductwork is not reduced.
- .10 Fusible Links: ULC approved with melting point of 165°F (74°C) on supply, return and exhaust air systems. Use fusible links with melting point of 286°F (141°C) on return and exhaust air systems if used for smoke venting.
- .11 Standard of Acceptance
  - .1 Static Type – Price FD, Type A, B, or C as required, Nailor, Controlled Air.
  - .2 Dynamic Type – Price FDD, Type A, B, or C as required, Nailor, Controlled Air.
- .12 Fire damper access panel/door in rigid ductwork shall be equal to Nailor 0800 type, with acoustic insulation of duct is lined, without insulation if duct is unlined.
- .13 The following air systems shall be equipped with static or dynamic fire dampers as noted:

Air System	Service	Static Type	Dynamic Type
AHU-xx			
AHU-yy			
AHU-zz			

## 2.13 Fire/Smoke Combination Dampers

### 2.13.1 Minimum Requirements:

- .1 Smoke dampers to be labelled to ULC Standard CAN/ULC S112.1-M90 and UL 555S.
- .2 Pivoted blade type.
- .3 Auxiliary operating shaft.
- .4 Galvanized steel frames, blades, gussets and blade stops.
- .5 Stainless steel jamb seals.
- .6 Silicone rubber blade seals.
- .7 Factory assembled caulked sleeve to required length (Contractor to advise).
- .8 ULC approved fusible links with melting point of 165°F (74°C) on supply, return and exhaust air systems. Use fusible links with melting point of 286°F (141°C) on return and exhaust air systems if used for smoke venting.
- .9 For dampers less than 2.7 ft<sup>2</sup> (0.25 m<sup>2</sup>) damper size shall be same size as duct size measured inside damper frame. Enlarge ducts to accommodate damper frames.
- .10 Smoke dampers shall be equipped with two CSA approved end switches linked directly to damper blade. End switches shall provide positive status indication of full open and full closed blade position. Mount switches in self-contained enclosure and wired outside of duct.
- .11 Actuators for smoke dampers shall be supplied with smoke dampers as single entity which meets applicable UL555 and UL 555s qualification for both dampers and actuators. Actuators shall be rated for 350°F (177°C) elevated temperature classification. Actuators shall be mounted so supply duct smoke damper fails to closed position and return/exhaust dampers fail to open position.
- .12 Actuators (unless otherwise noted) shall be 120/1/60. Coordinate with Electrical.

2.13.2 Standard of Acceptance:

- .1 Leakage Class II, Ruskin FSD-36, Price.

2.13.3 Standard of Acceptance:

- .1 Leakage Class I, Ruskin FSD-60, Price.

**2.14 Fire Dampers – Ceiling**

2.14.1 Minimum Requirements:

- .1 ULC tested and labelled.
- .2 Spring loaded heat retardant blanket or insulated damper blades.
- .3 165°F (74°C) fusible links.

- .4 Where diffuser/grille neck is smaller than diffuser/grille face area, provide UL listed CK 2000 thermal blanket over ceiling plenum side of exposed diffuser/grille.
- .5 Install above each diffuser/grill mounted in fire rated ceiling.
- .6 Provide transition plates (round to rectangular).

2.14.2 Standard of Acceptance:

- .1 Price, Ruskin CFSR, Nailor Hart.

**2.15 Fire Dampers – Combination Register Damper**

2.15.1 Minimum Requirements:

- .1 Warnock- Hersey tested and labelled.
- .2 Combined opposed blade damper with spring tensioned fusible link.
- .3 Fasten to 10 ga (3.51 mm) thick steel sleeve, welded with integral flange on register side.

2.15.2 Standard of Acceptance:

- .1 EH Price VCS-4, Tuttle & Bailey 90A.

**2.16 Fire Stop Flaps**

2.16.1 Minimum Requirements:

- .1 Single damper flap with spring catch.
- .2 ULC tested and labelled.
- .3 Construct of minimum 16 ga (1.61 mm) thick sheet steel with  $\frac{1}{16}$ " (<sub>16</sub>) thick on unexposed side and corrosion-resistance pins and hinges.
- .4 ULC approved fusible links with maximum melting point of 165°F (74°C).
- .5 Arranged not to reduce duct free area.

2.16.2 Standard of Acceptance:

- .1 Ruskin CFSF.

**2.17 Flow Measuring Devices - Air**

2.17.1 Flow Measuring Station:

- .1 16 ga (1.61 mm) thick galvanized steel casing with duct connecting flanges.
- .2 Aluminum honeycomb air straightening cell.
- .3 Total pressure sensors and static pressure sensors interconnected by copper manifolds.
- .4 Total and static pressure external ports with fittings for connecting to flow meter or control system.
- .5 Identification label listing unit size, design air quantity and direction of air flow.

- .6 Capable of 0-5000 fpm range, 2% of reading sensor airflow accuracy, complete with transmitter configuration to match DDC Controls connection and measurement requirements.
  - .7 Accessories:
    - .1 Magnehelic differential pressure gauge scaled in air volume cfm (L/s).
  - .8 Standard of Acceptance:
    - .1 Air Monitor Fan E and DAMD, EBTRON Gold GTx116-P+, Ebton Elf for ducts less than 14" (350 mm) diameter.
- 2.17.2 Airflow Probe (Duct or Fan Inlet):
- .1 Aluminum construction.
  - .2 Multiple traverse probes.
  - .3 Traverse probe to contain multiple total and static pressure sensors located along exterior surface of probe and internally connected to respective averaging manifolds.
  - .4 Threaded end support rod and mounting plate with gasket and signal fittings.
  - .5 Fan inlet probes (two per inlet) with dual end support swivel brackets suitable for mounting in fan inlet bell.
  - .6 Capable of producing an output signal linear and scaled to air volume (4-20 mADC, 0-10 VDC, 0-5VDC).
  - .7 Capable of local digital display of continuous indication of air volume.
  - .8 Standard of Acceptance:
    - .1 Air monitor VOLU-probe/7200AZ (Duct).
    - .2 Air monitor VOLU-probe/7200AZ (Fan Inlet).

## 2.18 **Implosion/Explosion Doors**

- 2.18.1 Doors shall be in accordance with WCB Regulations, constructed as per hinged access doors.
- 2.18.2 Latches shall be Brixon Safety Latches (Brixon Manufacturing Co., 859 North Prior Avenue, St. Paul, Minnesota, 55104).
- 2.18.3 Latches shall be complete with handles and have adjustable release force as follows:

Latch Model	Release Force Range
2H	5 lb (2.3 kg) to 33 lb (15 kg)
3H	20 lb (9.1 kg) to 180 lb (82 kg)
4H	44 lb (20 kg) to 260 lb (118 kg)

- 2.18.4 Refer to drawings for locations of implosion/explosion doors and required number of latches.
- 2.18.5 Provide heavy duty safety chains to limit door swings.

- 2.18.6 Adjust tensions on implosion/explosion door latches so door opens at static pressure differential not greater than 2" w.g. (500 Pa) above/below specified static pressure rating of duct or plenum.
- 2.18.7 Perform tension tests on doors to verify doors open at settings on latches.
- 2.18.8 Adjust tensions on latches and permanently mark final setting of adjustment screws.

## **2.19 Instrument Test Ports**

### **2.19.1 Application:**

- .1 Provide instrument test ports in each plenum access door (unless more than one door serves a plenum compartment).
- .2 Locate ports to permit easy reading of instruments.

### **2.19.2 Minimum Requirements:**

- .1 16 ga (1.61 mm) thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 1" (25 mm) minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.

### **2.19.3 Standard of Acceptance:**

- .1 Duro Dyne IP1 or IP2.

## **2.20 Anaesthetic Gas Scavenging Devices**

2.20.1 Nitrous oxide gas scavenging devices shall be provided as described below and shall be wall mounted where indicated on drawings and/or listed below.

2.20.2 Class 1 Anaesthetic Gas Scavenging devices complete with ¾" (20 mm) and 1¼" (32 mm) taper fitting for connection to standard anaesthetic gas disposal tubing. Device shall be suitable for connection to building exhaust system.

2.20.3 Outlet nameplate permanently colour coded in accordance with CSA Z305.1, and sealed behind protective Lexan cover.

2.20.4 Outlets to be single modular units designed for ganging of rough-in plates in field to form multiple units.

2.20.5 Chrome trim plate to provide automatic plaster adjustment from ½" (15 mm) to ⅞" (22 mm).

2.20.6 Outlet complete with ¾" (20 mm) OD Type L inlet supply tube which shall connect to building exhaust duct.

2.20.7 Standard of Acceptance: Tri-Tech Medical, Model M1133 recessed wall outlet.

2.20.8 Outlet Locations:

- .1 Maternal Care Program, LBRP rooms.
- .2 Bio-Medical Engineering.
- .3 Anaes Work Room.
- .4 Special Procedure Angio.

### 3 . **EXECUTION**

#### 3.1 **Biosafety Cabinets – Manual Valves**

- 3.1.1 Manual valve to be installed at exhaust connection to each biosafety cabinet.

#### 3.2 **Balancing Dampers**

- 3.2.1 Provide balancing dampers at points on low pressure supply, return and exhaust systems where branches are taken from larger duct as required for proper air balancing complete with 1" (25 mm) high stand-off bridges for operators to allow full, continuous duct insulation.
- 3.2.2 Provide balancing dampers at each run out to grille or diffuser.
- 3.2.3 Identify airflow direction and blade rotation and open and closed position
- 3.2.4 On round ductwork larger than 12" (300 mm) diameter and externally insulated rectangular ductwork, provide sheet metal bridge to raise quadrant type operator above insulation thickness (coordinate with Section 23 07 13). Provide open end bearing where bridges are used. Bridges on uninsulated round ducts shall be at least 1" (25 mm) high.
- 3.2.5 Where quadrant type operators are used, lever shall be arranged parallel with damper blade complete with 1" (25 mm) high stand-off bridge for operators to allow continuous duct insulation to be applied on the duct.

#### 3.3 **Backdraft Dampers**

- 3.3.1 Install backdraft dampers on exhaust and relief openings through building walls and roof on exhaust fans where control dampers are not called for or indicated.

#### 3.4 **Control Dampers – Automatic**

- 3.4.1 Packaged equipment specified to be complete with control dampers, shall include control dampers as normally supplied by equipment Manufacturer unless otherwise noted.
- 3.4.2 Other automatic control dampers are specified in Controls Sections.

- 3.4.3 Under this section be responsible for receipt, handling, storage and installation of control dampers supplied under Control or other Sections.
- 3.4.4 Indicated size of control dampers is dimension outside frame. Oversize ductwork to include depth of damper frame if pressure drop across damper exceeds 0.1" w.g. (25 Pa).
- 3.4.5 Control damper frames shall be fitted tightly into ductwork and sealed airtight.
- 3.4.6 Check that dampers are installed square and true. Ensure damper end linkages are easily accessible. Provide saw-cuts with black paint in the exposed ends of all damper shafts, aligned with damper blade for visual indication of damper blade position.
- 3.4.7 Do not install control dampers in thickness of wall unless otherwise indicated.

### **3.5 Duct and Plenum Access**

- 3.5.1 Locations: Provide access doors and panels as follows:
  - .1 Doors: Where indicated on drawings.
  - .2 Panels:
    - .1 Every 40'-0" (12.2 m) on ductwork.
    - .2 Base of each duct riser.
    - .3 Both side of equipment blocking duct e.g.
      - .1 Air flow measuring stations.
      - .2 Coils.
    - .4 At or to one side of other equipment in duct, e.g.
      - .1 Backdraft dampers (counter weight side).
      - .2 Balance dampers serving multiple outlets/inlets.
      - .3 Bearings (fans/motors).
      - .4 Control dampers.
      - .5 Control sensors.
      - .6 Fire dampers (rectangular ducts and round ducts 13" (325 mm) diameter and larger - latch side).
      - .7 Heat detectors (upstream from device).
      - .8 Smoke dampers (operator side).
      - .9 Smoke detectors (upstream from device).
    - .5 Panels need not be provided where access is available through door or register mounted to side of duct.
    - .6 Kitchen exhaust access requirement specified under "Ductwork - Kitchen - Exhaust."
  - .3 Patches:
    - .1 Where required for cleaning and where access panels are not specified e.g. on both sides of turning vanes.

- .4 Flexible duct - on round duct and round fire dampers up to 12" (300 mm) diameter.

- 3.5.2 Seal frames airtight.
- 3.5.3 Install to not interfere with airflow.
- 3.5.4 Install to provide access for service and cleaning.
- 3.5.5 Do not use sheet metal screws for attaching access panels to ductwork.
- 3.5.6 Round ducts 13" (325 mm) diameter and larger shall include a short collar for installation of access panels.
- 3.5.7 Small rectangular ducts shall be transitioned to minimum dimension across duct of 13" (325 mm) for installation of access panels.

### **3.6 Duct Connectors – Vibration Isolation**

- 3.6.1 Ensure flexible duct connectors do not reduce duct free area on suction side of fans.

### **3.7 Ductwork – Flexible**

- 3.7.1 Installed lengths shall be limited to 6 times duct diameter but not longer than 4'-0" (1.2 m).
- 3.7.2 Connect to ductwork and diffusers with stainless steel worm drive clamps or Panduit adjustable clamps or Thermaflex duct strap applied over two wraps of duct tape. Use stainless steel clamps on connections to fire dampers.
- 3.7.3 Minimum centreline radius of flexible ductwork bend shall be 1.5 time duct diameter, alternatively, sheet metal elbow may be used at branch takeoffs and boot diffuser connections.
- 3.7.4 Support with 1" (25 mm) x 22 ga (0.85 mm) galvanized steel straps at a maximum of 24" (600 mm). Straps shall completely encircle duct.
- 3.7.5 Support clear of ceiling assembly, light fixtures and hot surfaces.

### **3.8 Fire Dampers**

- 3.8.1 Install in accordance with the SMACNA Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems - Fourth Edition 1992. Demonstrate fire damper drop test for **all 50% 25% 10%** of fire dampers installed in this project.
- 3.8.2 Fire damper sleeves must not extend more than 3" (80 mm) from wall on each side.
- 3.8.3 Fire dampers shall be installed within wall thickness of fire separation.
- 3.8.4 Wall openings sized to allow sleeve/damper expansion.



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- 3.8.5 Arrange dampers so linkages and locking catches are accessible from access side of fire damper. Provide an access panel at all fire dampers, complete with red stencilled "F.D" label.
  - 3.8.6 Install to close in direction of normal airflow.
  - 3.8.7 Size so free area of duct is maintained through assembly. All fire dampers shall be Type B – Blades of airstream, unless specifically noted otherwise or as required for specific installation.
  - 3.8.8 Install in galvanized steel sleeve, retained in place with retaining angles on four sides at each face of wall.
  - 3.8.9 Connect ductwork to damper sleeves using break-away duct joints on faces.

**3.9 Flow Measure Devices – Air**

- 3.9.1 Install in accordance with Manufacturer's recommendations. Minimum distance from air turbulence - producing fittings, transitions etc. shall be maintained.
- 3.9.2 Mount air volume gauges at height for easy visual inspection and install interconnection piping.

**END OF SECTION**

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## 1. GENERAL

### 1.1 Related Work

1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

### 1.2 Quality Assurance

1.2.1 Product of Manufacturer who regularly engages in production of such units and issues complete catalogue data on products.

### 1.3 Submittals

1.3.1 Submit shop drawings detailing attenuator data specified in schedule.

1.3.2 Provide engineering certification of sound attenuator performance (insertion loss, pressure drop **and regenerated noise** under stated operation conditions) certified by Professional Engineer and supported by test results, if required by Consultant.

## 2. PRODUCTS

### 2.1 Sound Attenuators

2.1.1 Minimum Requirements:

- .1 Fabricate attenuators to SMACNA Standards, air-tight at twice operating pressure, with sufficient strength to withstand normal handling, transportation installation and operational stresses and consistent with ductwork in which attenuator will be installed. Split spot welds or sagging insulation will result in rejection of sound attenuator.
- .2 The attenuators shall be inorganic, incombustible, impart no odours to air, and shall not erode due to airflow over internal surfaces.
- .3 If internal velocity through sound attenuator may cause erosion of insulation, provide glass fibre cloth to protect insulation from erosion.
- .4 Provide label on attenuators with Manufacturer's name and flow direction.
- .5 Paint attenuator inside and out with anti-rust prime coat paint.
- .6 Construct attenuators located outdoors of 18 ga (1.31 mm) galvanized steel, 20 ga (0.95 mm) stainless steel perforated liner. Provide internal horizontal baffle supports for insulation at 24" (600 mm) intervals. Provide drainage to avoid pooling

of moisture in attenuator. If media is wrapped in plastic, provide galvanized check wire between perforation and plastic to separate plastic from perforation by  $\frac{1}{8}$ " (3 mm) minimum. Provide details of similar local installation including letter from Manufacturer of insulation that their product can be used in an outdoor environment without significant deterioration.

- .7 Attenuators (where scheduled) shall be lined with Alfa temp cloth or equivalent. Acoustic ratings with lining shall be equal to standard attenuator.
- .8 Attenuators for corrosive fume applications shall be packless type units constructed of 316 stainless steel.
- .9 Attenuators for air systems with HEPA or 95% NBS filters shall be packless type units.
- .10 Attenuators downstream of kitchen exhaust hoods shall be packless type constructed of 304 stainless steel to suit duct system. Arrange baffles to avoid accumulations. Provide drain connections for cleaning.

2.1.2 Acceptable Products:

- .1 IAC, Vibron, Karfund, Vibro Acoustics, VAW Systems.

**2.2 Sound Attenuators (Packless)**

2.2.1 Minimum Requirements:

- .1 Submit certification with shop drawings that silencers can be used in typical fume hood corrosive applications, including systems exhausting radioactive isotopes.
- .2 Fabricate attenuators to SMACNA standards, air-tight at twice the operating installation and operational stresses. Non-continuous or rough welds will result in rejection of a sound attenuator.
- .3 The sound attenuators shall be **304 galvanized** steel with no cavities or insulation, which may trap or retain particles from the fume exhaust gases.
- .4 Measure sound attenuator performance, both aerodynamic and acoustical, by an approved laboratory. Supply details of testing methods used, if requested. Provide engineering certification of sound attenuator performance (insertion loss, pressure drop, and regenerated noise under stated operation conditions), if requested.
- .5 Provide labels on attenuators with Manufacturers name and flow direction.

2.2.2 Acceptable Products:

- .1 IAC, Vibron, Korfund, Vibro Acoustics, XAW. E. H. Price, VAW Systems.

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**3 . EXECUTION**

**3.1 Sound Attenuators**

- 3.1.1 Inspect attenuators arriving on site to ensure they meet specified requirements. Report deficiencies to Manufacturer and Consultant.
- 3.1.2 Install attenuators in accordance with Manufacturer's instructions.

**END OF SECTION**

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## 1. **GENERAL**

### 1.1 **Related Work**

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

### 1.2 **Quality Assurance**

- 1.2.1 Catalogued or published ratings shall be from tests carried out by Manufacturer or from independent testing agency signifying adherence to codes and standards.

### 1.3 **Submittals**

- 1.3.1 Fan shop drawings shall include sound rating data and fan curves showing operating point plotted on curves.
- 1.3.2 Fan shop drawings shall include motor efficiencies. Refer to Section 23 05 13 for minimum motor efficiencies.

### 1.4 **General**

- 1.4.1 Motors powered by variable speed drive controllers shall be EEMAC class B with Type F 'inverter duty' insulation, shall have 1.15 service factor on sine wave power, 1.0 service factor on PWM power and meet NEMA Code MG-1, 1993 Part 31.
- 1.4.2 Provide ECM DC motors complete with manual speed dial and 0-10V DC controls signal terminal for variable speed control. See Section 23 05 13 for ECM motor requirements.

## 2. **PRODUCTS**

### 2.1 **Air Curtain Units**

- 2.1.1 Base frame of 16 ga (1.61 mm) thick steel.
- 2.1.2 2-speed direct driven double inlet forward curved fans.
- 2.1.3 Fans balanced and rubber isolated.
- 2.1.4 Aluminum cover housing with inlet grille.
- 2.1.5 **Hot water** heating coil where scheduled.
- 2.1.6 Discharge grille with adjustable vanes integral with the unit or remote mounted in the ceiling. Provide duct extension for ceiling mounted units.
- 2.1.7 High-off-low fan switch integral with unit suitable for remote mounting.

- 2.1.8 Sound level 10'-0" (3.0 m) in front of the unit in free field shall not exceed 59 dBA on high speed and 54 dBA on low speed.
- 2.1.9 Unit shall be ULC listed and shall bear AMCA certified ratings seal.

## **2.2 Fans – General**

- 2.2.1 Provide fans selected for maximum efficiency and generating noise levels on site not exceeding levels indicated. If fans are not specified at maximum efficiency, advise mechanical Consultant before tendering and submit alternate price for maximum efficiency fans. If approval to supply noisier fans is not obtained prior to tendering, provide equipment meeting ASHRAE levels on site without loss in efficiency.
- 2.2.2 Submit fan sound power levels with shop drawings measured to applicable AMCA standards, or other data acceptable to Engineer. Provide test data, if requested. Indicate on shop drawings test configuration, including ductwork, and end reflection corrections applied to data and/or if such corrections have been omitted.
- 2.2.3 Fans: statically and dynamically balanced, constructed in conformity with AMCA-99-83. Dynamically balance fans to  $\frac{1}{16}$ " per second (1.5 mm/s) vibration amplitude, maximum measured on bearing housings. Provide fan shafts with critical speed at least 1.5 times operational speed.
- 2.2.4 Ratings: based on tests performed in accordance with AMCA 210, and ASHRAE 51-85. Unit shall bear AMCA certified rating seal.
- 2.2.5 Refer to drawings for motor position, rotation and discharge arrangements.
- 2.2.6 For motors less than 10 hp (7.5 KW) provide standard adjustable pitch drive sheaves +/- 10% range. Use mid-position of range for specified rpm (r/min).
- 2.2.7 For motors 10 hp (7.5 KW) and larger, provide fixed pitch drive sheaves with split tapered bushing and keyway. Provide final drive sheaves of size to suit final balancing.
- 2.2.8 Match drive and driven sheaves.
- 2.2.9 V-belts shall conform with American Belt Manufacturers standards. Multiple belts shall be matched sets.
- 2.2.10 Minimum drive rating shall be 150% of nameplate rating of motor.
- 2.2.11 Not less than 2-belt configuration required for motors  $\frac{3}{4}$  hp (0.56 KW) and larger.
- 2.2.12 Provide osha style belt guard with tachometer ports for belt drive fans.
- 2.2.13 Where fans are used for smoke exhaust, motor, bearings, operators, etc. shall be capable of three hours of operation at 482°F (250°C).

- 2.2.14 Bearings shall have minimum L-10 life of 100,000 hours based on maximum safe speed of fan class.
- 2.2.15 Where required, fans shall be treated to suit airstream in which they are used.
- 2.2.16 Provide secure attachment points for seismic restraints. Mounting brackets shall be suitable for seismic loading.

**2.3 Fans – Motors and Variable Speed Drives**

- 2.3.1 Fans with motors up to ½ hp (0.37 KW) shall be of a type suitable for variable speed control from a rheostat style controller. Use permanent split capacitor (PSC) motors or other suitable type.
- 2.3.2 Provide motors and variable frequency drive/motor assemblies generating noise levels which are imperceptible in occupied space, and outside building, relative to fan noise. Provide acoustical data confirming required performance prior to tendering. If approval is not obtained prior to tendering, provide equipment meeting specified imperceptible requirement without loss in efficiency.

**2.4 Fans – Axial (Constant Volume)**

2.4.1 Minimum Requirements:

- .1 Steel tubular casing, long type, with flanged ends and stationary guide vanes where scheduled.
- .2 Mounting feet.
- .3 Aluminum airfoil blade impeller with adjustable pitch angle.
- .4 Rotating parts factory statically and dynamically balanced.
- .5 Totally enclosed motor, direct drive.
- .6 Casing with externally mounted junction box.
- .7 Galvanized or prime and factory enamel coating over interior of casing, including steel accessories. Galvanized or prime coating over exterior parts of casing and steel components.
- .8 Provide extended lubricator for fan bearings ¾" (20 mm) diameter and larger.
- .9 Acceptable Products: Chicago, Penn/Barry, Joy, Woods.

2.4.2 Accessories:

- .1 Inlet bell and screen where scheduled or when not directly connected to ductwork on inlet side.
- .2 Inlet and outlet cones where scheduled and/or indicated on drawings.
- .3 Matching flanges.
- .4 Fans to be supplied adjusted for duty schedule.
- .5 Acoustic centre pod (where specified) in discharge cone shall be constructed from 23% open area perforated

galvanized steel packed with inorganic fibre under compression. Dimensions of pod as follows: length of pod to match length of discharge cone (with extension, if applicable, to reach downstream side of fan motor), diameter to match diameter of fan motor.

## **2.5 Fans – Axial (Variable Pitch in Motion)**

### **2.5.1 Minimum Requirements:**

- .1 Steel tubular casing, long type, with flanged ends and stationary guide vanes.
- .2 Aluminum airfoil blade impeller with controllable pitch mechanism.
- .3 Rotating parts factory statically and dynamically balanced.
- .4 Pneumatic actuator.
- .5 Totally enclosed motor, direct drive.
- .6 Casing with externally mounted junction box and external grease nipples.
- .7 Galvanized or prime and factory enamel coating over interior of casing, including steel accessories. Galvanized or prime coating over exterior parts of casing and steel components.
- .8 Acceptable Products: Chicago, Barry, Joy, Woods.

### **2.5.2 Accessories:**

- .1 Acoustic centre pod (where specified) in discharge cone shall be constructed from 23% open area perforated galvanized steel packed with inorganic fibre under compression. Dimensions of pod as follows: length of pod to match length of discharge cone (with extension, if applicable, to reach downstream side of fan motor), diameter to match diameter of fan motor.
- .2 Inlet and outlet cones where scheduled and/or shown on drawings.
- .3 Inlet bell and screen where scheduled.
- .4 Matching flanges

## **2.6 Fans – Cabinet**

- 2.6.1 Steel cabinet arranged for ducted inlet and outlet connections complete with duct collars (where shown) or ceiling exhaust opening complete with exhaust grille (where shown).
- 2.6.2 Acoustically insulated cabinet.
- 2.6.3 Centrifugal fan on rubber isolators.
- 2.6.4 Backdraft damper.
- 2.6.5 Access panel.



- 2.6.6 Integral motor thermal overload protection.
- 2.6.7 Motor disconnect plug and integral receptacle.
- 2.6.8 Solid state speed control – where scheduled.
- 2.6.9 Acceptable Products: Broan, Delta Breez, Nutone, Reversomatic, Penn/Barry, Panasonic, Air King, Lexton.

**2.7 Fans – Ceiling Exhaust**

- 2.7.1 Centrifugal blower, motor vibration isolated.
- 2.7.2 Built-in backdraft damper.
- 2.7.3 White plastic exhaust grille.
- 2.7.4 Adjustable hanger bracket.
- 2.7.5 Pre-wired outlet box, plug-in receptacle.
- 2.7.6 Solid state speed control – where scheduled.
- 2.7.7 Acceptable Products: Broan, Delta Breez, Nutone, Reversomatic, Penn/Barry, Panasonic, Air King, Lexton.

**2.8 Fans – Ceiling Ventilators**

- 2.8.1 Large diameter propeller blades, metal construction.
- 2.8.2 Baked enamel white finish.
- 2.8.3 Totally enclosed, permanently lubricated ball-bearing motors.
- 2.8.4 Arrange for downward blowing.
- 2.8.5 Manual, infinitely variable on/off speed control switch **one control for each fan.**
- 2.8.6 “Down-rod” suitable for suspension height.
- 2.8.7 Sound state speed control switch(es) where scheduled.
- 2.8.8 Acceptable Products: Banvil, Canarm, Wilcorp.

**2.9 Fans – Centrifugal**

- 2.9.1 Welded steel fan wheel with air foil **backward inclined** blades, unless otherwise specified.
- 2.9.2 Bearings: Heavy-duty pillow-block grease lubricated ball or roller self-aligning type.
- 2.9.3 Gasketed scroll access panel, secured with quick release fasteners.
- 2.9.4 ¾” (20 mm) scroll drain and brass plug.
- 2.9.5 Enamel painted steel fan wheels and inside scrolls.
- 2.9.6 Prime coat painted outside scroll including supports and steel accessories.
- 2.9.7 Rust preventative coating on fan shafts.

- 2.9.8 Drip proof motor.
- 2.9.9 On single inlet fans provide extended lubricators on inlet side bearings.
- 2.9.10 Belt drives.
- 2.9.11 Belt guards complete with tachometer holes.
- 2.9.12 Coupling guards.
- 2.9.13 Fan inlet safety screens.
- 2.9.14 Steel frame base and motor slide rails.
- 2.9.15 Acceptable Products: Penn/Barry, Twin-City, Chicago, Greenheck, Loren-Cook.

**2.10 Fans – Centrifugal (Plenum)**

- 2.10.1 Welded steel fan wheel with airfoil **backward inclined** blades, unless otherwise specified.
- 2.10.2 Bearings: Heavy-duty pillow-block grease lubricated ball or roller self-aligning type.
- 2.10.3 Gasketed scroll access panel, secured with quick release fasteners.
- 2.10.4 ¾" (20 mm) scroll drain and brass plug.
- 2.10.5 Enamel painted steel fan wheels.
- 2.10.6 Rust preventative coating on fan shafts.
- 2.10.7 Drip proof motor.
- 2.10.8 Fan assembly fully enclosed with expanded mesh screen, approved to WCB Standards.
- 2.10.9 Direct drive fans shall be designed specifically for the duty and allow for easy motor replacement. Provide heavy-duty mechanical coupling and bearings for arrangement 8 where called for.
- 2.10.10 Belt drives with belt guard's c/w tachometer holes.
- 2.10.11 Coupling guards.
- 2.10.12 Fan inlet safety screens.
- 2.10.13 Steel frame base and motor slide rails.
- 2.10.14 Acceptable Products: Penn/Barry, Twin-city, Chicago, Greenheck, Loren-Cook

**2.11 Fans – Mixed Flow In-Line**

- 2.11.1 Mixed flow In-Line fan, arrangement as scheduled.
- 2.11.2 Steel tubular casing with inlet and outlet collars for slip fit duct connections.
- 2.11.3 Welded steel stationary guide vanes.

- 2.11.4 Access door to provide cleaning and service access.
- 2.11.5 Rotating parts statically and dynamically balanced at factory.
- 2.11.6 Drip-proof motor, belt driven with adjustable motor base.
- 2.11.7 Heavy duty pillow block ball bearings. Extended lubricators.
- 2.11.8 Field rotatable housing.
- 2.11.9 Belt guard.
- 2.11.10 Acceptable Products: Fantech, Kanaflakt, Greenheck, Loren-Cook.

**2.12 Fans – Tubular In-Line Centrifugal**

- 2.12.1 Tubular In-Line centrifugal fan, arrangement as scheduled.
- 2.12.2 Steel tubular casing with flanged ends and stationary guide vanes with corrosion resistant finish.
- 2.12.3 Access door to provide cleaning and service access.
- 2.12.4 Non-overloading airfoil wheel.
- 2.12.5 Rotating parts factory statically and dynamically balanced.
- 2.12.6 Drip-proof motor, belt driven.
- 2.12.7 Heavy duty pillow block ball bearings. Extended lubricators.
- 2.12.8 Companion flanges; Ceiling brackets; Belt guard.
- 2.12.9 Acceptable Products: Greenheck, Loren-Cook, Penn/Barry, Twin-City.

**2.13 Fans – Mixed flow Induced Dilution Exhaust**

- 2.13.1 Submittals:
  - .1 Fan Manufacturer shall furnish certificate of guarantee stating fan, mixing plenum, outlet nozzle, stack extension if any, and related accessories specified have been pre-tested at factory and curves supplied with shop drawings have been de-rated for system effects created by accessories.
- 2.13.2 Minimum Requirements:
  - .1 Impellers shall be mounted directly to motor shaft to provide direct drive, arrangement 4 type fan. Motors shall be isolated from primary exhaust air stream and shall be visible and accessible from fan exterior for inspection and service.
  - .2 Mixed flow impellers shall consist of combination axial/backward curved blades and shall be of welded steel construction. Impellers shall have non-stall and non-overloading performance characteristics with stable operation anywhere on fan curves.
  - .3 Stationary discharge guide vane sections shall be provided to increase fan efficiencies.

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- .4 Fan dynamic balance not to exceed 0.5 mil, peak to peak, at blade pass area when operating at fan frequency. Vibration isolation shall be limited to rubber-in-shear pad type isolators.
  - .5 Fan assemblies shall be designed for mounting on conventional roof curb without need for guy wire supports.
  - .6 Discharges shall include twin FRP nozzles with passive third central stacks that are capable of generating aspiration. FRP shall be chemically and UV resistant.
  - .7 Steel entrainment windbands shall provide secondary induction of outside air. Induction shall take place downstream of fan impeller and shall not influence BHP or static pressure requirements. Windbands shall discharge up to 270% of design flow rates. Manufacturers shall publish discharge volumes for fans at specified primary exhaust flow.
  - .8 Non-ferrous inlet bell shall be provided to reduce sparking in event of motor bearing failure.
  - .9 Fans shall be modular construction and capable of being assembled on roof.
  - .10 PTFE gaskets shall be provided at companion flanged joints.
  - .11 Fasteners shall be 316 stainless steel.
  - .12 Bolted access door shall be provided for impeller inspection on each fan.
  - .13 Fans and accessories shall have internal drain systems to prevent rain water from entering building duct system.
  - .14 Electric motors shall be TEFC Mill & Chemical duty with 1.15 service factor and L-50 bearing life of 200,000 hours. Motors shall have sealed bearings up through 256T NEMA frame. Motors on BS-1 and larger fans shall be C-Face and foot mounted. Motors shall comply with efficiencies listed in ASHRAE 90.1.
  - .15 NEMA 3R non-fused disconnect switch shall be provided, mounted and wired to motor.
  - .16 Coatings-All steel and aluminum surfaces shall be prepared for coating by blasting or chemical etching. Coating shall be Epoxy (8-10 mils) for protection against weather, chemical vapours and splashes.

**2.13.3 Accessories:**

- .1 Inlet mixing plenums shall be provided by fan Manufacturer. Each plenum shall be sized to support weight and performance requirement of number of fans listed on schedule. Multiple fan plenums shall be insulated double wall construction with structural stiffeners or shall be

continuously welded, heavy gauge single wall construction. For single thickness plenums, coatings shall be same as specified for fans. Plenums shall be capable of supporting fan(s) without guy wires or supports. Plenums shall include hinged access doors and safety screens over primary air inlets. Primary air inlets shall be located on bottom or side as indicated on drawings. Unless otherwise specified, plenums shall be suitable for mounting on roof curbs.

- .2 Stainless safety screens shall be supplied over bottom primary air inlets.
- .3 Bypass dampers shall be provided with mixing plenums for outside air with primary exhaust. Dampers shall be opposed blade low leakage air foil control dampers with extended shaft for connection to operator. Dampers shall be aluminum construction. Rain hoods shall be provided with each damper.
- .4 Low leakage isolation dampers shall be constructed of aluminum air foil extrusions and coated with epoxy. Operators shall be 2 position, spring return and shall be 24 V or 110 V electric. Electric operator shall be factory wired (via a transformer when required) to fan disconnect switch to open when fan is energized and close via spring return when de-energized. When fan ships separate from plenum, wiring and conduit shall be factory supplied for easy connection in field.
- .5 Vortex breakers shall be provided on side inlet and multiple fan plenums.
- .6 Units shall be provided with attenuators.
  - .1 Outer shell of sound attenuator to be constructed of fibre reinforced plastic with minimum  $\frac{3}{16}$ " (4.5 mm) wall thickness.
  - .2 Attenuator to be packed with sound attenuating fibreglass. Acoustical media to be isolated from air stream by tedlar lining.
  - .3 Air passageway of attenuator to be lined with perforated metal.
  - .4 Attenuator must not increase height of fan unit. Acoustic screening may not be used.
  - .5 Attenuator must meet the following dynamic insertion losses as tested with fan unit:

Fan Size	63Hz	125Hz	250Hz	599Hz	1000Hz	2000Hz	4000Hz	8000Hz
TS-2	0	4	9	11	12	13	9	4
TS-3	8	7	12	15	15	13	10	6

Fan Size	63Hz	125Hz	250Hz	599Hz	1000Hz	2000Hz	4000Hz	8000Hz
TS-4	5	8	9	11	12	12	10	6

.6 Access to motor junction box of fan unit cannot be blocked by sound attenuator.

.7 Fan performance curves must include performance losses due to addition of sound attenuator per factory-tested data.

.7 14 ga (1.99 mm) galvanized steel seismic roof curb shall be provided with units to support fans/plenums. Curb shall be canted for rigidity in wind loads. Curb shall be 14" (350 mm) high. Curb shall include rigid fibreglass liner and wood nailer. Roof curbs shall be seismically secured to roof. When flashed to mounting curb it shall provide weatherproof whole.

2.13.4 Standard of Acceptance: Strobic Air – Tri-Stack

## 2.14 **Fans-In-Line Centrifugal**

2.14.1 In-line centrifugal fan with axial flow construction.

2.14.2 Square housing, steel with galvanized finish.

2.14.3 Access panel to provide cleaning and service access.

2.14.4 Backward inclined, non-overloading wheel.

2.14.5 Drip-proof motor.

2.14.6 Permanently lubricated pillow block ball bearings.

2.14.7 Rust preventative coating on shafts.

2.14.8 Belt or direct driven as scheduled.

2.14.9 Belt guard, motor cover, where externally belt driven.

2.14.10 Plug-in electrical disconnect switch, mounted on the outside of the fan housing.

2.14.11 Insulated housing lining.

2.14.12 Solid state speed controller where scheduled.

2.14.13 Acceptable Products: Greenheck, Loren-Cook, Delhi, Lau.

## 2.15 **Fans – Utility**

2.15.1 Steel wheel and reinforced scroll on integral supports.

2.15.2 Gasketed scroll access panel, secured with quick release fasteners.

2.15.3 ¾" (20 mm) scroll drain and brass plug.

2.15.4 Rust preventative coating on shaft.

2.15.5 Enamel painted fan wheels and scrolls.

2.15.6 Weatherproof enamelled cover for motor drive.

2.15.7 Belt driven sets with adjustable motor bed plate and variable pitch drive sheave.

2.15.8 Acceptable Products: Greenheck, Loren-Cook, Delhi, Lau.

**2.16 Fans – Propeller**

2.16.1 Formed steel or aluminum propeller blades.

2.16.2 Spun steel venture.

2.16.3 Grease lubricated ball bearings suitable for operating in any position.

2.16.4 Belt driven with adjustable drive sheave and belt guard or direct driven as scheduled.

2.16.5 Motor mounting brackets.

2.16.6 Totally enclosed motor.

2.16.7 Fan guard as scheduled.

2.16.8 Automatic backdraft dampers with gasketed edges as scheduled.

2.16.9 Acceptable Products: Greenheck, Loren-Cook.

**2.17 Fans – Roof Supply**

2.17.1 Centrifugal non-overloading wheel.

2.17.2 Belt or direct drive as scheduled.

2.17.3 Removable roof cap.

2.17.4 Louvered side panels.

2.17.5 Removable filters.

2.17.6 Integral base suitable for mounting on roof curb.

2.17.7 Vibration isolators.

2.17.8 Head mounted disconnect switch.

2.17.9 Roof curb.

2.17.10 Acceptable Products: Penn/Barry, Delhi, Lau, Greenheck, Loren-Cook, Muffan.

**2.18 Fans – Window/Wall**

2.18.1 Acceptable Products: Xpelair, Vent-Axia, Reversomatic.

2.18.2 Window Type:

- .1 Plastic casing and plastic outlet grille.
- .2 Plastic inlet electrically (or manual cord) operated shutters.
- .3 Two speed controller and starter with pilot light.

2.18.3 Wall Type:

- .1 Plastic wall box and outlet grille.
- .2 Plastic wall duct with fan.

- .3 Interior panel with electrically operated shutter.
- .4 Two speed controller and starter with pilot light.

## **2.19 Gauges – Air Pressure**

### **2.19.1 Ranges:**

- .1 Supply fans: 0 - 6" w.g. (1,500 Pa).
- .2 Return/exhaust fans: 0 - 2" w.g. (500 Pa).

### **2.19.2 Standard of Acceptance:**

- .1 Dwyer Series 2000.

## **3 . EXECUTION**

### **3.1 Air Curtains**

- 3.1.1 Air curtain units to be mounted as indicated on drawings (exposed above door or concealed above ceilings). On ceiling located units, install discharge grille supplied with unit in ceiling and connect to unit with duct extension.

### **3.2 Fans**

- 3.2.1 Install fans as indicated, complete with vibration isolators and seismic restraints as specified in Sections 23 05 48 and 23 05 49.
- 3.2.2 Install fans with flexible connections on inlet ductwork and on discharge ductwork. Ensure metal bands of connectors are parallel with minimum 1" (25 mm) flex between ductwork and fan during running.
- 3.2.3 Install connectors to be clear of air stream. Provide flange extensions as necessary. Ensure accurate alignment of duct of fan.
- 3.2.4 Provide safety screens where fan inlet or outlet is exposed.
- 3.2.5 Provide belt guards on belt driven fans.
- 3.2.6 Provide and install sheaves and belts required for final air balance.
- 3.2.7 Assist Balancing Agency in altering blade pitch angles as required for final air balance. Provide access to fan wheel for blade adjustment.
- 3.2.8 Mount floor mounted fans on 4" (100 mm) thick concrete housekeeping bases (bases under Division 3).
- 3.2.9 Mount roof mounted fans on curbs 8" (200 mm) minimum above roof.

### **3.3 Fans – Kitchen Hood Exhaust**

- 3.3.1 Installation of commercial cooling kitchen hood/canopy exhaust fans shall be in accordance with NFPA-96.



- 3.3.2 Adjust height of roof curb as may be required to ensure top of fan discharge is a minimum 40" (1.0 m) from roof.
- 3.3.3 Roof mounted exhaust fan shall be installed minimum of 10'-0" (3.0 m) away from fresh air intakes and properly lines located in horizontal plan. Wall terminations shall be in accordance with NFPA-96.
- 3.3.4 Provide interlocks between building fire alarm system, kitchen hood fire suppression system, normally closed gas supply solenoid to kitchen appliances, exhaust fan and make-up air unit.
- 3.3.5 Local switch shall be used to activate kitchen exhaust fan. If hood is equipped with time clock, local switch not required.
- 3.3.6 When exhaust fan is activated, make-up air unit for area shall be activated.
- 3.3.7 If make-up air unit is direct-fired unit, proof of exhaust fan operation is required prior to starting make-up air unit.
- 3.3.8 Upon activation of hood fire suppression system, gas valve shall close, and exhaust fan shall continue to operate. Exhaust fan operation to be verified with hood fire suppression system supplier to insure it conforms to requirements for specific suppression system supplied.
- 3.3.9 Hood fire suppression system panel shall signal main fire alarm panel to turn off make-up air unit for kitchen area.
- 3.3.10 Provide manual momentary contact switch with seal in relay contacts to open normally closed electric gas solenoid valve after loss of power due to fire alarm shut-down or building power loss.
- 3.3.11 Provide emergency shut-down push/pull switch to turn normally closed solenoid gas supply off to kitchen equipment.
- 3.3.12 In event that suppression system is supplied with mechanical gas valve, provision of reset and emergency shut-down switch is not required.
- 3.3.13 Switches are to be clearly identified with lamicaid labels.

**3.4 Fans – Mixed Flow Induced Dilution Exhaust**

- 3.4.1 Install fans on roof curb with 1" (25 mm) thick gasket (provided by fan Manufacturer) sized for  $\frac{1}{8}$ " (3 mm) deflection under weight of fans. Fan base to be securely fastened to curb by means of stainless steel bolts. Provide hemi-grommets (Mason HG) under hold-down bolts. Use lock nuts and ensure bolt can be turned by hand after lock nut secured.

**3.5 Gauges – Air Pressure**

- 3.5.1 Mount gauges for easy visual inspection.
- 3.5.2 Piping to be formed in true vertical/horizontal lines free from kinks.

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3.5.3 Seal penetrations of plenums or ducts.

**END OF SECTION**

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## 1. GENERAL

### 1.1 Related Work

1.1.1 This Specification Section forms part Contract Documents and is to be read, interpreted and coordinated with other parts.

### 1.2 Quality Assurance

1.2.1 Catalogued or published ratings shall be those obtained from tests carried out by Manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

## 2. PRODUCTS

### 2.1 Single-Duct Variable Air Volume Box

#### 2.1.1 General:

- .1 Manufacturers, other than those listed in the acceptable products list, wishing to bid shall make detailed submission responding to each point outlined in specification in exact same form. Listing of valve for valve, taken from drawings, shall be included, showing design selection for alternate proposed with airflow capacities and minimum static pressure requirement.

#### 2.1.2 Minimum Requirements:

- .1 Rated to AHRI Standard 880 with ARI seal. Provide identical products to tested unit.
- .2 Air valves shall be supplied as factory assembly unit, comprising of basic unit, access section, reheat coil and attenuator, as specified – see Equipment Schedules on drawings.
- .3 At inlet velocity of 2,000 ft/m (10 m/s), differential static pressure required to operate any air valve size shall not exceed 0.15" w.g. (37 Pa) for any unit with attenuator section and without reheat coil.
- .4 Air valves shall incorporate multi-point flow sensor equal to flow measures as per 23 33 00. Cross flow sensor or button sensors are not acceptable.
- .5 Casing constructed from 22 ga (0.85 mm) thick galvanized steel. Provide attachment tabs on top of casings for ceiling hangers.
- .6 Pressure independent operation.

#### 2.1.3 Unit Internal Insulation:

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- .1 Standard Insulation:
    - .1 1" (25 mm) fibreglass insulation. Exposed face of insulation to be faced with non-woven mat. Exposed raw edges and joints to be sealed with galvanized metal.
  - .2 Special Insulation:
    - .1 ¾" (20 mm) thick FF Fibre Free Foam insulation. Exposed Insulation edges and corners covered with zinc coated metal angles.
  - 2.1.4 Control Dampers:
    - .1 Heavy gauge steel damper with peripheral gasket and self-lubricated bronze Oilite or Delrin bearings.
    - .2 Air leakage of closed damper shall not exceed 2% of nominal rating at 3" w.g. (750 Pa) inlet static pressure.
  - 2.1.5 Reheat Coils:
    - .1 Water reheat coils enclosed in galvanized steel casing and factory installed on air valves.
    - .2 Copper tubes and aluminum fins. Coil performance shall be in accordance with AHRI Standard 410 Forced Circulation Air Cooling and Air Heating Coils.
    - .3 Capacities as scheduled.
  - 2.1.6 Access Panels:
    - .1 8" (200 mm) x 5" (125 mm) lift-off galvanized access panel. Positive gasket seal and camlocks. Mounted in frame and located upstream of reheat coil on the top and bottom of air valve.
  - 2.1.7 Sound Attenuators:
    - .1 Standard Attenuator:
      - .1 Casing constructed from 22 ga (0.85 mm) thick galvanized steel. Provide attachment tabs on top of casing for ceiling hangers.
      - .2 Attenuator lined with 1" (25 mm) fibreglass insulation. Exposed face of insulation to be faced with non-woven mat. Exposed raw edges and joint to be sealed with glasfab and or metal nosing insulation coating/sealer.
    - .2 Special Attenuator:
      - .1 Casing constructed from 22 ga (0.85 mm) thick galvanized steel. Provide attachment tabs on top of casing for ceiling hangers.
      - .2 Attenuator lined with ¾" (20 mm) thick FF Fibre Free Foam insulation. Exposed insulation edges and corners covered with zinc coated metal angles.

2.1.8 Selection Range:

Inlet Size	Selection Range (cfm (L/s))	Minimum Turndown (cfm (L/s))
6" (150 mm)	80 cfm (38 L/s) - 380 cfm (180 L/s)	80 cfm (38 L/s)
8" (200 mm)	380 cfm (180 L/s) - 700 cfm (330 L/s)	148 cfm (70 L/s)
10" (250 mm)	700 cfm (330 L/s) - 1,165 cfm (550 L/s)	230 cfm (110 L/s)
13" (325 mm)	1,165 cfm (550 L/s) - 1,630 cfm (770 L/s)	320 cfm (150 L/s)
14" (350 mm)	1,630 cfm (770 L/s) - 2,120 cfm (1,000 L/s)	445 cfm (210 L/s)
16" (400 mm)	2,120 cfm (1,000 L/s) - 2,540 cfm (1,200 L/s)	580 cfm (275 L/s)

2.1.9 Acoustic Requirements:

- .1 Provide air valves as indicated on drawings and scheduled, such that noise criteria specified in Table 1 below are not exceeded under the following site conditions. Meet applicable Codes and other specified requirements.
  - .1 1.5" w.g. (375 Pa) static pressure on supply and return/exhaust units.
  - .2 Armstrong Cortega769 ceiling tile.
  - .3 Price SPD/ASPD series square plaque diffuser selected for 700 ft/m (3.56 m/s) neck velocity, as specified.
- .2 Conduct full mock-up tests with Representative air valves, suspended ceiling, diffuser and simulated room absorption, to demonstrate specified NC criteria will be met.
- .3 Submit proposed test details prior to testing. Test data to include measured noise level (as opposed to sound power) under mock-up conditions, as indicated in AHRI 880 – 2011 Performance Rating of Air Terminals, Figure 1, together with mock-up room details, dimensions and measured absorption (using reference sound source). Submit statement of test accuracy.
- .4 Provide measured data, together with details of added treatment required to meet criteria, e.g. Thermaflex MK-E lined flexible connector, additional treatment to control radiated noise, etc.

**Table No. 1**  
**Maximum Allowable Background Noise Levels, NC**

Max. NC	Areas
25-35	Operating Rooms, ICU/CCU, Patient Rooms

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Max. NC	Areas
30-40	Wards, Corridors and Public Areas
30	Recovery Rooms
30	Isolation Rooms, Nurseries
35	Medical Imaging, Emergency, Treatment Areas, Laboratories
30	Director's Office/Manager's Office
30	Conference Room/Board Room/Library/Classrooms/Seminar rooms
35	Offices/Psych. Assessment/Counselling
35	Multi-purpose
35	Exam Rooms/Testing Rooms
45	Storage
--	Mechanical/Electrical/Communications

2.1.10 Air Valve Identification:

- .1 Manufacturer shall number air valves in accordance with numbers indicated on drawings. Secure 2" (50 mm) high, Gothic style, self-adhesive, black, stick-on letters (Letrasign or Brady Quick-Align) on one side and on bottom of air valves.

2.1.11 Controls and Actuators:

- .1 Microprocessor based controller and damper actuator will be supplied by Controls Contractor. Controller shall be provided in pre-assembled unit for mounting on air valve.
- .2 Controller and actuator shall be field mounted on air valve by Controls Contractor.
- .3 Controls arranged for pressure independent, constant volume operation or variable volume operation as noted.
- .4 Resettable to any air volume between zero and maximum rated volume.
- .5 External taps for balancing gauge.

2.1.12 Standard of Acceptance: EH Price SDV-5 (supply), SDV-5 (return/exhaust).

2.1.13 Acceptable Manufacturers: EH Price, Nailor, Kreuger, Titus.

**2.2 Air Terminal Units – Mixing Boxes**

2.2.1 General:

- .1 Manufacturers, other than those listed in acceptable Manufacturers list, wishing to bid shall make detailed submission responding to each point outlined in specification in exact same form.

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2.2.2 Minimum Requirements:

- .1 Rated to AHRI Standard 880-2011, Performance Rating of Air Terminals with AHRI seal. Provide identical products to tested unit.
- .2 At inlet velocity of 2,000 ft/m (10 m/s), differential static pressure required to operate air valve shall not exceed 0.15" w.g. (37 Pa) for unit with attenuator section.
- .3 Mixing box shall incorporate multi-point cross grid flow sensors, with minimum 1.5x signal amplification, located in cold deck inlet and downstream in mixing section.
- .4 Casing constructed from 22 ga (0.85 mm) thick galvanized steel. Provide attachment tabs on top of casings for ceiling hangers.
- .5 Leakage through casing with 100% blocked discharge at 1" w.g. (250 Pa) maximum system pressure shall not exceed 2%.

2.2.3 Unit Internal Insulation:

- .1 1" (25 mm) fibreglass insulation. Exposed face of insulation to be faced with non-woven mat (Knauf Duct Liner EL or Owens Corning Areomat Duct Liner only). Exposed raw edges and joint to be sealed with metal noising insulation coating/sealer.

2.2.4 Control Dampers:

- .1 Heavy gauge steel damper with peripheral gasket and self-lubricated bronze oilite or Delrin bearings.
- .2 Air leakage past closed damper not to exceed 0.6 cfm (0.28 L/s) per 4" (100 mm) of blade circumference at 3" w.g. (750 Pa) inlet static pressure.

2.2.5 Flexibility:

- .1 Hot and cold inlet ports shall be capable of being reversed in the field.

2.2.6 Mixing:

- .1 Boxes shall mix hot and cold air streams to attain maximum temperature variation across discharge duct of 10% of difference between hot and cold ducts. Measurement shall be taken 6" (150 mm) straight downstream of box.

2.2.7 Box Identification:

- .1 Manufacturer shall number mixing boxes in accordance with numbers indicated on the drawings. Secure 2" (50 mm) high, Gothic style, self-adhesive, black, stick-on letters (Letrasign or Brady Quick-Align) on one side and on bottom.

2.2.8 Acoustical Performance:

- .1 With inlet static pressure of 1" w.g. (250 Pa) and up to flow quantities listed below, the generated noise from mixing boxes shall be free of audible pure tones and shall not exceed the following sound power levels (Lw re: 1 pW).

Octave Band			125	250	500	1000	2000	4000
Flow (cfm (L/S))	Size Inches (mm)							
200 cfm (95 L/S)	4" (100 mm)	Discharge	51	46	39	26	21	
200 cfm (95 L/S)	4" (100 mm)	Radiated	53	46	44	37	33	26
400 cfm (190 L/S)	6" (150 mm)	Discharge	62	56	50	36	27	23
400 cfm (190 L/S)	6" (150 mm)	Radiated	60	49	44	36	32	27
700 cfm (330 L/S)	8" (200 mm)	Discharge	64	60	53	40	31	30
700 cfm (330 L/S)	8" (200 mm)	Radiated	61	53	48	41	35	29
850 cfm (400 L/S)	9" (225 mm)	Discharge	65	59	52	38	31	36
850 cfm (400 L/S)	9" (225 mm)	Radiated	62	52	48	42	38	32
1,150 cfm(545 L/S)	10" (250 mm)	Discharge	68	60	54	40	32	38
1,150 cfm (545 L/S)	10" (250 mm)	Radiated	62	55	48	41	36	32
1,700 cfm (800 L/S)	12" (300 mm)	Discharge	69	62	55	44	38	41
1,700 cfm (800 L/S)	12" (300 mm)	Radiated	62	55	51	44	36	33
2,700 cfm (1,275 L/S)	14" (355 mm)	Discharge	69	65	59	44	45	48
2,700 cfm (1,275 L/S)	14" (355 mm)	Radiated	67	59	56	46	42	38

- .2 Discharge and radiated sound power data may be traded off by maximum of 2 decibels, i.e. if radiated noise in given octave band meets specifications within margin of 2 decibels, discharge noise may increase by 2 decibels.
- .3 Provide quietest mixing box for specified duty.

#### 2.2.9 Controls:

- .1 Microprocessor based controller and damper actuator will be supplied by the Controls Contractor.

#### 2.2.10 Standard of Acceptance: EH Price DDQ5000

### 2.3 Fan Terminal Units

#### 2.3.1 General:



- .1 Fan terminal units shall vary primary air supply in response to cooling demand and shall contain variable speed fan to deliver constant air volume to occupied space while mixing primary air and return plenum air.

**2.3.2 Minimum Requirements:**

- .1 Fan terminal unit shall be factory set to deliver design primary air volume.
- .2 Minimum and maximum primary air volume shall be field adjustable.
- .3 Primary air volume control regulator shall be pressure independent.
- .4 Galvanized steel casing enclosing air volume damper fan and heating coil.
- .5 Secure attachment points for seismic anchoring.
- .6 Casing acoustically lined with 1" (25 mm) thick glass fibre insulation. Exposed face of insulation faced with non-woven mat. Exposed raw edges and joints sealed with glasfab and/or metal nosing insulation coating/sealer.
- .7 Full sized bottom access panel in casing.
- .8 1" (25 mm) removable fibreglass filter for recalculating air stream.
- .9 Air volume damper leakage not to exceed 2% of rated airflow quantity at 1" w.g. (250 Pa) static air pressure.
- .10 Forward curved blower with direct drive split capacitor motor with infinitely adjustable motor speed control. Fan assembly to be isolated from casing.
- .11 Hot water heating coil with copper tubes and aluminum fins where scheduled.
- .12 Damper motors and coil control valves are specified in Controls Section.
- .13 Fans shall be energized when duct static pressure is sensed.
- .14 During unoccupied mode (zero primary system static pressure) primary air damper shall close and fan and heating coil shall be energized when call for heat).

**2.3.3 Box Identification:**

- .1 Manufacture shall number terminal boxes in accordance with numbers indicated on drawings. Number shall be painted in black on two sides and on bottom. Numbers shall be 2" (50 mm) high.

**2.3.4 Acoustical Performance:**

- .1 The Manufacturer shall submit acoustical performance data for all sizes of boxes supplied.

- .2 The test data shall be generated with pressure differential between inlet and outlet of 0.3" w.g. (75 Pa), 1" w.g. (250 Pa) and 2" w.g. (500 Pa).
- .3 Test data submitted shall include sound power levels through six octave bands, measured in accordance with ANSI standard SI.21-1972 and ADC 1062 R4.
- .4 Discharge and radiated sound power data should be included.

### 3. **EXECUTION**

#### 3.1 **Air Terminal Units – Air Valves**

- 3.1.1 Install in accordance with Manufacturers recommendations.
- 3.1.2 Arrange for suitable ceiling access to units. Provide access doors or locate near easily removable ceiling components.
- 3.1.3 Support air terminal units independently of ductwork.
- 3.1.4 Install units with minimum four duct diameters straight inlet duct, same size as inlet.
- 3.1.5 Where inlet flow deflections and/or turbulence alter factory calibration by more than 10%, installer shall field adjust the air volume calibration settings to compensate.
- 3.1.6 Provide seismic restraints in accordance with details in SMACNA Guidelines or alternatively slack cables.
- 3.1.7 Provide isolation valves, control valve and balancing valves on piping connections.

#### 3.2 **Air Terminal Units – Mixing Boxes**

- 3.2.1 Install in accordance with Manufacturer's recommendations.
- 3.2.2 Arrange for suitable ceiling access to units. Provide access doors or locate near easily removable ceiling components.
- 3.2.3 Support mixing boxes independently of ductwork.
- 3.2.4 Install units with a minimum of four duct diameters of straight inlet duct, same size as the inlet, upstream of the inlets.
- 3.2.5 Where inlet flow deflections and/or turbulence alter factory calibration by more than 10%, installer shall field adjust air volume calibration settings to compensate.
- 3.2.6 Provide seismic restraints in accordance with details in SMACNA Guidelines or alternatively slack cables.
- 3.2.7 Provide isolation valves, control valve and balancing valves on piping connections.

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**3.3 Fan Terminal Units**

- 3.3.1 Install in accordance with Manufacturers recommendations.
- 3.3.2 Arrange for suitable ceiling access to units. Provide access doors or locate near easily removable ceiling components.
- 3.3.3 Support fan terminal units independently of ductwork.
- 3.3.4 Where inlet flow deflections and/or turbulence alter factory calibration by more than 10%, installer shall field adjust air volume calibration settings to compensate.
- 3.3.5 Install units with minimum four duct diameters straight inlet duct, same size as inlet.
- 3.3.6 Install on rubber in shear isolators.
- 3.3.7 Provide seismic restraints in accordance with details in SMACNA Guidelines or alternatively slack cables.
- 3.3.8 Provide flexible connections for heating coil piping and electrical connection.
- 3.3.9 Provide isolation valves, control valve and balancing valves on piping connections.

**END OF SECTION**

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1. **GENERAL**

1.1 **Related Work**

1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

1.2 **Quality Assurance**

1.2.1 Catalogued or published ratings shall be those obtained from tests carried out by Manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

2. **PRODUCTS**

2.1 **Air Terminals**

2.1.1 General:

- .1 Grilles, registers and diffusers shall be product of one Manufacturer.
- .2 Refer to drawings for sizes and air quantities.
- .3 Refer to schedules on drawings for details.
- .4 Base air outlet application on space noise level of NC 30 maximum.
- .5 Air terminals shall be checked for compatibility with ceiling types. Refer to Architectural reflected ceiling plans.
- .6 Manufacturer (other than design listed) shall match performance data and indicate specific comparison for each item, with shop drawing submission.
- .7 Ceiling mounted air terminals shall be provided with means for attachment of two seismic security wires at opposite corners on each air terminal.
- .8 Provide concealed baffles, where necessary, to direct air away from walls, columns or other obstructions within radius of air terminal operation.
- .9 Provide auxiliary frames for diffusers located in drywall ceilings and grilles mounted in gypsum walls in public areas. In other areas grilles should be attached to ductwork, or flanged to outside of the opening.
- .10 Standard of Acceptance for General Grilles, Registers and Diffusers: EH Price, Nailor, Titus, Krueger, Tuttle & Bailey.

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**2.2 Air Terminals – Operating Room**

- 2.2.1 Installed air distribution system for operating rooms shall have been tested in accordance with “Recommended Procedure for the Determination of Microbiologic Air Cleanliness,” as published by American College of Surgeons, Committee on Operating Room Environment, and shall have met requirements for Class 1 Microbiologic Clean Air. Test data shall be included in shop drawing submission.
- 2.2.2 Manufacturer shall provide services of qualified Factory Engineer or technician to supervise adjustment and balancing of operating room system.
- 2.2.3 Standard of Acceptance: Kruger Sterilflo System.

**2.3 Air Terminals – HEPA Filter/Fan Units**

- 2.3.1 Self-Powered HEPA fan unit with solid state speed controller.
- 2.3.2 Airtight filter housing construction. Inlet air supply collar sealed to housing.
- 2.3.3 Extruded aluminum border mounting frame suitable for either gasketed T-bar or plaster ceiling installation.
- 2.3.4 Removable aluminum perforated faceplate with hinge clips to provide access to filters.
- 2.3.5 Hanger brackets at each corner.
- 2.3.6 Filter frame with high efficiency 99.97% HEPA filter.
- 2.3.7 10” (250 mm) diameter duct connection collar.
- 2.3.8 ECM - energy efficient motor.
- 2.3.9 Room sound level shall be less than 55 dBA, when measured at 30” (750 mm) from filter face at 90 ft/m (0.457 m/s) (average face velocity) in accordance with IEST RP-CC0022.2, Recommended Practice for Unidirectional Flow Clean-Air Devices.
- 2.3.10 Finish: White finish, border and face plate.
- 2.3.11 Standard of Acceptance:
  - .1 EH Price - Model FFU.

**2.4 Air Terminals – HEPA Filter Units**

- 2.4.1 Filter housing shall be stainless steel with continuously welded corners. Inlet collar shall be sealed to top of filter housing. Static pressure port shall be fitted to allow measurement of pressure drop across filter. Unit is to be factory sealed and tested to assure leakage is consistent with filter.
- 2.4.2 Border mounting frame suitable for either gasketed T- bar or plaster ceiling installation.

- 2.4.3 Frame shall have integral knife edge flange, which penetrates silicone gel to provide leak proof seal.
- 2.4.4 Removable stainless steel perforated faceplate with quick-release fasteners to provide access to filters.
- 2.4.5 Volume control damper shall be located in inlet collar. Remote cable operator shall be provided to adjust damper while filter in place.
- 2.4.6 Hanger brackets at each corner.
- 2.4.7 Filter shall be 99.97% HEPA. Filter shall be held in place by four cam type retracts, providing means of removing and replacing filters without disturbing filter housing in ceiling or duct connection.
- 2.4.8 Unit provided with test ports before and after filter so that filters can be tested for integrity using a scan test (CSA-Z317 requirement).
- 2.4.9 12" (300 mm) diameter duct connection collar.
- 2.4.10 Standard of Acceptance:
  - .1 EH Price - Model LFDCSS.

## **2.5 Louvres – Motorized**

- 2.5.1 Extruded aluminum: frame depth 4" (100 mm).
- 2.5.2 Blades limited to 45° to horizontal in open position.
- 2.5.3 Blades at 5" (125 mm) centres with up-turned rain stops on trailing edges.
- 2.5.4 Concealed motor operator.
- 2.5.5 Electric motor to be included (120/1/60).
- 2.5.6 Baked enamel finish to Consultant choice.
- 2.5.7 Removable 16 ga (1.29 mm) diameter aluminum wire bird screen with ½" (15 mm) mesh.
- 2.5.8 Standard of Acceptance:
  - .1 Airolite T645E.

## **2.6 Louvres – Stationary**

- 2.6.1 General:
  - .1 Extruded aluminum frames and blades.
  - .2 Welded construction with exposed joints ground flush and smooth or mechanically fastened with stainless steel fasteners.
  - .3 Lower assembly sealed and water tight.
  - .4 Removable 16 ga (1.29 mm) diameter aluminum wire bird screen with ½" (15 mm) mesh. Bird screen mounted in 20 ga (0.81 mm) thick aluminum folded frame. Frame to be installed inside louver.

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- .5 Factory applied baked enamel finish to Consultants colour choice.
  - .6 Mill finish.
  - .7 Anodized permanodic hard colour finish.
- 2.6.2 Specific:
- .1 Drawing designation - Type “\_\_\_”
  - .2 Frame 4” (100 mm) deep.
  - .3 4” (100 mm) deep blades inclined at 45° to the horizontal.
  - .4 Blades at 3½” (90 mm) on centres.
  - .5 Blades arranged with up-turned rain stops on trailing edges and drop channels on leading edges.
  - .6 Jamb drainage channels.
  - .7 Blades and frame 12 ga (2.05 mm) thick extruded aluminum.
  - .8 Standard of Acceptance: Airolite K6774, Nailor 445DB, C/S A4097, Ten Plus D4493.
- 2.6.3 Specific:
- .1 Drawing designation - Type “\_\_\_”
  - .2 Frame 6” (150 mm) deep.
  - .3 6” (150 mm) deep blades inclined at 45° to the horizontal.
  - .4 Blades at 3½” (90 mm) on centres.
  - .5 Blades arranged with up-turned rain stops on trailing edges and drop channels on leading edges.
  - .6 Jamb drainage channels.
  - .7 Blades and frame 12 ga (2.05 mm) thick extruded aluminum.
  - .8 Standard of Acceptance: Airolite K-6776, West Vent XT-635WV, Ten Plus D6403.
- 2.6.4 Specific:
- .1 Drawing designation - Type “\_\_\_”
  - .2 Frame 5” (125 mm) deep.
  - .3 Blades constructed in inverted “vee” style.
  - .4 Blades 5” (125 mm) deep, at 2” (50 mm) on centres.
  - .5 Standard of Acceptance: Airolite K-605, Westvent XT-520W, Ten Plus R5455.
- 2.6.5 Specific:
- .1 Frame 4” (100 mm) deep.
  - .2 Blades inclined at 45° to the horizontal.
  - .3 Blades at 5” (125 mm) on centres.
  - .4 Continuous blade appearance.
  - .5 Blades and frame 12 ga (2.05 mm) thick extruded aluminum.
  - .6 Standard of Acceptance: Airolite CB609.
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**2.7 Louvered Penthouse**

- 2.7.1 Welded assembly including welded, mitred corners for continuous blade effect.
- 2.7.2 Louvres 4" (100 mm) deep at 4" (100 mm) centres at 45° to horizontal complete with curb cap frame and drip ledge on bottom.
- 2.7.3 Aluminum reinforcing angles on vertical louver sections and pitched roof sections.
- 2.7.4 ½" (15 mm) mesh aluminum wire bird screen on inside of louvers.
- 2.7.5 Undercoat insulation under roof.
- 2.7.6 Roof material shall be 12 ga (2.05 mm) thick aluminum.
- 2.7.7 Finish shall be baked enamel, colour to Consultant's choice.
- 2.7.8 Roof curb.

**2.8 Hoods – Gooseneck**

- 2.8.1 Galvanized steel construction.
- 2.8.2 Thickness and fabrication to ASHRAE and SMACNA standards.
- 2.8.3 ½" (15 mm) aluminum wire bird screen mounted in removable U-frame.
- 2.8.4 Mount unit on minimum 12" (300 mm) high curb base.

**2.9 Hoods – Roof – Relief/Intake**

- 2.9.1 Aluminum construction.
- 2.9.2 Shape as indicated.
- 2.9.3 ½" (15 mm) aluminum wire bird screen mounted in removable U-frame.
- 2.9.4 Factory baked enamel finish.
- 2.9.5 Roof curb.
- 2.9.6 Backdraft damper.

**2.10 Roof Vents**

- 2.10.1 Application: Kitchen range hood vent, exhaust fan vent, etc.
- 2.10.2 Minimum Requirements:
  - .1 26 ga (0.55 mm) galvanized metal construction with all joints soldered.
  - .2 Cantilevered lid on gable ends and flat roof flange.
  - .3 Minimum 14" (350 mm) high, size as indicated on the drawings.
- 2.10.3 Standard of Acceptance:
  - .1 Menzies Metal Products BUR Vents.



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## 2.11 Range Hoods – Domestic

### 2.11.1 Minimum Requirements:

- .1 30" (750 mm) wide.
- .2 Aluminum washable filter.
- .3 Lights and light switch.
- .4 Solid state fan speed control.
- .5 Suitable for horizontal or vertical ducting.
- .6 Built-in backdraft damper and duct collar for use with 10" (250 mm) x 3-1/4" (86 mm) ducting.
- .7 Baked enamel finish to Consultant's colour choice.

### 2.11.2 Accessories:

- .1 Flush wall cap with aluminum grille.

### 2.11.3 Standard of Acceptance:

- .1 Broan-NuTone.

## 3 . EXECUTION

### 3.1 Air Outlets and Inlets

- 3.1.1 Provide grilles, registers, diffusers as schedule and as noted on the plans. Provide specific mounting type coordination with wall, floor and ceiling types as noted.
- 3.1.2 Install with cadmium plated screws in counter sunk holes where fastenings are visible.
- 3.1.3 Install ductwork as high as practical, using offsets where required to obtain maximum duct neck lengths for diffusers.
- 3.1.4 Refer to Architectural Reflected Ceiling plans for exact locations of air terminals, and coordination with ceiling type.
- 3.1.5 Paint ductwork behind grilles with matte black paint where duct or insulation surfaces are visible.
- 3.1.6 Attach registers and grilles to branch ducts with duct necks having minimum length to prevent grille or register damper from protruding into branch duct.
- 3.1.7 Where air terminals are installed in mechanical grid ceiling, provide minimum two 12 ga (2.75 mm) galvanized steel wire seismic security bridles at opposite corners of each air terminal and such that air terminal cannot fall.
- 3.1.8 Hand over door grilles to General Contractor for installation.

### 3.2 Louvres

- 3.2.1 Provide necessary flashing and counterflashing for louvres installed in walls.

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- 3.2.2 Caulk louvre and flashing and counterflashing to make installation water tight.
  - 3.2.3 Blank-off panels shall be constructed to SMACNA standards, minimum 20 ga (1.00 mm) sandwich panel with 1" (25 mm) thick fibreglass insulation.
  - 3.2.4 Blank-off panels shall have painted flat black enamel finish.
  - 3.2.5 Install backdraft dampers / motorized dampers at all louvres in accordance with requirements per ASHRAE 90.1 and as indicated on drawings.

**END OF SECTION**

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**1 .      GENERAL**

**1.1      Related Work**

1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

**1.2      Filters – Quality Assurance**

1.2.1 Filters shall be by one Manufacturer.

1.2.2 Filter media shall be ULC listed and labelled, Class I or Class II.

1.2.3 Filters shall be suitable for air at 100% RH and air temperatures between 37°F (3°C) and 122°F (50°C).

1.2.4 Dust holding capacity: Air Filter Institute (AFI) Test.

1.2.5 Efficiency: based on ASHRAE 52-76, atmospheric dust spot efficiency. "Absolute filter" efficiency shall be tested with 0.3 Poly-alpha-olefin (PAO) smoke.

1.2.6 Representative filters shall have been tested by an independent test laboratory and test results shall be made available on request.

**2 .      PRODUCTS**

**2.1      Filters – General**

2.1.1 Mark filter identification on each filter.

2.1.2 Provide two sets of filter media (for each filter) - one for initial installation and one for handover to the Owner as a spare. This does not apply to HEPA filters. Obtain signed receipt.

2.1.3 Panel filter media used during "temporary heating" shall be replaced by new media on substantial completion.

2.1.4 Filters sections shall be designed for 500 ft/m (2.54 m/s) maximum air flow velocity.

2.1.5 Filters sizes shall conform to existing VGH - Physical Plant Standard. 24" (600 mm) x 24" (600 mm), 24" (600 mm) x 20" (500 mm), 24" (600 mm) x 12" (300 mm), or 12" (300 mm) x 12" (300 mm).

2.1.6 Roll type filters, automatic advance or otherwise will not be considered acceptable means of filtration.

2.1.7 Use of permanent washable type impingement filters not acceptable.

**2.2      Filters – Panel Type**

2.2.1 2" (50 mm) thick disposable pleated cotton media.

- 2.2.2 Enclosing frame shall be constructed from rigid, heavy-duty high wet strength beverage board with diagonal support members bonded to both sides of each pleat.
- 2.2.3 Efficiency: MERV 7 15 per ASHRAE Standard 52.2 and an average dust spot efficiency of 25% to 30% per ASHRAE Standard 52.1.
- 2.2.4 Standard of Acceptance: AAF AM-AIR 300, Farr 30/30.

**2.3 Filters – Final**

- 2.3.1 Disposable bag type with fine glass fibre media, self-inflating with holding frame and not requiring rigid support basket.
- 2.3.2 Efficiency: as scheduled.
- 2.3.3 Standard of Acceptance: AAF Dri-Pak, Farr N/S

**2.4 Filters – Final**

- 2.4.1 12" (300 mm) deep disposable pleated fine glass fibre media.
- 2.4.2 Rigid galvanized steel enclosing frame.
- 2.4.3 Efficiency: as scheduled.
- 2.4.4 Standard of Acceptance: AAF Varicel, Farr Riga-Flo

**2.5 Filters – Final (synthetic)**

- 2.5.1 Progressively structured filter medium made from unbreakable synthetic microfibre media, bag type filters.
- 2.5.2 Front frame made from corrosion resistant hard polyurethane foam.
- 2.5.3 Filter pockets self-supporting with integral wire struts, leak-free bonds.
- 2.5.4 Efficiency: as scheduled.
- 2.5.5 Standard of Acceptance: Viledon.

**2.6 Filters – HEPA**

- 2.6.1 HEPA filters shall be individually tested and certified.
- 2.6.2 Efficiency: as scheduled.

**2.7 11.5" (290 mm) deep disposable pleated fine glass fibre media with safe-edge aluminum separators.**

- 2.7.1 Rigid galvanized steel enclosing frame.
- 2.7.2 Neoprene expanded rubber gasket.
- 2.7.3 High capacity model.
- 2.7.4 Standard of Acceptance: Camfil/Farr Filtra 2000, Airguard Microguard 2000, Flandees Alpha 2000.

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**2.8 Filters – High Efficiency Germicidal**

**2.8.1 Description:**

- .1 The filter system shall be comprised of three primary elements as manufactured by StrionAir Inc.: Disposable Filter Element, Filter Enhancement Module and Master Control Unit.
- .2 System shall have minimum filtration efficiency rating of MERV 15 per ASHRAE Standard 52.2. Rating shall be at face velocity of 500 ft/m (2.54 m/s). Independent test data shall be provided.
- .3 System shall be CSA 22.1, UL 867 rated.

**2.8.2 Filter to Filter Seal:**

- .1 Filters constructed of rigid plastic frame, vertical sides to contain knife-edges with closed cell foam gaskets. Orientation of lip and gasket are reversed on adjacent filters providing twin lip to gasket seals with minimal filter bypass.

**2.8.3 Filter to Rack Seal:**

- .1 Filter seals on downstream side of filter and upstream side of filter rack. Seal to be part of filter and not rack.

**2.8.4 System Command and Communications Modules (SCCM):**

- .1 Each SCCM shall have two power modules able to power up to 16 FEM units.
- .2 Each SCCM unit requires 120C power supply with local disconnect by Electrical. Mechanical to provide wiring from disconnect to SCCM module.
- .3 Each SCCM module will have one dry contact or 0 to 10 VDC output for alarm annunciation on BMS system.

**2.8.5 Disposable Filter Elements:**

- .1 Initial resistance shall not exceed 0.37" w.g. (92 Pa) at 500 ft/m (2.54 m/s) face velocity.
- .2 Filters shall be UL 900 class II rated.
- .3 Ultra-low-bypass Disposable Filter Element shall consist of mini-pleated microglass fibre filter media packs with conductive metal grid attached to downstream surface acting as downstream field electrode. Enclosing frame shall be constructed of moulded polymer with integrated gasket to eliminate side-to-side and top and bottom air bypass. Media pack shall be mechanically and chemically bonded to inside edge of enclosing frame.

**2.8.6 Filter Enhancement Modules (FEM):**

- .1 Each StrionAir Air Filter installation shall consist of one FEM unit per pre-filter.

- 
- .1 Modules shall be UL 5V rated.
  - .2 Filter Enhancement modules shall be composed of precision stamped stainless steel assembly acting as Ionization Array and assembly composed of high voltage cable held in tension by insulating polymer supports acting entirely as Upstream Field Electrode. These components shall be enclosed within UL94 5V rated extruded polymer frame.
  - .3 Each Filter Enhancement Modules shall consume average of 7 watts and maximum of 29 watts and draw no more than 0.2A at 120 VAC, depending upon operation conditions.
  - .4 Ionization, oxidative stress and static charge accumulation shall be used to achieve efficiency reported.
  - .5 Independent documentation proving filters meet specifications shall be provided. No Manufacturer generated testing results will be acceptable.
- 2.8.7 Maser Controls Unit (SCCM):
- .1 8 FEM units per System Command and Communication Modules (SCCM).
  - .2 Master Control Units shall contain power and control functions necessary to properly operate system Filter Enhancement Modules. Control Modules and supporting electronics shall be enclosed within NEMA 2 enclosure. External to enclosure shall be visually and physically accessible LED indicators of power functions and power on/off switch.
  - .3 Each Master Control Unit shall use power input of 115V/1/60 VAC, 60 Hz @ 3A. Master Control Units shall be BMS enabled.
  - .4 Each SCCM unit requires 120 V power supply with local disconnect (by Electrical). Mechanical to provide wiring from disconnect to SCCM module.
  - .5 Each SCCM modules shall have one dry contact or 0 to 10 VDC output for alarm annunciation on the BMS system.
- 2.8.8 Filter Rack:
- .1 Filter rack shall be extruded aluminum, low bypass S-Rack and manufactured by StrionAir. Filter racks shall be flat panel in configuration to enable side or downstream loading. Frames shall be cut to size and drilled for simple speed screw assembly into modules from sizes noted in schedules and plans. Tracks shall be permanently gasketed to eliminate air bypass. Where required, vertical support members shall be furnished to support horizontal members.
- 2.8.9 Standard of Acceptance: StrionAir GC Air Systems.

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**2.9      Filters – Carbon**

- 2.9.1 General: Regenerative activated carbon in perforated multiple cells, complete with supporting frames, removable trays and one-piece gasketed removable grid.
- 2.9.2 Media: Activated carbon from coconut shell, 50-55 minute absorption capacity in accordance with standard accelerated chloropicrin test.
- 2.9.3 Test element: Each cell or bank of cells to be complete with detachable test elements to indicate extent of saturation of actual installation.

**2.10      Filters – Grease**

- 2.10.1 Media: 14 ga (1.99 mm) mesh steel screen, zinc electroplated, alternate layers of flat herringbone crimp, four layers per 1" (25 mm) rod reinforced, enclosed in 20 ga (0.95 mm) stainless steel frame.

**2.11      Filter – Holding Frames**

- 2.11.1 Built-up Frames:
  - .1 Provide separate holding frames for each bank of panel filters and each bank of final filters.
  - .2 Factory fabricated from 14 ga (1.99 mm) galvanized steel with spring retaining clips and neoprene gaskets.
- 2.11.2 Slide-In-Frames:
  - .1 Provide slide-in-channels for filters mounted in ductwork where noted. Provide hinged and gasketed access doors.

**2.12      Filter – HEPA Holding Frame**

- 2.12.1 Factory manufactured. Rigid galvanized steel casing, minimum 16 ga (1.61 mm) thick.
- 2.12.2 Frames to have high degree of sealing integrity. Filters shall fit tightly in housing with no air leakage between filters and between filters and housing.
- 2.12.3 HEPA frames shall be provided with filter locking mechanism.

**2.13      Filter Housings**

- 2.13.1 Factory manufactured. Rigid galvanized steel casing minimum 16 ga (1.61 mm) thick.
- 2.13.2 Housing to have a high degree to sealing integrity. Filters shall fit tightly in housing with no air leakage between filters and between filters and housing.
- 2.13.3 Extruded aluminum or steel tracks for slide-out, side withdrawal of filters.
- 2.13.4 Hinged access door for filter servicing.

2.13.5 Standard of Acceptance: AAF Poly-Seal, Cambridge Side-Flo, Farr Glide/Pack.

## **2.14 Filter Gauges**

2.14.1 Application:

- .1 Across each filter bank. (Provide two individual gauges for combined panel and final filter banks.)

2.14.2 Minimum Requirements:

- .1 Ranges:
  - .1 Panel filters: 0 - 1" w.g. (250 Pa).
  - .2 Final filters: 0 - 2" w.g. (500 Pa).

2.14.3 Standard of Acceptance:

- .1 Dwyer series 2000.
- .2 Dwyer Photohelic Series 3000.

## **3 . EXECUTION**

### **3.1 Filters**

- 3.1.1 Do not operate fan system connected to filter banks until filters (temporary or permanent) are in place. Provide new filters at handover to Owner. Replace filter used during construction.
- 3.1.2 Provide filter banks in arrangement shown with removal and access indicated. Demonstrate removal of filters prior to substantial completion.
- 3.1.3 Provide and install Dwyer filter pressure gauges across each filter installation.

### **3.2 HEPA Filter Testing**

- 3.2.1 Provide site demonstration that HEPA filter installation performs to specification. Simulate conditions using ASHRAE DOP test method. Filters to be replaced at no cost to Owner if performance tests indicate efficiency lower than specified.

### **3.3 Ecology Kitchen Exhaust Units**

- 3.3.1 Install units in accordance with recommendation of ULC, NFPA-96 and Manufacturer's instructions and as indicated.
- 3.3.2 Provide fan sheaves required for final air balance.
- 3.3.3 Transition exhaust duct to full inlet opening of filter section.
- 3.3.4 Exhaust duct connection to filter section to be continuously welded.
- 3.3.5 Control wiring between ecology unit and control panel by Control Contractor.



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3.3.6 Unit to be seismically secured to roof curbs.

**3.4 Filter Gauges**

3.4.1 Mount gauges for easy visual inspection.

3.4.2 Piping to be formed in true vertical/horizontal lines free from kinks.

3.4.3 Seal penetrations of plenums or ducts.

**3.5 Filter Holding Frames**

3.5.1 Built-up frames shall be installed and bolted together (and sealed air-tight with specified duct and plenum sealers) to form filter bank.

3.5.2 Provide necessary reinforcing for filter banks over three frames high. Brace with vertical steel stiffeners, minimum 14 ga (1.99 mm) thick, riveted or bolted to frames and attached to top and bottom of plenum. When bolting frames together, provide spaces between holding frames as necessary to centre filters on coils (see drawing sections).

**END OF SECTION**

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## 1. **GENERAL**

### 1.1 **Related Work**

1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

### 1.2 **Reference Standards**

1.2.1 Install packaged boiler(s) in accordance with current Regulations of the Province of Ontario, CSA B51, ASME Codes, CSA B140.7.2., CAN1-3., Canadian Electric Code, CSA B139, CSA B139S1, CAN1-B149.1, ANSI B31.1, except where specified otherwise.

### 1.3 **Submissions**

1.3.1 Submit certificate of inspection from Technical Standards and Safety Authority (TSSA).

### 1.4 **Shop Drawings**

1.4.1 Submit shop drawings as per Section 23 05 00.

1.4.2 Indicate components, assembly dimensions, weights and loadings, required clearances, location and size of field connections, valves, strainers and thermostatic valves required for complete system.

1.4.3 Submit product data indicated rated capacities, weights, specialities and accessories, electrical requirements and wiring diagrams, including heating surface area.

1.4.4 Submit Manufacturer's installation instructions.

### 1.5 **Start-Up**

1.5.1 Manufacturer's Representative to provide start-up and burner adjustment service and maintenance and operating instructions to Owner's maintenance staff. Test reports to be submitted for review and inclusion in maintenance manuals.

## 2. **PRODUCTS**

### 2.1 **Acceptable Manufacturers and Products**

2.1.1 As listed for the specified boiler type below.

### 2.2 **General**

2.2.1 Packaged Boiler: Complete with burner and necessary accessories and controls, and ready for attachment of water supply, return and drain piping, (including condensate drain on condensing boilers, fuel

- 
- piping, electrical connections, and chimney connection. UL/ULC labelled.
- 2.2.2 Designed and constructed in accordance with ASME Code requirements.
- 2.2.3 The pressure vessels shall bear Canadian Registration Number (CRN) for The Province of Ontario before being shipped from the factory.
- 2.2.4 Electrical components CSA approved.
- 2.2.5 Packaged boiler must receive factory tests to confirm construction, controls, and operation of unit. Boilers to be test fired before shipment.
- 2.2.6 Include boiler assembly and wiring diagrams and operating and maintenance manual with boiler package.
- 2.2.7 Check available drawings and ensure the proposed boiler will fit in space allotted and can be maintained and operated in normal manner.
- 2.2.8 Furnish electrically-heated **hot water** generator complete with standard equipment and accessories as described herein. Hot water generator shall be packaged type, factory assembled, wired and tested, UL listed and bear Underwriters' Laboratories label.
- 2.2.9 Immersion resistance type heating elements, copper sheathed, replaceable without special tools.
- 2.2.10 ASME designed pressure vessel and in accordance with CSA codes and the Provincial Boiler Code and Regulations.
- 2.2.11 Equip boiler with following trim controls, together with other controls and devices required to produce approved, safe and complete unit:
- .1 Conduit cabinet.
  - .2 Terminal blocks.
  - .3 Magnetic contactors.
  - .4 Control transformer.
  - .5 Control circuit on-off selector switch.
  - .6 Pilot light for each step of heating elements.
  - .7 One set of dry contacts for common alarm.
  - .8 Alarm horn mounted on control panel with silencing switch for reset.
  - .9 Inspection and cleanout holes.
  - .10 Pressure relief valve.
  - .11 Electronic low water control complete with alarm contacts.
  - .12 Pressure gauge.
  - .13 Temperature gauge (hot water boilers).
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- 2.2.12 Boiler insulation: 2" (50 mm) glass fibre, covered with heavy gauge metal jacket finished with heat resistant enamel paint.
- 2.2.13 Electric Boiler Heating Elements: Water temperature regulated by modulating step controller with water temperature sensors operating between two adjustable temperature setpoints operates magnetic contactors which energize electric resistance heating elements. High limit control de-energizes heating elements at ...°F (...°C).
- 2.2.14 Standard of Acceptance:
  - .1 Steris/Amsco CES Series, A.O. Smith, SuperHot, Rudd, Chromalox.

### 2.3 **Boiler Sequence Control**

- 2.3.1 Hot Water Boiler Sequencing:
  - .1 Supply lead lag programming control to integrate multiple boiler installation and automatically sequence firing of boilers in balance with changing load conditions.
  - .2 Control shall automatically program individual boilers in or out of operation in response to temperature variations as sensed by temperature sensor installed in supply water header common to boilers.
  - .3 Temperature sensor, through controller, shall operate **three** ON-OFF pneumatic-electric (PE) switches, one for each boiler, each wired into its respective boiler control operating high limit cut-off (ON-OFF) control circuit. PE switches shall be sequenced (see below) at fall in flow water temperature to 200°F (93°C), 198°F (92°C), 196°F (91°C) respectively.
  - .4 Manual selector switch shall alternate **three** boilers through PE switches to the following sequence.

## 3. **EXECUTION**

### 3.1 **Installation**

- 3.1.1 Install boilers on 4" (100 mm) concrete housekeeping pad or concrete piers and level, as required.
- 3.1.2 Do not deviate from required service and maintenance clearances as required by code.
- 3.1.3 Mount unit level. Anchor boiler with bolts and inserts suitable for seismic loading.
- 3.1.4 Pipe relief valves and air vents on hot water boilers to floor drain.
- 3.1.5 Manufacturer's Representative shall:
  - .1 Certify installation in writing.
  - .2 Provide start-up and burner adjustment service.

- .3 Carry out on-site performance verification tests.
- .4 Provide maintenance and operating instructions.
- 3.1.6 Test reports to be submitted for review and inclusion in maintenance manuals.

### **3.2 Boiler Efficiency Test**

- 3.2.1 Test boiler in accordance with ASME short form test procedure after installation and hook-up but before handing units over to Owner. Forward to Consultant for approval appropriate data and calculations. Make alterations and repeat tests until test results prove each unit performs as specified. Make temporary connections, provide meters, equipment and instruments, provide engineering personnel required. Forward three copies of final approved test results to Consultant.

**END OF SECTION**

**1. GENERAL**

**1.1 Related Work**

1.1.1 This Specification Section forms part of Contract Documents and is to read, interpreted and coordinated with other parts.

**1.2 Quality Assurance**

1.2.1 Constructed in accordance with ASTM A653 / A653M-13 and Provincial Pressure Vessel regulations.

**1.3 Submittals**

1.3.1 Shop drawings shall include dimensions, locations and size of tapings, and performance data to compare with specification.

**2. PRODUCTS**

**2.1 Heat Exchangers – Plate and Frame – To be certified to ARI-400-2014.**

2.1.1 Suitable for maximum working pressure of 125 psi (860 kPa).

2.1.2 Frames: Carbon steel with baked epoxy enamel finish.

2.1.3 Guide Bars: Hard chrome-plated carbon steel with zinc treated carbon steel paint protected shroud.

2.1.4 Plates: Type 304 stainless steel.

2.1.5 Nozzles: Constructed of 316L stainless steel.

2.1.6 Gaskets: Nitrile or Ethylene propylene rubber.

2.1.7 Acceptable Products: Alfa Laval, Xylem (Bell & Gossett), Armstrong, Sondex, GEA, Taco.

**3. EXECUTION**

**3.1 Shell and Tube Heat Exchanger Installation**

3.1.1 Install level. Anchor heat exchangers and supports with bolts and inserts suitable for seismic loading.

3.1.2 Arrange piping so tube bundle can be removed after disconnecting two unions or flanges adjacent to head, without disturbing installed equipment or piping.

3.1.3 Install with safety relief valve piped to drain, **vacuum breaker**, hose bibb and drain valve.

3.1.4 Install thermometer wells with thermometers on inlet and outlet of water side.

3.1.5 Install pressure gauge on inlet and outlet pipes.

**3.2 Plate Type Heat Exchanger Installation**

3.2.1 Install level. Anchor heat exchangers and supports with bolts and inserts suitable for seismic loading.

3.2.2 Install with safety relief valve piped to drain, **vacuum breaker**, hose bibb and drain valve.

3.2.3 Install thermometer wells with thermometers on inlet and outlet of water side.

3.2.4 Install pressure gauge on inlet and outlet pipes.

**END OF SECTION**

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1. **GENERAL**

1.1 **Related Work**

1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

1.2 **Quality Assurance**

1.2.1 Catalogued or published ratings shall be those obtained from tests carried out by Manufacturer or by independent testing agency signifying adherence to codes and standards.

1.3 **References**

1.3.1 AHRI 1060.

2. **PRODUCTS**

2.1 **Heat Recovery Ventilators – Flat Plate Type**

2.1.1 General:

- .1 Factory packaged, self-contained and pre-wired unit, CSA certified.
- .2 Packaged heat recovery ventilator consisting of flat plate heat exchanger, ventilation air fan, exhaust air fan, dampers, temperature sensors and controls, suitable for operation with low outdoor air temperatures to -22°F (-30°C).
- .3 Unit shall be constructed in accordance with CSA C22.2 and UL 1812 and shall carry the ETL and (C)ETL label of approval.
- .4 Insulation shall comply with NFPA 90A requirements for flame spread and smoke generation.
- .5 Tested and rated in accordance to AMCA 210, AHRI 1060 and ASHRAE 84, test procedures for airflow and thermal effectiveness.
- .6 Single point power connection only, voltage as identified in the schedules.
- .7 Units shall be run tested prior to shipment.
- .8 Unit shall be capable of providing constant volume at specified external static pressure at all fan operating speeds.

2.1.2 Unit Cabinet:

- .1 Unit shall include baked on, polyester pre-painted 20 ga (1.00 mm) galvanized steel finish. Warranty cabinet finish for



10 years against cracking, chipping, peeling, brazing or spotting.

- .2 Cabinet shall be insulated throughout with minimum 1" (25 mm) foil faced fire retardant material.
- .3 Painted galvanized metal cabinet, internally lined and insulated – suitable for outdoor installation where unit is exposed to outdoor environment.
- .4 Main access panel shall be hinged and provide access to components requiring servicing.
- .5 Outdoor and exhaust side filters with service access. Provide MERV 13 minimum efficient air filters.

**2.1.3 Fans:**

- .1 Supply air and exhaust air fans with single speed motors.
- .2 Fan ratings based on tests in accordance with AMCA Standard 210.
- .3 Fans selected to operate on stable, efficient part of fan curve when delivering air quantities scheduled against static pressure of system.
- .4 Fan blades shall be statically and dynamically balanced and tested prior to shipment.
- .5 Fan shall be provided with internal vibration isolation mounts.
- .6 Motors shall be continuous duty, permanently lubricated and matched to fan loads. Motor selection shall include 15% service factor.

**2.1.4 Flat Plate Heat Exchanger:**

- .1 Rugged aluminum or polypropylene flat plate heat exchanger designed for general purpose or corrosive applications and shall meet UL 94 HB flame spread test, and be removable from unit.
- .2 Cross leakage of less than 1%.
- .3 Fifteen year warranty on flat plate heat exchanger.

**2.1.5 Controls:**

- .1 Unit shall be provided with factory mounted and factory wired microprocessor control, requiring only field connection to building DDC system and/or remote sensing devices and wiring to unit mounted terminal strips.
- .2 Service connectors shall be quick disconnect type.
- .3 Unit circuitry shall allow dry contacts for occupancy control, remote fan interlock on call for ventilation, selection of low or high speeds, remote sensor contacts, interlock with building DDC system. Dry contacts for control functions to be building DDC system compatible.

- .4 Automatic defrost cycle.
- .5 Dirty filter contacts.
- 2.1.6 Accessories:
  - .1 Frost Control Options:
    - .1 Recirculation Defrost Cycle: Unit shall be equipped with recirculation defrost to prevent frost from forming on flat plate heat exchanger and to prevent negative pressure from occurring in building.
    - .2 Exhaust Only Defrost Cycle: Unit shall be equipped with exhaust only defrost to prevent frost from forming on flat plate heat exchanger and to maintain exhaust ventilation at all times.
    - .3 Damper Defrost: Unit shall have continuous damper operation on outdoor air inlet to prevent frost build-up.
  - .2 Corrosion resistant external finish, suitable for outdoor installation.
  - .3 Two speed fan.
  - .4 Duct-Mounted Smoke Sensor with controller for field installed control of fan operation.
  - .5 Flow Measuring Station.
  - .6 CO2 Controller: Non-dispersed infrared control shall be provided to trigger ventilation at levels above 1,000 ppm of CO2.
- 2.1.7 Standard of Acceptance: Venmar CES Inc., Munters/Deschamps, Innovent.

## **2.2 Heat Recovery Ventilators – Rotary Type**

- 2.2.1 General:
  - .1 Factory packaged, self-contained and pre-wired unit, CSA certified.
  - .2 Packaged heat recovery ventilator consisting of rotary type heat exchanger, ventilation air fan, exhaust air fan, necessary dampers, temperature sensors and controls, suitable for operation with low outdoor air temperatures (-40°F (-40°C)).
  - .3 Units shall be listed per UL 1995 and bear the UL label.
  - .4 Tested and rated in accordance to AMCA 210, AHRI 1060 and ASHRAE 84, test procedures for airflow and thermal effectiveness.
  - .5 Performance shall be as scheduled.
  - .6 Single point power connection only, voltage as identified in schedules.

- .7 Units shall be run tested prior to shipment.
- .8 Unit shall be capable of providing constant volume at specified external static pressure at all fan operating speeds.
- .9 Unit shall be warranted to be free from defects in material and workmanship for period of five years.

**2.2.2 Cabinet:**

- .1 Unit shall include pre-painted galvanized steel finish. Warranty finish for cabinet 10 years against cracking, chipping, peeling, brazing or spotting.
- .2 Panels exposed to weather shall be minimum of 18 ga (1.31 mm) galvanized steel.
- .3 Unit shall be internally lined galvanized sheet metal creating double wall.
- .4 Where top panels are jointed there shall be overlapping, standing seam to ensure positive weather protection.
- .5 Metal-to-metal seams shall be factory sealed, requiring no caulking at job site.
- .6 Unit base to be designed for curb mounting. Unit base shall overhang curb for positive seal against water run-off.
- .7 Cabinet shall be insulated throughout with minimum 1" (25 mm) foil faced fire retardant material.
- .8 Main access panels shall be hinged and provide access to components requiring servicing.
- .9 Outdoor and exhaust side filters with service access. Provide MERV 13 minimum efficient air filters.

**2.2.3 Fans:**

- .1 Supply air and exhaust air fans with separate single speed motors, in draw-through configuration.
- .2 Fan ratings are based on tests made in accordance with AMCA Standard 210.
- .3 Fans must be selected to operate on stable, efficient part of fan curve when delivering air quantities scheduled against static pressure of system.
- .4 Fan shafts shall be mounted in permanently lubricated, sealed ball bearing pillow blocks. Bearings shall be selected for minimum (L10) life in excess of 100,000 hours at maximum cataloged operating speeds.
- .5 Fan blades shall be statically and dynamically balanced and tested prior to shipment.
- .6 Fans shall be provided with internal vibration isolation mounts.

- .7 Motors shall be continuous duty, permanently lubricated and matched to fan loads. Motor selection shall include 15% service factor.
- .8 Adjustable sheaves on belt-driven fans with motors less than 10 hp (7.5 KW) shall allow independent balancing of exhaust and supply airflows.

**2.2.4 Energy Recovery Wheel:**

- .1 Wheel shall be enthalpy type for both sensible and latent heat recovery and be designed to ensure laminar flow. Energy recovery device shall transfer moisture entirely in vapour phase.
- .2 Energy transfer ratings shall be AHRI Certified to Standard 1060 and bear AHRI certification symbol for AHRI Air-to-Air Energy Recovery Ventilation Equipment Certification Program based. Ratings "in accordance with 1060" without certification are not acceptable.
- .3 Wheel design shall consist of removable segments for ease of service and cleaning. Wheel shall be constructed of lightweight polymer media to minimize shaft and bearing loads. Polymer media shall be mounted in stainless steel rotor for corrosion resistance.
- .4 Desiccant shall be silica gel for maximum latent energy transfer. Silica gel desiccant shall be permanently bonded to wheel media to retain latent heat capability after cleaning. Wheels with sprayed on desiccant coatings, or with desiccant applied after wheel formation are not acceptable.
- .5 Energy recovery drive belt material shall be high strength urethane and shall be factory installed in pre-stretched state, eliminating need for field belt tension adjustment.
- .6 Cross leakage of less than 1%.
- .7 Five year parts and labour warranty on heat exchanger material and heat wheel motor/turning system.

**2.2.5 Hot Water Coil:**

**2.2.6 Hot water coil shall be factory tested and rated in accordance with AHRI 410 Forced Circulation Air Cooling and Air Heating Coils.**

- .1 Coils shall have copper tubes with permanently expanded aluminums fins, 10 fins per inch or less.

**2.2.7 Electric Coil:**

- .1 Electric heat shall be UL listed and circuit fused per NEC over 48 amps.
- .2 Heater shall be multi-step control, factory wired and installed.
- .3 Control with be 24 V with class 2 transformer.

- .4      Airflow switch to shut-down heater if air flow stops.

2.2.8 Controls:

- .1      Unit shall be provided with factory mounted and wired control, requiring only field connection to building DDC system and/or remote sensing devices and wiring to unit mounted terminal strips.
- .2      Service connectors shall be quick disconnect type.
- .3      Unit circuitry shall have dry contacts for occupancy control, remote fan interlock on call for ventilation, selection of low or high speeds, remote sensor contacts, interlock with building DDC system. Dry contacts for control functions to be building DDC system compatible.
- .4      Controls will receive building DDC system on/off signal, and shall control operation of each fan independently.
- .5      Dirty filter contacts.
- .6      Rotary wheel independent speed control, building DDC system compatible.

2.2.9 Accessories:

- .1      Frost Control Options:
  - .1      Variable wheel speed: Unit shall have the energy recovery wheel speed controlled to prevent frost build-up on wheel.
  - .2      Inlet heater: Unit shall have electric heater on outdoor air inlet, in addition to wheel speed controlled to prevent frost build-up on energy recovery wheel, where wheel speed control is not adequate.
- .2      Corrosion resistant external finish suitable for outdoor installation.
- .3      Roof curb shall be full perimeter type, sized for site seismic zone, with gasketting provided for field installation between curb and unit base.
- .4      Two speed fan.
- .5      Duct-Mounted Smoke Sensor with controller for field installed control of fan operation.
- .6      Flow Measuring Station.
- .7      CO2 Controller: Non-dispersed infrared control shall be provided to trigger ventilation at levels above 1,000 ppm of CO2.
- .8      Weather hoods (on outdoor Models) shall be tested in accordance with AMCA Standard 500-L to prevent water penetration.

2.2.10 Standard of Acceptance: Greenheck Model: ERCH.

**3 . EXECUTION**

**3.1 Heat Recovery Ventilators Installation**

- 3.1.1 Install in accordance with Manufacturer's recommendations.
- 3.1.2 Start-up Heat Recovery Ventilators in accordance with Manufacturer's start-up instructions. Provide start-up report to Consultant, and include in O & M manual.

**END OF SECTION**

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**1.      GENERAL**

**1.1      Related Work**

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

**1.2      Quality Assurance**

- 1.2.1 Unit and major components shall be product of same Manufacturers regularly engaged in production of such units who issues complete catalogue data on such products.

.1 Standard of Acceptance: Engineered Air, Haakon, Huntair, Scott Springfield, Annexair

- 1.2.2 Unit shall be factory built, and carry necessary approvals. Coils shall be water tested and AHRI certified. Fan(s) shall be run and tested to performance. Test results shall be submitted for vibration, sound and airflow performance.

- 1.2.3 Allow travel costs for Consultant to inspect unit(s) at factory prior to shipping. Provide 5 working days' notice to Consultant to schedule trip.

- 1.2.4 Review project schedule and ensure shop drawing submission and review unit delivery is compatible with project requirements. Allow minimum of 6 weeks for shop drawing review process.

- 1.2.5 Manufacturers shall provide construction methods to achieve sound data as specified and provide data obtained by either:

.1 AMCA lab simulation.

.2 Test data of actual unit.

.3 Sound data shall be measured and provided in accordance with AHRI Standard 260P.

**1.3      Submittals**

- 1.3.1 Provide technical information relevant to product being provided, including but not limited to information indicated in schedules.

- 1.3.2 Product data shall include dimensions, weight, capacities, certifications, casing construction details, gauges and finishes of material.

- 1.3.3 Submit fan curve details, showing operating points at clean filter, dirty filter and mid-point loaded filter with parameters specified. Select fans at maximum efficiency for specified duty.

- 1.3.4 Submit sound power levels for air handling unit inlet and outlet and casing radiation at rated capacity in accordance with AMCA.

- 1.3.5 Shop drawings shall include motor efficiencies. Refer to Section 23 05 13 for minimum motor efficiencies.
- 1.3.6 Submit each air-handling unit on separate 1:25 scale drawing showing construction details and dimensions of entire unit and internal components.
- 1.3.7 Submit Manufacturer's recommended installation instructions.

#### **1.4 Variable Speed Drives**

- 1.4.1 Motors powered by variable speed drive controllers shall be EEMAC Class B with Type F insulation, shall have 1.15 service factor and shall be suitable to be driven by PWM variable speed drive controllers. Motor Manufacturer shall submit in writing confirmation that motors are designed to withstand voltage peaks of 1400V and voltage rate of rise of 2000V/microsecond at frequency of 20 kHz.

## **2 . PRODUCTS**

### **2.1 Air Handling Unit – Custom Built**

#### **2.1.1 General:**

- .1 Factory fabricated and assembled modular components as indicated. Field fabrication of units will not be accepted. Field assembly of unit sections is acceptable if unit cannot be installed as single unit. Include for cost of any field assembly.
- .2 Overall dimensions and configurations are to be as indicated on drawings. However, this does not absolve Manufacturer from responsibility for engineering, operational integrity and performance of unit provided.
- .3 Unit shall carry necessary approvals.
- .4 Refer to schedules for capacity requirements/design parameters/component type. Other features normally required to complete and safe operation are implicit requirement and shall be included.

#### **2.1.2 Electrical:**

- .1 Wiring shall be factory CSA approved.
- .2 Complete factory power wiring in EMT conduit from motors and lights to point power connections.
- .3 Provide one 120 V/1/Phase connection to junction box for marine lights.
- .4 Provide power connections from each fan motor to junction boxes on outside of unit casing.
- .5 Electrical Contractor to provide disconnects, starters and power wiring to unit junction boxes. If variable speed drives are used Electrical shall wire to disconnect switches (could



be integral on VSD) and from disconnect switches to VSDs and from VSDs to motor junction boxes. If disconnect is placed between VSD and motor, auxiliary sets of contacts are required to let VSD know it has been shut-off.

- .6 Provide power connections from each fan motor to VSDs and to junction boxes on outside of unit casing for indoor units.
- .7 Provide factory installed empty 1" (25 mm) conduit throughout length of unit with J-boxes in each section for Control Contractor's use.

**2.1.3 Mounting Frame:**

- .1 Casings shall be supported on welded structural channel supports designed for support of entire unit without deflection.
- .2 Steel base shall be suitable for seismically bolting unit to roof curbs or housekeeping pads or welding unit to embedded steel plates in concrete roof curbs or housekeeping pads/curbs.
- .3 Integral lifting lugs for hoisting.
- .4 Unit(s) shall be mounted on metal seismic roof curb(s) provided with unit(s). Roof curbs shall be seismically secured to roof. When flashed to mounting curb unit shall provide weatherproof whole.
- .5 Unit(s) shall mate to concrete mounting curb provided under Division 3. When flashed to mounting curb unit shall provide weatherproof whole.
- .6 Provide suitable means for seismically securing units.

**2.1.4 Floor:**

- .1 Plenum floors shall be rigid of welded construction using, as minimum, structurally reinforced 12 ga (2.75 mm) MS checker plates; be free from dishing and be formed as drain pan with standing upturned angle. Seams and corners shall be continuously welded. Floor shall be completely flooded after assembly and written certification submitted by Manufacturer that there are no leaks.
- .2 Floor shall be finished with two-component epoxy polyamide non-skid paint.
- .3 Pipe/duct penetrations through floor shall have minimum 1½" (40 mm) sleeve up-stand, welded.
- .4 Removable open gratings shall be provided over floor openings.
- .5 Underside of base shall be insulated with 2" (50 mm) thick 4 lb/ft³ (64 kg/m³) density glass fibre acoustic insulation.

**2.1.5 Drain Pans:**

- .1 Coil drain pans of 16 ga (1.59 mm) minimum stainless steel shall be recessed into floor and shall be integral part of floor paneling, minimum of 6" (150 mm) and 2" (50 mm) deep respectively with welded corners. Drain pans under each 'wet' coil must extend upstream and downstream as required to ensure no carryover. Drain pans shall also extend under cold coil headers and return bends.
- .2 Drain pan shall be sloped to outlet and outlet pipe bottom invert shall be below bottom of pan. Drain pan shall be provided with interior 1¼" (32 mm) copper pipe drain piped to outside of unit.
- .3 Provide drain pans under coil banks to allow for cleaning. Cap drain connections at exterior of unit for dry coils.
- .4 Provide information to Contractor indicating minimum required exterior trap depths.

2.1.6 Casing:

- .1 Rooftop unit(s) shall be weatherproof and equipped for installation outdoors. This shall include prevention of infiltration of rain and snow into unit.
- .2 Unit casing shall be minimum 16 ga (1.61 mm) galvanized sheet metal. Finish coat shall be air-dry enamel, to exposed surfaces. Colour to Architects choice for rooftop units.
- .3 Units shall be tested to 3% leakage at 1.5 times operating pressure.
- .4 Generally, with structurally framed units, walls and roofs shall be of interlocking construction, with at least two breaks at each interlocking joint. Joints shall be secured by sheet metal screws or pop rivets.
- .5 Wall joints shall be broken in, roof joints shall be broken out for rigidity. Joints shall be caulked with water impervious sealant (Weatherman 222).
- .6 Required holes in casing for controls, electrical, piping etc. shall have grommets. Seal factory utilized openings neatly and airtight. Site sealed openings shall be to standard set by Manufacturer.
- .7 Provide radiused bell mouth duct outlet connections for supply plenum installations and for plug fan inlet.
- .8 Insulate interior walls with 2" (50 mm) thick, 3 lb/ft³ (48 kg/m³) min. density glass fibre neoprene coated acoustic insulation. Edges of insulation shall be covered with metal Z bars. Insulation pins shall be secure and ends trimmed and covered with neoprene caps.
- .9 Interior face of insulated walls shall be covered with 22 ga (0.85 mm) unpainted perforated galvanized steel liner (except immediately downstream from cooling coils).

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- .10 Provide 22 ga (0.85 mm) galvanized sheet metal covering on acoustically lined plenum walls for 4'-0" (1.2 m) downstream from cooling and heat extract coils.
  - .11 Provide marine lights with protective metal cage and glass seals in unit compartments complete with extra-long life krypton bulbs (60 W min.) or compact fluorescent lamps of equivalent wattage. Provide vapour proof fluorescent lights in corridors. Light switches with indicator lights shall be installed outside next to each plenum door.
  - .12 Provide duplex receptacle in any service corridor.
  - .13 Provide motor lifting rail for motors over 25 hp (18.6 KW).
- 2.1.7 Access Doors:
- .1 Access doors shall be provided for access to internal parts, fully lined, with welded steel door frame and Ventlock310 latches complete with front and inside handles and front door pull. Arrange access doors so they open against airflow and static pressure. Door seal shall be closed cell neoprene bulb type.
  - .2 Doors shall be 24" (600 mm) wide by 60" (1,500 mm) high unless casing size requires shorter door or equipment removal requires wider door.
  - .3 Access doors shall include 10" (250 mm) diameter windows. Windows should be maximum of 67" (1,650 mm) from roof or mechanical room floor.
  - .4 Exterior access doors shall be hollow-core insulated metal doors with 1 $\frac{3}{4}$ " (45 mm) thickness, set in formed metal frames. Two ventlock handles and lock set, which shall be equivalent to Corbin-Mortised manufacture.
  - .5 Provide rain excluding seals and gutters for external access doors.
- 2.1.8 Fans:
- .1 Fan sections shall be equipped with structural steel channels located under isolator loads to add rigidity, eliminate floor deflection, and distribute loads to perimeter structural channel.
  - .2 Centrifugal fans shall be rated in accordance with AMCA Standard Test Code Bulletin 210. Fans shall bear AMCA sticker.
  - .3 Fans and fan assemblies shall be dynamically balanced during factory test run.
  - .4 Fan shafts shall be selected for stable operation at least 25% below first critical RPM.
  - .5 Backwardly inclined and airfoil fans shall be used.
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- .6 Bearings: Heavy-duty pillow-block grease lubricated ball or roller self-aligning type. Bearings shall have an average life of 200,000 hours at design operating conditions in accordance with AMSI B3.15. Inboard bearing lube line shall be extended to outboard bearing.
  - .7 Bearing support shall be from rigid structural steel base frame. Frame shall be internally isolated and seismically restrained from fan cabinet structural frame.
  - .8 Drives shall be adjustable on fans with motors 5 hp (3.7 KW) or smaller. On fans with motors above 5 hp (3.7 KW) fixed drive shall be provided. Include for one sheave change per fan, during air balance procedure.
  - .9 Drives shall be selected for 150% of motor nameplate horsepower and include 2 belts minimum.
  - .10 Sheaves shall be keyed to drive shafts.
  - .11 Motor mounting shall be adjustable.
  - .12 Plenum fan assemblies fully enclosed with expanded mesh screen, approved to Workplace Safety and Insurance Board (WSIB) Standards.
  - .13 Belt drive with belt guards complete with tachometer holes.
  - .14 Fan inlet safety screens.
- 2.1.9 Vibration Isolation:
- .1 Vibration isolators and seismic restraints shall be in strict accordance with Section 23 05 48. Substitute vibration isolators will be accepted.
- 2.1.10 Control Dampers:
- .1 Control dampers to be T.A. Morrison – (1000) airfoil or Ruskin CD-50.
  - .2 Control dampers to be located inside unit so damper actuators are accessible from inside unit.
  - .3 For mixing plenums, arrange dampers to enhance mixing of air streams.
- 2.1.11 Coils – Liquid:
- .1 To be supplied by unit Manufacturer as scheduled.
    - .1 Coil Casings: Material to match unit casing. Provide insulated sheet metal housings over cooling coil return bends. Blank-off plates as required.
    - .2 Heating coils: ARI tested to 250 psi (1,725 kPa) as per ARI Test Code. Pitched in unit casing for drainage. Copper tube mechanically expanded into aluminum fins. Performance as scheduled.

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- .3 Cooling coils: Tested to 250 psi (1,725 kPa) as per ARI test code. Copper tube mechanically expanded into aluminum fins. Performance as scheduled.
  - .2 Coils (except cooling coil) shall be fully enclosed within casing and mounted on epoxy primed and painted angle iron racks manufactured to allow coils to slide out. No air bypass around coils will be permitted.
  - .3 Support racks for cooling coils shall be 304 Stainless Steel.
  - .4 Removable coil access panel(s) to permit removal of coil through casing wall. Provide individual access panel for each coil section to allow removal of one coil without affecting connections to any other unit component.
- 2.1.12 Louvres/Hoods:
- .1 Outside louvres and hoods with 1" (25 mm) birdscreen.
- 2.1.13 Humidifiers – Steam:
- .1 Stainless steel steam jacketed dispersing manifold with internal noise attenuating screen,
  - .2 Stainless steel separating chamber.
  - .3 Steam control valve with pneumatic or electric actuator. Coordinate with Controls Contractor.
  - .4 Y type strainer and inverted bucket trap.
  - .5 Electric temperature switch, field installed, to prevent cold start-up of humidifier.
  - .6 Length and number of manifolds as scheduled.
  - .7 Humidifier supplier to be responsible to ensure humidifier tube spacing and location are selected to ensure complete steam absorption before reaching coil bank or filters.
- 2.1.14 Filter Service Ladders:
- .1 Provide rolling ladders in each filter compartment for servicing of pre-filter and final filters.
  - .2 Minimum Requirements:
    - .1 Constructed from lightweight electric welded steel tubing with press formed safety steps.
    - .2 Spring loaded casters which retract to lock ladder or raise unit for mobility of unit and rubber tipped feet.
    - .3 Safety rails to comply with WSIB Standards and regulations.
    - .4 4 steps including platform and platform height of 38" (950 mm).
- 2.1.15 Filters – General:
- .1 Filter media shall be ULC listed, Class I or Class II.
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- .2 Filters: suitable for air at 100% RH and air temperatures between 37°F (3°C) and 122°F (50°C).
- .3 Efficiency: based on ASHRAE 52-76, atmospheric dust spot efficiency.
- .4 Dust holding capacity: Air Filter Institute (AFI) Test.
- .5 Representative filters shall have been tested by independent test laboratory and test results made available on request.
- .6 Filter identification shall be clearly marked on each filter.
- .7 Provide two sets of filter media (for each filter) – one for installation and one for handover to Owner as spare. Obtain signed receipt.
- .8 Filter holding frames fabricated from 16 ga (1.61 mm) galvanized steel with spring retaining clips and neoprene gaskets.
- .9 No air bypass around filter frames will be allowed. Provide access space for servicing filters. Install filter slide rails and doors for side access where required.
- .10 Each filter section shall be designed to receive standard sized filters only. Use of odd-sized filters is not permitted.

2.1.16 Filters – Panel Type:

- .1 Minimum Requirements:
  - .1 2" (50 mm) thick disposable pleated cotton media.
  - .2 Enclosing frame shall be constructed from rigid, heavy duty high wet strength beverage board with diagonal support members bonded to both sides of each pleat.
  - .3 Efficiency: 25% to 30%.
- .2 Standard of Acceptance:
  - .1 AAF AM-AIR 300, Farr 30/30.

2.1.17 Filters – Final:

- .1 Minimum Requirements:
  - .1 12" (300 mm) deep disposable pleated fine glass fibre media.
  - .2 Rigid galvanized steel enclosing frame.
  - .3 Efficiency: as scheduled.
- .2 Standard of Acceptance:
  - .1 AAF Varicel, Farr Riga-Flo.

2.1.18 Filter Gauges:

- .1 Application:
  - .1 Across each filter bank. Provide 2 individual gauges for combined panel and final filter banks.

- .2 Minimum Requirements:
  - .1 Ranges: Panel filters – 0 - 1" w.g. (250 Pa), Final filters: 0 - 2" w.g. (500 Pa).
- .3 Sensing probes and shut-off vent valves for each filter bank. Provide space between filter banks for pressure sensing.
- .4 Standard of Acceptance:
  - .1 Dwyer Series 2000.
  - .2 Dwyer Photohelic Series 3000 (Where filter pressure drop is monitored by the BMS).

2.1.19 Implosion/Explosion Doors:

- .1 Doors shall be in accordance with Workplace Safety and Insurance Board (WSIB) Standards and regulations, constructed as for hinged access doors.
- .2 Latches shall be Brixon Safety Latches (Brixon Manufacturing Co., 859 North Prior Avenue, St. Paul, Minnesota, USA, 55104).
- .3 Latches shall be complete with handles and shall have adjustable release force as follows:

LATCH MODEL	RELEASE	FORCE	RANGE
2H	5 lb (2.3 kg)		To 33 lb (15 kg)
3H	20 lb (9.1 kg)		To 180 lb (82 kg)
4H	44 lb (20 kg)		To 180 lb (118 kg)
	.4	Refer to drawings for locations of implosion/explosion doors and required number of latches.	
	.5	Provide heavy duty safety chains to limit door swings.	
	.6	Adjust tensions on implosion/explosion door latches so doors open at static pressure differential not greater than 2" w.g. (500 Pa) above/below specified static pressure rating of plenum.	
	.7	Perform tension tests on doors to verify that doors open at settings on latches.	
	.8	Adjust tensions on latches, and permanently mark final setting of adjustment screws.	

2.1.20 Heat Recovery Units:

- .1 Provide packaged heat recovery units or sections as specified in schedules.
- .2 Provide access to unit for cleaning.
- .3 Provide integral drain pan in floor under entire unit with exterior drain connection.

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- .4 Provide by-pass dampers for:
    - .1 100% outside air flow not through unit.
    - .2 100% by-pass of warm air stream (return air) when not needed.
    - .3 Freeze/frost protection.
  - 2.1.21 Variable Speed Controllers:
    - .1 For smaller VSDs which are suitable for unit mounting provide suitable stand-off panels on outside of AHU casing for field mounting of variable speed drive units. Provide rubber grommet isolators at attachment points to AHU casing.
  - 2.1.22 Plenum Cleanliness:
    - .1 Wash clean plenums and corridor areas before shipping.
  - 2.1.23 Duct Connectors - Vibration Isolation:
    - .1 Provide flexible duct connections to provide vibration isolation at duct or plenum connections to fan units. See Figure 2-19 SMACNA HVAC Duct Construction Standards, 1975.
    - .2 Minimum Requirements:
      - .1 Pre-assembled 3" (80 mm) minimum long flexible connection with 3" (80 mm) long, 24 ga (0.70 mm) galvanized steel duct connectors on each side of flexible connection.
    - .3 Standard of Acceptance:
      - .1 Duron Dyne "Durolon", Ventfabrics "Ventlon".
  - 2.1.24 Dampers:
    - .1 Opposed type blade for modulating dampers unless otherwise indicated: parallel type blade for two position dampers unless otherwise indicated. Extruded aluminum or formed galvanized steel blades, frames, gussets and blade stops.
    - .2 Shafts - galvanized or SS steel with keyways for securing blades to shafts hardware - keyed to prevent blade slippage and provide smooth blade movement.
    - .3 Assemblies - rigid and adequately braced with corner gussets.
    - .4 Maximum frame dimensions - 48" (1,200 mm) wide and 48" (1,200 mm) high, unless otherwise indicated. Apply multiple equal modules for larger sized dampers.
    - .5 Bearings and seals - suitable for exposure to minimum of -20°F (-29°C) on outside air and exhaust air dampers and maximum of 200°F (93°C) for interior dampers.



- .6 Maximum blade width - 8" (200 mm).
- .7 Low leakage type with blade and frame seals for intake and exhaust (air outlets maximum leakage in closed position shall be 4 cfm/ft<sup>2</sup> (20 L/s per m<sup>2</sup>) of face area at 1" w.g. (250 Pa) pressure differential, equal to Ruskin SD50 dampers).
- .8 Check dampers are installed square and true and blades close tightly against seals and stops.
- .9 Ensure damper end-linkages are easily accessible.
- .10 Provide additional drive shaft bearing if drive shaft longer than 3" (80 mm).
- .11 Do not install dampers within thickness of wall.

**2.1.25 Fire/Smoke Combination Dampers:**

- .1 Minimum Requirements:
  - .1 Pivoted blade type Ruskin FSD-60.
  - .2 ULC tested and labelled.
  - .3 Class II leakage rated.
  - .4 1-½ hour minimum fire rating.
  - .5 Auxiliary operating shaft.
  - .6 Galvanized steel frames, blades, gussets and blade stops.
  - .7 Stainless steel jamb seals.
  - .8 ULC approved fusible links with melting point of 160°F (70°C) on supply, return and exhaust air systems.
  - .9 Damper end switches - one for open position and one for closed position.

**2.1.26 Spray Wash:**

- .1 Heat recovery being the essence of equipment, maintenance of clean surfaces for efficient heat exchange, as well as area 1 m upstream for servicing is paramount.
- .2 Provide necessary spray wash facility integrated with wash down system provided with cooking hoods being served by respective heat recovery unit.
- .3 Coordinate with Manufacturer of hoods to ensure complete integration.
- .4 Wash system shall include, but not be limited:
  - .1 Time controllable wash cycle.
  - .2 Hot water solenoid valve(s).
  - .3 Detergent pump and injection system with storage tank.
  - .4 Manual shut-off and drain valves, for system(s) servicing.

- .5 Automatic dumping of water systems for freeze protection.
- .6 Utility connections, e.g. power, drain, water (H and C), conduit for DDC controls extended into unit service corridor.
- .7 Wash manifold positioned on both sides of exhaust section - pressure equalized. Wash manifold for face and bypass damper.
- .8 Spray nozzles to be easily accessible for servicing.
- .9 Cleanouts provided for drainage piping cleaning - accessible.
- .10 Water run surfaces protected against corrosion (by material choice or surface coating(s), i.e. stainless steel or epoxy coated galvanized steel.
- .11 Surfaces drain, particularly floors, to eliminate standing water.
- .12 Belt guards.

**2.1.27 Plenum Leakage Test:**

- .1 Leakage test each plenum to ensure zero leakage across supply and exhaust plenum walls and across separating wall plenums to corridors, to a static pressure 2" w.g. (500 Pa) in excess of plenum design static pressure.
- .2 Use equipment capable of demonstrating leakage.

**2.1.28 Plenum Cleanliness:**

- .1 Wash clean plenums and corridor areas before shipping.

**2.1.29 Filters – General:**

- .1 Filter media shall be UL listed, Class I or Class II.
- .2 Filters: suitable for air at 100% RH and air temperatures between 37°F (3°C) and 122°F (50°C).
- .3 Efficiency: based on ASHRAE 52-76, atmospheric dust spot efficiency.
- .4 Dust holding capacity: Air Filter Institute (AFI) Test.
- .5 Representative filters shall have been tested by an independent test laboratory and test results shall be made available on request.
- .6 Filter identification shall be clearly marked on each filter.
- .7 Provide two sets of filter media for each filter - one for installation and one for handover to the Owner as spare. Obtain signed receipt.
- .8 Filter holding frames fabricated from 16 ga (1.61 mm) galvanized steel with spring retaining clips and neoprene gaskets.

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2.1.30 Filters - Panel Type:

- .1 Minimum Requirements:
  - .1 2" (50 mm) thick disposable pleated cotton media.
  - .2 Enclosing frame shall be constructed from rigid, heavy duty high wet strength beverage board with diagonal support members bonded to both sides of each pleat.
  - .3 Efficiency: 25% to 30%.
- .2 Standard of Acceptance:
  - .1 AAF AM-AIR 300, Farr 30/30.

2.1.31 Filters – Final:

- .1 Minimum Requirements:
  - .1 12" (300 mm) deep disposable pleated fine glass fibre media.
  - .2 Rigid galvanized steel enclosing frame.
  - .3 Efficiency: as scheduled.
- .2 Standard of Acceptance:
  - .1 AAF Varicel, Farr Riga-Flo.

2.1.32 Fresh Air Intake Cowl:

- .1 Fresh air intake cowl shall be sized for maximum inlet air velocity of 200 ft/m (1.01 m/s).
- .2 It shall be equipped with:
  - .1 Intake bird screen.
  - .2 Manifold collecting plenum with bottom inlets and slide dampers. Dampers in place in overall systems balancing process.

2.1.33 Gauges - Air Pressure:

- .1 Application:
  - .1 Across each filter bank. (Provide 2 individual gauges for combined panel and final filter banks).
  - .2 Across the following fans:
    - .1 SF-1, EF-1: SF-2, EF-2.
  - .3 Across heat recovery coil supply air side and exhaust air side.
- .2 Minimum Requirements:
  - .1 Ranges:
    - .1 Panel filters: 0 - 1" w.g. (250 Pa).
    - .2 Final filters: 0- 2" w.g. (500 Pa).
    - .3 Supply fans: 0 - 6" w.g. (1,500 Pa).
    - .4 Exhaust fan: 0 - 2" w.g. (500 Pa).
    - .5 Heat recovery coil: 0 - 1" w.g. (250 Pa).

- .2 Accessories:
  - .1 Copper or aluminum tubing.
  - .2 Static pressure pick-up tips.
  - .3 Mounting assembly.
  - .4 Plastic vent valves.
- .3 Standard of Acceptance:
  - .1 Dwyer Series 2000.

2.1.34 Ancillary Features:

- .1 Exterior access doors shall be hollow-core insulated metal doors with 1 $\frac{3}{4}$ " (45 mm) thickness, set in formed metal frames. Two ventlock handles and lock set, which shall be equivalent to Corbin-Mortised manufacture.
- .2 Provide rain excluding seals and gutters for access doors.
- .3 Service corridors shall be provided with:
  - .1 Minimum of two lights with wire casing wired in conduit to switches.
  - .2 Duplex receptacles for service tool operation.
  - .3 Separate 120 V circuit to power DDC control panel.
- .4 Power supply to heat recovery unit shall be:
  - .1 One 3 phase 600V service for power.
  - .2 One 1 phase 120 V service for lighting and other uses.
  - .3 One 1 phase 120 V service for receptacles.

### 3 . **EXECUTION**

#### 3.1 **Unit Installation**

- 3.1.1 Where air units are fabricated and shipped in component sections, components shall be field assembled using bolted, gasketed companion flanges to make single airtight unit. Test for leakage and seal as required.
- 3.1.2 Install units as indicated and to Manufacturers' recommendations.
- 3.1.3 Maintain proper clearance around equipment to permit performance of service maintenance, coil removal and repair.
- 3.1.4 Make ductwork, piping, and wiring connections to unit in accordance with drawings.
- 3.1.5 Pipe from condensate drains to **[roof]** drain complete with trap. Install unit so curb / housekeeping pad height sufficient to accommodate depth of 'P' trap.
- 3.1.6 Install suspended unit with bracing or cable restraints to accommodate seismic loading.

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- 3.1.7 Seismically secure floor/roof mounted AHUs to curbs or housekeeping pads by either bolting or welding to embedded steel plates. Ensure curbs/housekeeping pads are securely attached to structure.

**END OF SECTION**

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## 1. **GENERAL**

### 1.1 **Related Work**

- 1.1.1 This Specification Section forms part of Contract Documents and are to be read, interpreted and coordinated with other parts.

### 1.2 **Scope**

- 1.2.1 Provide a complete radiant heating and cooling system as shown on the drawings and as specified herein.
- 1.2.2 Coordinate installation of control system outlined in Section 25 .

### 1.3 **Quality Assurance**

- 1.3.1 Manufacturer's Qualifications for Radiant Heating and Cooling System Components: Firms regularly engaged in manufacture of radiant heating and cooling system products and tools of the types, materials, and sizes required; whose products have been in satisfactory use in similar service for not less than 5 years.
- 1.3.2 Installer's Qualifications: Installer must have completed a certified training program or be a certified Contractor by one of the listed acceptable Manufacturers, and shall have at least two years of successful installation experience on projects with radiant heating and cooling piping systems similar to that required for this project.
- 1.3.3 Codes and Standards: Comply with local, state and federal laws and ordinances.
- 1.3.4 All radiant heat and cooling system components shall be provided by one Manufacturer.
- 1.3.5 Provide 25 year Manufacturer's guarantee against manufacturing defects on materials installed within ceiling or topping. Installer shall provide five year warranty against faulty workmanship.
- 1.3.6 Radiant heating and cooling installer shall provide water balancing downstream of each independent circuit to achieve design water flows.
- 1.3.7 Radiant surface temperatures shall not exceed 91°F (33°C) at design heat output or be less than dew point at design cooling output.

### 1.4 **Submittals**

- 1.4.1 Shop Drawings:
- .1 Submit Manufacturer's technical product data and installation instructions for radiant slab piping materials and products for approval before ordering and/or installing any of the system components.

- .2 Radiant system installer shall provide detailed shop drawings including piping/capillary mat layouts and equipment locations including the following information:
  - .1 For each radiant heating and cooling system submit:
    - .1 Space identification.
    - .2 Radiant zone and loop schedule pipe/capillary mat layouts.
    - .3 Active pipe length per circuit.
    - .4 Pipe type, size, installation details, spacing and length of each loop.
    - .5 Manifold lengths, space requirements and mounting details.
    - .6 Pumps, controls, control units and zone motors; thermostat and manifold locations.
    - .7 Miscellaneous accessories such as air vents, flow meters, drain valves and pressure bypass.
    - .8 Electrical requirements and locations of power supply required; transformers.
    - .9 Pressure test certificates signed by radiant heating and cooling system installer and General Contractor stating initial and final pressure and time of test as well as space temperature during installation shall be provided to Consultant prior to concealing the system (pouring, topping or concrete for in-slab applications). Include copies in Mechanical Maintenance Manuals.

## 1.5 **Coordination**

- 1.5.1 Mechanical Contractor shall coordinate with General Contractor to schedule installation of radiant heating and cooling system.
- 1.5.2 Tube spacing shall not exceed specified value to ensure even surface temperatures.
- 1.5.3 Verify exact location, space requirements and access details for manifolds and control unit before start of work.

## 2. **PRODUCTS**

### 2.1 **Radiant Slab Heating and Cooling System**

- 2.1.1 Standard of Acceptance: Uponor, Rehau, Giacomini, Watts Radiant or X-PERT, HeatLink (PEX-a).
- 2.1.2 Radiant Slab Piping:
  - .1 Radiant slab piping shall be flexible high molecular cross-linking polyethylene piping (PEX) complete with oxygen diffusion barrier, DN15 203°F (95°C) i.d., 5/8" (16 mm) o.d.

Maximum operating pressure and temperature; 100 psi (690 kPa) and 205°F (96°C), respectively.

- .2 PEX piping shall be manufactured in accordance with the Engle method, the Dow-Corning method or the Sioplas method or electron beam processing method in accordance with ASTM F876, F877-85.
  - .3 Oxygen diffusion barrier shall comply with DIN 4726 requirements and shall limit oxygen diffusion through PEX piping walls to less than 0.04g/m<sup>3</sup>/day at 105°F (40°C).
- 2.1.3 For slab-on grade installations the sub-slab insulation shall be minimum 2" (50 mm) thick Type V, 100 psig compressive strength rigid insulation. Coordinate with Architectural and Structural details and plans.

## **2.2 Supply and Return Manifolds**

- 2.2.1 Provide modular supply and return manifolds of cast bronze or stainless steel construction as used in typical radiant heating and cooling systems complete with wall support brackets, end caps, automatic air vents, hose bibbs, thermometers; supply module with built in shutoff valves and return module with flow regulating and balancing valves complete with flow indication. Headers to be modular (3 to 13 circuits) with O-ring seals for each header.
- 2.2.2 Manifolds to be placed in an accessible manifold housing. Housing to be a pre-manufactured metal access box. Doors are to be hinged to allow for unobstructed access.
- 2.2.3 Refer to Architectural details for specific requirements for access door design.
- 2.2.4 All loop numbers to be marked on radiant loop pipe before connecting to manifold. Space identification and loop number is to be printed and placed on each pipe and where it connects to the supply and return header. All loops must be clearly identified to allow for future balancing.
- 2.2.5 Manifolds to be protected during construction from dirt, dust or concrete during the pour (i.e., by using a plastic wrap).

## **3. EXECUTION**

### **3.1 Radiant Slab Heating and Cooling System Installation**

- 3.1.1 Radiant piping shall be installed in strict accordance with all applicable code requirements and with the piping Manufacturer's installation instructions. Allow for sufficient installation assistance and site supervisions by the piping Manufacturer's Representative.



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- 3.1.2 System operating parameters, number of supply and return manifolds and number of individual loops shall be as indicated on the drawings.
  - 3.1.3 Spacing and length of individual radiant slab piping loops shall be as shown on drawings. Maximum loop length shall not exceed 328 ft (100 m) for ½" (15 mm) per pipe unless specified otherwise. Loop length limits for ⅝" (16 mm) per 492 ft (150 m), and for ¾" (20 mm) per is 722 ft (220 m), based on a maximum per loop friction of 25 ft (7.5m).
  - 3.1.4 Ensure that the minimal piping bend radius is not less than the minimum allowable bend radius for the given pipe size as specified by the Manufacturer. Typically, minimum bend radius shall be at least eight times the outside pipe diameter.
  - 3.1.5 Radiant heating and cooling piping installed on top of structural concrete slab shall be secured to the slab by suitable fastening method approved by the piping Manufacturer. Where the tubing is to be installed in a structural slab, provide 6" (150 mm) x 6" (150 mm) steel mesh, wired to re-bar to act as a mounting mat for the radiant tubing. Coordinate mesh elevation in slab for low level (radiant ceiling) or higher level (radiant floor) application.
  - 3.1.6 Where the tubing is to be installed in a topping slab, the tubing shall be tied to the 6" (150 mm) x 6" (150 mm) steel mesh, stapled into the base slab/flooring such that the tube has at least 1" (25 mm) coverage over top of the tube to the finished surface of the topping.
  - 3.1.7 For PEX piping, piping loop connections at the supply and return manifolds shall be made with compression type fittings supplied by the piping Manufacturer. Provide tube band supports where loops are connected to the manifolds.
  - 3.1.8 For PP piping all piping connections shall be by heat fusion or approved heat fusion to threaded fittings.
  - 3.1.9 Piping to be fully enclosed in a protective elbow or straight conduit where it penetrates into the slab, or where it penetrates control or expansion joints in the concrete slab as per Manufacturer's recommendations. The protective conduit shall extend at least 6" (150 mm) on either side.
  - 3.1.10 All individual radiant heating and cooling piping circuits shall be laid in a configuration as show on the drawings as single continuous piping loops with no splices in the concrete slab.
  - 3.1.11 All radiant heating and cooling piping damage requiring replacement or repair shall be reported to the Consultant who will evaluate the reported damage and will decide at his/her discretion if a replacement of the entire damaged loop is required or if an in-slab piping repair can be authorized. No in-slab piping repairs are to be made without a written authorization of the Consultant. If in-slab

repair joints are authorized, only brass insert compression couplings approved by the Manufacturer are to be used. All in-slab repairs shall be made in strict accordance with the Manufacturer's instructions and shall be inspected, pressure tested and approved by the Manufacturer's Representative and the Engineer and clearly recorded on the as-built drawings. The manufacturer's representative shall confirm in writing that the repairs will not void any product certifications for the piping.

- 3.1.12 Closely coordinate radiant heating and cooling piping payout with other trades. Avoid sanitary drain piping penetrations, electrical conduit penetrations, partition wall anchors, furniture anchors, etc. through floor assemblies.
- 3.1.13 In all areas where other trades will be drilling, coring or anchoring other equipment, furniture or structures to the slab, the Contractor shall mark locations of in-slab piping on the concrete slab surface to avoid penetration of fasteners used (i.e., Hilti, Ramset, etc.).
- 3.1.14 The radiant heating and cooling system shall not be used for temporary heating until the structural slabs are sufficiently cured and until all controls and safety devices are in place and in working order.
- 3.1.15 Thoroughly clean, degrease and flush the new system. System cleaning to be in accordance with the specifications and/or Manufacturer's recommendations.
- 3.1.16 Pressure test system to minimum of 100 psi (690 kPa) for period of not less than 12 hours prior to placing concrete. During concrete pouring, pressure shall be checked at regular intervals to ensure no leakage has occurred.
- 3.1.17 No in-slab pipe joints shall be allowed.

### **3.2 Hydrostatic/Air Testing**

- 3.2.1 Pressure test radiant piping by using minimum 80 psi (550 kPa) to maximum 100 psi (690 kPa) hydrostatic test shall commence immediately following the respective loop and header installation. The radiant system piping shall remain pressurized until the substantial completion.
- 3.2.2 Hydrostatic pressure test is a more reliable indicator of a potential problem and is therefore, the preferred method. However, caution is required when installing radiant system during winter with structure and system exposed to climatic elements and freezing temperatures. It is the Contractor's responsibility to protect the integrity of the system by thoroughly purging it with compressed air until it is completely dry and reverting to air pressurization during cold weather.
- 3.2.3 The system will be maintained under pressure while topping is being poured. Initial pressure at start of pour shall be recorded. Log

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pressures at 12 hour intervals for 48 hours after pour and forward test information to Consultant. Include copies in Mechanical Maintenance Manuals.

**3.3 Testing, Balancing and Warranties**

- 3.3.1 Contractor is responsible to make all necessary adjustments to the radiant heating and cooling system equipment and controls and shall ensure system is properly tested, balanced and operating.
- 3.3.2 Balance the entire radiant heating and cooling system to flows specified on the drawings.
- 3.3.3 Submit detailed balancing report indicating recorded flows, pressure and temperature drops for each of the radiant loops and the entire system.
- 3.3.4 Submit a detailed test and inspection report of the radiant slab piping system signed by the radiant piping Manufacturer's Representative.
- 3.3.5 A 25 year limited warranty (in writing) must be issued by the radiant piping Manufacturer.
- 3.3.6 Adjust loop flow rates and educate occupants during first year of operation to ensure occupants are satisfied with their system.

**END OF SECTION**

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1. **GENERAL**

1.1 **Related Work**

- 1.1.1 This Specification Section forms part of Contract Documents and is to be read, interpreted and coordinated with other parts.

2. **PRODUCTS**

2.1 **Humidifiers - Electric**

2.1.1 CSA approved.

2.1.2 Steam generator section:

- .1 Self-contained disposable cylinder microprocessor controlled electrode steam generator containing lattice electrodes.
- .2 Auto-Adaptive control system to monitor and optimize water conductivity, fill and drain rate.
- .3 LED display panel to indicate unit operating parameters, including current draw, humidistat demand, steam production, capacity limitation and fault messages (including end of cylinder life).
- .4 Drain and fill solenoid valve with built-in strainer, pressure reducing and flow regulating orifice.
- .5 Primary voltage terminal block contactors and thermal overload protection.
- .6 Fuse protected primary-to-24 V control transformer and low voltage terminal strip.
- .7 Humidifier to be suitable for control by ON/OFF 24 V humidistat.
- .8 Cabinets 16 ga (1.61 mm) steel cabinet with enamel finish and three separate compartments for plumbing, low voltage and high voltage, with lockable access doors.
- .9 Wall mounting bracket.
- .10 Factory tested package assembly.
- .11 Provide one replacement cylinder for each circuit of each humidifier.

2.1.3 Steam Distributor:

- .1 Suitable for application with specified humidifier.
- .2 Length as required, suitable for insertion in duct as indicated on drawings.

- .3 Unit to incorporate condensate separator and return leg.
- 2.1.4 Accessories:
  - .1 Duct mounted ON/OFF hi-limit humidistat, 15% to 90% RH range.
  - .2 Duct mounted pressure differential switch, for air proving interlock.
- 2.1.5 Standard of Acceptance: Nortec NH Series, Pure Humidifier, DriSteem Vaporstream, Neptonic.

## **2.2 Humidifiers - Evaporative**

- 2.2.1 Casing: Galvanized steel reinforced and braced for seismic loading. Access doors.
- 2.2.2 Drain Tank: Welded black steel, prime coated inside and out with zinc chromate, iron oxide, phenolic resin paint.
- 2.2.3 Filters: Two row (wet and dry)
- 2.2.4 Water Inlet: Float valve assembly with brass rod, float ball and valve.
- 2.2.5 Spray Pumps: Centrifugal pump with brass impeller, in galvanized well; built-in overload protection. Refer to pump Schedule.
- 2.2.6 Distribution System: PVC piping.
- 2.2.7 Gasket and flange pipe penetrations, inspection panels, access doors and other openings in unit casing.

## **3 . EXECUTION**

### **3.1 Humidifiers - Electric Installation**

- 3.1.1 Installation to be checked and started by factory Representative.
- 3.1.2 Refer to Manufacturer's installation manual for installation of unit.
- 3.1.3 Confirm electrical service requirements of unit corresponds with available services.
- 3.1.4 Install unit to ensure adequate clearances for servicing.

### **3.2 Humidifiers - Evaporative Installation**

- 3.2.1 Place unit on neoprene cork pad same size as unit tank. Flash and counter flash with 20 ga (1.00 mm) galvanized iron, entering and leaving sides to eliminate exposure of cork to water.
- 3.2.2 Provide bleed line from sump drain to nearest floor drain, complete with globe valve (and solenoid valve).
- 3.2.3 Bolt spray pump directly to tank fitting.
- 3.2.4 Insulate exterior of unit as specified for ductwork.

- 3.2.5 Secure unit to structure with bolts and rubber grommets suitable for seismic loading.

**END OF SECTION**

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1. **GENERAL**

1.1 **Conformance**

- 1.1.1 All Sections of Division 21, 22, 23 and 25. Specifications form part of Contract Documents and are to be read, interpreted and coordinate with all parts. Conform to General Conditions and Division 00, 01, instructions to Bidders, Contract General Conditions and Supplements thereto form part of this Division and contain items related to mechanical work.

1.2 **Codes references and Standards**

- 1.2.1 The most current Ontario Building Code at time of the Standard's intended use, including Amendments.
- 1.2.2 National Research Council Canada (NRCC), National Energy Code for Building 2015.
- 1.2.3 Canadian Electrical Code, CE code, or CSA C22.1 (the latest edition).
- 1.2.4 American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE):
- 1.2.5 ANSI/ASHRAE 135-2008, BACnet – Data Communication Protocol for Building Automation and Control Networks, including amendments.
- 1.2.6 Consumer Electronics Association (CEA): CEA 709.1-2021, Control Network Protocol Specification.
- 1.2.7 Canadian Standards Association (CSA): CSA C22.2 No. 45, CSA C22.2 No. 75, CSA C22.2 No. 83.
- 1.2.8 Region of Peel, Digital and Information Services Department – RFP Information Security Requirements Document.

1.3 **Work Included**

- 1.3.1 Complete system of automatic controls.
- 1.3.2 Electronic facilities management/DDC control system.
- 1.3.3 Control devices, components, wiring and material.
- 1.3.4 Instructions to Owner.
- 1.3.5 Provide all system source Codes (programming) to Owner.
- 1.3.6 Bidders shall provide compliance/non-compliance and partial compliance statement for each item in this specification and sign off on each item of the specified items. Where non-compliant, the bidder shall provide an explanation and date on alternative provisions.

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**1.4 Quality Assurance**

- 1.4.1 Provide a complete system of automatic controls for mechanical systems by firms employing certified journeymen who specialize in this type of work and have proof of completing five projects of similar size and complexity.
- 1.4.2 Provide complete system of automatic controls for mechanical systems. The equipment shall be one Manufacturer and shall be installed by certified mechanics and electricians regularly employed by the Manufacturer, or the Manufacturer's approved system integrator.
- 1.4.3 It is the Contractor's responsibility to provide all items required to complete the installation, including but not limited to, all computer software and hardware, operator input/output devices, remote panels, sensors, controls, required to meet the performance requirements as set forth in this Section. The Contractor shall provide all wiring piping, raceways, conduit, installation supervision and labour, including calibration, adjustments and checkouts necessary for a complete and operational system. Acceptable Controls Vendors are as follows:
  - .1 Delta
  - .2 Johnson Controls
  - .3 Trane

**1.5 Submittals**

- 1.5.1 Submit shop drawings in accordance with Section 23 05 00.
- 1.5.2 Provide damper shop drawings which include data such as location, arrangement, velocities and static pressure drops for each system. Provide data for all control valve sizing including pressure drops with control valve shop drawing submission.
- 1.5.3 Include complete operating data, component setpoints, system drawings, wiring diagrams, installed program flow charts and program listing, written detailed sequences of operation and engineering data on each control system component. Include sizing as requested. Components are to be labelled and identified as to use. Submit to Mechanical Contractor for inclusion in Operating and Maintenance Manuals.
- 1.5.4 Provide, in addition to shop drawing submittals, a detailed list of maintenance instructions including daily, weekly, monthly and annual maintenance requirements for each component of the automatic control system. Copy to be included in the Mechanical Maintenance Manuals in the Maintenance and Lubrication Tab.
- 1.5.5 Label components on drawings and identify as to function.



- 1.5.6 Submit CDs, including backup CDs, with up-to-date programs in each controller. Provide original program CDs for each software package complete with validated registrations.

**1.6 Substantial completion Test Procedures**

- 1.6.1 Before the seven day acceptance test may begin, the DDC system must be completely operational including the following:
- .1 Every point shall be checked end-to-end to ensure accuracy and integrity of the system. Each point shall appear on a points list (to be prepared by the Contractor) and be signed off by both persons involved in the commissioning procedure.
  - .2 Basic control strategies shall be written in user-friendly control language. Major system problems preventing accurate control shall be reported in writing by the Contractor.
  - .3 Provide program flow charts for installed program.
  - .4 The measured variable, controlled variable and setpoint if calculated of each control loop should be placed on a 15 minute continuous trend for at least 24 hours to prove stability of loop.
  - .5 Each space sensor should be placed on a three hour trend for 100 samples.
  - .6 Run time totalizer should be set on all digital outputs.
  - .7 Load/save of panel programs must be demonstrated.
  - .8 All features of system shall be exercised
  - .9 Operator shall be briefed on operation of system, using a minimum of one 8 hour work day.
  - .10 A trend in one panel will be set up for a point from another panel. This point should also be trended in its own panel for the same intervals. Comparison of the two trends will indicate if any communication problems are occurring during the seven day test.
  - .11 Related binary inputs/outputs and related status points shall be connected to show alarm condition.

**1.7 Documentation**

- 1.7.1 The following documentation must be in place before completion of the test and substantial acceptance is granted:
- .1 Panel layout sheets complete with point name, point address and wire identification number. One copy attached to each respective panel door.
  - .2 All points tagged with point name, point address and panel number.

- .3 As-built control drawings.
- .4 As-built Eclipse program flow charts.
- .5 As-built ladder wiring diagrams showing all hardware interlocks.
- .6 Complete Operator's Manual.
- .7 Apparatus and Maintenance Manual for all sensors, transducers, solid state relays, etc.
- .8 Electrical approval certificate.
- .9 All of the above information with the exception of No.2 (point tags) shall be bound and presented in manuals, which are to be handed over to the Owner together with the Operating and Maintenance Manuals.

1.7.2 Once the above basic requirements are met and all other features of the system are complete and acceptable, substantial completion shall be granted. A deficiency list shall be prepared and holdbacks applied. All deficiencies shall be corrected prior to total acceptance. Warranty shall start from total acceptance.

## **1.8 Owner Orientation**

- 1.8.1 At completion, provide minimum of 3 day instruction period for operating personnel regarding control operation, calibration and unit operation. Instruction shall include but not limited to the following, user must be able to access all menus, change setpoints and ratios, acknowledge alarms and maintenance time reminders, access one panel from another, and follow program flow charts. This is in addition to Section 23 05 00 requirements.
- 1.8.2 The training session shall not be part of the system commissioning.
- 1.8.3 Submit training program to Consultants four weeks prior to substantial completion for their review and comments.
- 1.8.4 At the end of all the training sessions, obtain training completion form from Owner and submit report to Consultants.

## **1.9 Warranty**

- 1.9.1 On completion of mechanical system installation, Controls Contractor shall warranty complete control system as specified from defective material and workmanship for a period of one year.
- 1.9.2 In addition to the service required for call-backs, the Controls Contractor shall provide four complete inspections, consisting of at minimum of one 8 hour/day times four seasonal visits and as required for post occupancy adjustments. One in each session to adjust the controls as required with written reports submitted to the Engineer. Provide notification of when inspections are to be done.
- 1.9.3 Check and recalibrate all thermostats, sensors, damper and valve stroke and transducers at final year end inspection.

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**1.10 System Activation**

- 1.10.1 Submit control calibration check sheets. Check sheets to include unit identification, DDC panel tag number, controlled point tag number, sensed point tag number, actuator controlled setpoint, ratio, reset settings, interlock devices (i.e., limiting relays) and respective settings.
- 1.10.2 Provide attendance as required by Balancing and Commissioning Agents to set damper linkages; adjust to and set variable volume control and tracking devices and static pressure controls. Verify outdoor air flow rate at eight damper positions to ensure damper position corresponds to flow rate. Control calibrate algorithm to match air flow and damper position.
- 1.10.3 Adjust and calibrate all room sensors. Confirm proper operation of all terminal box and radiation valve control and sequencing.

**2 . PRODUCTS**

**2.1 General**

- 2.1.1 Provide control systems consisting of operator's devices, indicating devices, interface equipment and other apparatus required to operate mechanical system and to perform functions specified. Identify all components in field by plastic nameplate, and/or non-rip point baggage tags.
- 2.1.2 Provide materials and field work necessary to connect control components factory supplied as part of packaged equipment.
- 2.1.3 Unless specified otherwise, provide fully proportional components.
- 2.1.4 Provide labelled terminal strip connection in each unit and panel connection to external controls.

**2.2 Electrical Components, Wiring and Conduit**

- 2.2.1 Wiring and Conduit:
  - .1 By Electrical Trade:
    - .1 All power supply wiring to mechanical equipment.
    - .2 All power supply wiring and conduit to main control panels.
    - .3 All smoke detectors and wiring associated with life safety shut-down and start-up of air handling systems.
  - .2 By Mechanical Trade:
    - .1 All control system low voltage wiring.
    - .2 Conduits for control wiring and components associated with the mechanical work. All low and line voltage

control wiring shall be in EMT conduit in accordance with Electrical specifications.

- .3 All low and line voltage control wiring and conduit for specified motor interlocks.
- .4 Power wiring from electrical panel to control transformers distributed round the building.

#### 2.2.2 Components

##### .1 By Electrical Trade

- .1 All disconnect switches except as specified in Mechanical Equipment Schedules.
- .2 All motor protection switches, magnetic starters and contactors.
- .3 All line voltage relays to power and control mechanical equipment.
- .4 All wiring to and from variable speed drives supplied by mechanical trade.

##### .2 By Mechanical Trade:

- .1 All temperature control systems components and packaged equipment controls, relays and transformers.
- .2 All disconnect switches, relays, transformers as specified in Mechanical Equipment Schedules.
- .3 All thermostats, dampers, damper motors, timer clocks and control panels.
- .4 All low voltage transformers to power mechanical equipment controls.
- .5 All power wiring (120 V/1 Ph) to controls transformers, control panels and control devices requiring 120 V/1 Ph power wiring (infrared flush meters etc.)

#### 2.2.3 Minimum Wiring Requirements

- .1 All exposed wiring and wiring located above removable, acoustic ceiling tiles shall be run in plenum rated, 18 gauge, two wire, twisted, shielded pair. Two wire twisted pair shall be acceptable for sensor wiring or output; coaxial cable shall be acceptable for transmission wiring. Plenum rated wiring not in EMT conduit shall be run neatly bunched in J-hooks in a rectilinear fashion, running parallel to building. Cable lines must be run at least 12" (300 mm) above ceiling. Where controls cables and wiring is run through, or in "exposed ceilings", all wiring and cables shall be run in conduit. Where permission has been gained to run in a cable tray, only then can conduit be deleted, except for branches from the cable and individual run-outs.

- .2 Alternating current wiring over 24 V, both line and low voltage, shall not be run in the same conduit or cable with direct current signals. Direct current signals include communications wiring, analog input wiring, digital input wiring and analog output wiring. 24 V AC and 0-10 V DC may be run together.
- .3 Low voltage direct current wiring shall be 2-wire shielded, twisted pair, minimum 18 gauge.
- .4 Line voltage alternating current wiring shall be copper conductor, minimum 16 gauge.
- .5 Low voltage alternating current wiring shall be copper conductor, minimum 18 gauge.
- .6 Under no circumstances shall the Mechanical Controls Trade run controls cabling or wiring in the Electrical cable tray system without prior written permission from the Electrical Consultant and the Electrical Contractor. Unless otherwise agree or directed, all control cabling and wiring shall be run independently in conduits and/or separate raceways to be provided by the Controls Trade for their own use.

## 2.3 **Controllers**

- 2.3.1 The stand along digital control panels shall be microprocessor based, multi-tasking, multi-user, real-time digital control processors capable of operating independently of other controllers in the network. All unitary controllers, air handling unit controllers and VAV controllers shall operate as stand alone controllers.
- 2.3.2 Each standalone panel shall consist of modular hardware with plug-in enclosed processors, communication controllers, power supply and input/output modules. All plug-in printed circuit boards shall allow flexibility in application and rapid repair. All wiring within the standalone panels shall be labelled and run in raceway to accommodate servicing. The control panel shall contain a battery backed real time clock synchronized with other real time clocks in the network.
- 2.3.3 Surge and Transient Protection: Isolation shall be provided at all network terminations, as well as all field point terminations, to suppress induced voltage transients consistent with IEEE Standard 587-1980.
- 2.3.4 Analog to digital and digital to analog conversions shall have a minimum of 12 bit resolution.
- 2.3.5 All input points shall be universal in nature, allowing their individual function definition to be assigned through the application software. All unused input points must be available as universally definable at the discretion of the Owner. If the input points are not fully universal

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in nature, unused points must be equal in quantity between analog inputs and digital inputs.

- 2.3.6 Allow 10% minimum 10% spare capacity in each DDC 'Building Controller', and 'Application Specific Controllers' control panels for all point types.
- 2.3.7 All control sequences programmed into the standalone digital controller shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained. Power failures shall not cause the standalone digital controller memory to be lost, nor shall there be any need for batteries to be recharged or replaced to maintain the integrity of the controller database.
- 2.3.8 Any mechanical equipment which is required to operate on emergency power shall be controlled by a controller that is supplied by emergency power circuit connected to backed up generator and UPS power. The UPS power shall be provided by the Controls Contractor unless specifically noted otherwise in Electrical documentation. The DDC system shall monitor the generator and transfer switch so that appropriate action can be taken to the DDC system in the event of emergency power operation. Allow for all Electrical equipment.
- 2.3.9 All sensing inputs shall be provided via the following industry standards:
- .1 0 to 10 VDC
  - .2 4 to 20 mA.
  - .3 Resistance signals (1000 ohms, 10k Thermistor – nickel or platinum RTD's).
  - .4 Binary inputs shall be provided with filtering to eliminate false signals resulting from input bouncing.
  - .5 Counter inputs shall monitor dry contact pulses with an input resolution of 1 Hz minimum.
- 2.3.10 Digital outputs shall provide SPDT output contracts and be capable of directly switching the following voltages:
- .1 24 VAC at 36 VA operating/360 VA inrush.
  - .2 102 VAC at 180 VA operating/1800 VA inrush.
  - .3 240 VAC at 180 VA operation/1800 VA inrush.
- 2.3.11 Digital outputs shall be optically isolated from the controller's electronic circuit.
- 2.3.12 Control panel diagnostics shall consist of built-in, continuous operational and board level tests, software control sequence analysis and alarm exception logging. Light emitting diodes and/or the alphanumeric display shall annunciate hardware failures and control program errors or problems.

- 2.3.13 Provide one individual standalone control panel for every mechanical system. Where mechanical equipment items provide system redundancy, failure of the panel shall not result in failure of control of multiple mechanical equipment items.
- 2.3.14 The standalone control panels shall interface to additional panels of equipment as required to meet the performance specification. Each standalone panel shall be provided with an interface port for the hand held operator's terminal.
- 2.3.15 Any remote panel malfunction shall not affect the proper operation of the system or other remote panels.
- 2.3.16 All stand-alone control panels shall give full access to programming while communicating from a remote location (over the Internet/Intranet).

## **2.4 Field Control Devices**

### **2.4.1 Temperature Sensors:**

- .1 Shall be resistance type and shall be either 2-wire 1000 ohm nickel RTD or 2-wire 1000 ohm platinum RTD or 10K thermister type. Sensor shall have service tool communicating jack for interface with laptop computer service tool for adjustment and troubleshooting.
- .2 Shall be available for room, duct, outside or well mounting with proper ranges to suit application.
- .3 Shall give an end-to-end accuracy of not less than  $\pm 0.45^{\circ}\text{F}$  ( $\pm 0.25^{\circ}\text{C}$ ).
- .4 All room sensors shall be surface mount and complete with integral LCD display (room temperature, setpoint temperature, occupancy mode and fan status where override is specified),  $\pm 5.4^{\circ}\text{F}$  ( $\pm 3^{\circ}\text{C}$ ) setpoint adjustment and occupancy mode override push button and service tool communication jack for interface with laptop computer or service tool for adjustment and troubleshooting.
- .5 Outdoor air sensor shall be provided with solar shields and perforated plate to minimize solar and wind effects and transmitter shall be NEMA 3R construction.
- .6 Duct sensors shall be in insertion type complete with locking nut and mounting plate. Mounting box shall be weatherproof for all outdoor applications. Where duct dimension is greater than 48" (1,200 mm) averaging sensors complete with capillary support shall be used.
- .7 Immersion wells shall be of stainless steel materials for steam and domestic water systems and brass for other applications. Heat transfer compound shall be compatible with sensor. Sensor to be spring loaded construction with

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compression fitting for (20 mm) stainless steel sheathed construction.

- .8 HVAC Dual-Temp analogue temperature gauge and electrical temperature well: in lieu of providing separate analogue pipe temperature gauges thermowells and DDC pipe temperature thermowells, the controls contractor shall supply Wika brand dual-temp thermometer/transmitter, Model TR40/TW15 complete with TI.52 dial gauge. Supplier contact: JB5A, 604-590-8866, [www.wika.ca](http://www.wika.ca)
- .9 In-slab temperature sensors shall be stainless steel immersion wells with thermistor type sensor, installed in a standard 100 x 100 junction box with either top (floor) access or bottom of slab access.

#### 2.4.2 Motor Current Sensors

- .1 Shall have linear output proportional to the motor current draw.
- .2 Sensor shall connect to the controller by means of a 2-wire cable.
- .3 Sensor shall have dual HI/LO range selector.
- .4 Sensor shall have an accuracy of 1% of full scale, maximum response time of 100 milliseconds and a loading error not greater than .25% with a 1 megaohm load.

#### 2.4.3 Differential Pressure Sensors

- .1 Shall vary the output voltage with changes in differential pressure.
- .2 Shall connect to the controller by means of a 2-wire cable.
- .3 Shall have an end-to-end accuracy of not less than  $\pm 1\%$  of span including non-linearity and hysteresis.

#### 2.4.4 Static pressure sensors shall:

- .1 Vary the output voltage with changes in static pressure.
- .2 Connect to the controller by means of a 2-wire cable.
- .3 Have an end-to-end accuracy of not less than  $\pm 1\%$  of span including non-linearity and hysteresis.

#### 2.4.5 Humidity sensors shall:

- .1 Be equipped with non-interactive span and zero adjustment complete with 2-wire isolated loop powered 4-20 mA 0-100% linear proportional output. Sensing probe shall be constructed of Type 304 stainless steel.
- .2 Have a control range of 20% to 80%.
- .3 Have an accuracy of plus or minus 3% RH over an ambient temperature range of 70°F (21°C) to 80.6°F (27°C).

#### 2.4.6 Airflow measuring stations shall:



- .1 Vary the output voltage with changes in supply and return airflow. The airflow traverse probe, which shall be capable of producing steady non-pulsating signals, consists of multiple total and static pressure sensors placed at equal distances as per ASHRAE Standards for duct traversing.
  - .2 Connect to the controller by means of a 2-wire cable.
  - .3 Have end-to-end accuracy for variable volume control of not less than  $\pm 0.05\%$  of the airflow.
  - .4 Acceptable Manufacturers: Air Monitor Corp., Tek-Air Systems Inc., Ebtron Gold Series - G7x116 P+, or Ebtron Elf for  $\leq 14"$  (350 mm)  $\varnothing$  ducts.
- 2.4.7 Room Occupancy Sensors – Wattstopper C1-12, C1-24 Passive Infrared HVAC/BAS Ceiling Sensor or Equal
- .1 12 VDC or 24 VAC/VDC supply power, UL/ULC listed.
  - .2 Complete with five (5) year warranty, dual element, temperature compensated pyro-electric sensor.
  - .3 Complete with time delay adjustment 30 seconds to 30 minutes.

## **2.5 Transducers**

- 2.5.1 Electronic to pneumatic transducers shall:
- .1 Have linear output pressure proportional to the input signal, either voltage or current.
  - .2 Connect to the controller by means of a 2-wire cable.
  - .3 Have an end-to-end accuracy of not less than  $\pm 1\%$  of span including non-linearity and hysteresis.
  - .4 Have supply air filter to eliminate moisture and particulate contamination.

## **2.6 Line Filters**

- 2.6.1 The line filter shall be rated at 3A, 250 VAC, 50/60 Hz and shall be capable of filtering out electromagnetic interference.

## **2.7 Residential Suite Programmable Thermostat/Controller**

- 2.7.1 The controller shall be capable of controlling a 6 port modulating valve for heating/cooling, and a variable airflow ECM fan.
- 2.7.2 Controller shall come complete with:
- .1 7 day programmable digital thermostat.
  - .2 0-10 VDC output to control fan speed.
  - .3 0-10 VDC output to control 6 port control valve.
  - .4 LCD screen showing room temperature set point, time, day, and related schedule and status.

- 2.7.3 Controller shall control FCU in line with the sequence of operation noted later in the specification.
- 2.7.4 Specification based on Spartan TE256 controller.

**2.8 6 Port Control Valves**

- 2.8.1 Provide 6 port control valves to serve all fan coil units.
- 2.8.2 Valves shall be characterized to provide a linear change in flow rate through the stroke of the valve. The travel shall include a deadband to ensure no cross over between HW and CHW.
- 2.8.3 Valves shall fail in last position.
- 2.8.4 Valves to come complete with a modulating 24V actuator.
- 2.8.5 Valves based on Spartan SV601 control valves.

**2.9 Control Valves**

- 2.9.1 Provide valves in accordance with general valve specification with maximum 3 psi pressure drop.
- 2.9.2 Valves shall "fail-safe", spring return to normal position. 2-way and 3-way valves for liquids shall have either equal percentage or linear characteristics. Size 2-way valve operators to close against maximum pump shutoff head. Control valve coefficient shall be determined with the valve in the 100% open position. Control valves using a limited stroke to create the required flow coefficient shall not be acceptable.
- 2.9.3 All control valves shall be threaded type. All valve bodies shall have a replaceable packing gland.
- 2.9.4 Control valves shall be globe type with modulating electronic actuator. Base bid valve for fan coil shall be SIEMENS SSD61U 0-10vDC actuator with MZ series body. Actuators for valves on larger coils in air handlers shall have spring return to normal position. 2-way and 3-way valves for liquids shall have equal percentage characteristic. Minimum shut off head leakage shall not exceed 1% of full design flow.
  - .1 Acceptable Product: Belimo CCV Characterized Control Valve.
- 2.9.5 Steam valves shall have modified linear characteristics. Provide separate valves for each bank of coil. Provide two valves in parallel where steam loads exceed 1500 lb/hr (0.19 kg/s). Capacities for two valves in parallel shall be 1/3 - 2/3 load capacities sequenced with pilot positioner so that smaller valve opens first. Size low pressure valves for approximately 10 psi (70 kPa) inlet pressure and 5 psi (35 kPa) pressure drop.

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**2.10 Pressure Independent Control Valves (PIV's)**

- 2.10.1 Provide valves in accordance with general valve specification with maximum 3 psi (20 kPa) pressure drop.
- 2.10.2 Valves shall 'fail-safe', spring return to normal position. 2-way and 3-way valves for liquids shall have either equal percentage or linear characteristics. Size 2-way valve operators to close against maximum pump shutoff head. Control valve coefficient shall be determined with the valve in the 100% open position. Control valves using a limited stroke to create the required flow coefficient shall not be acceptable.
- 2.10.3 All control valves shall be threaded type. All valve bodies shall have a replaceable packing gland.
- 2.10.4 Control valves shall be pressure independent against a differential pressure of 5-50PSI with modulating electronic actuator.
- 2.10.5 Acceptable product: Belimo PICV, Griswold PICV and Tour and Anderson PICV

**2.11 Dampers**

- 2.11.1 Automatic dampers shall be 14 ga (1.63 mm) extruded aluminum multiple blade mounted to 4" (100 mm) extruded aluminum flanged frame. Frame shall be installed with polystyrene on all four sides. Frame seals shall be of extruded TPE. Individual blades shall be internally insulated **thermally** broken extruded aluminum not exceeding 8" (200 mm) in width or in length with interlocking edges and compressible seals. Blade gaskets shall be of extruded EPDM. Provide oil impregnated bronze or nylon bearings with additional thrust bearings for vertical blades. Dampers exposed to outside air or used as exterior isolation dampers shall be AMCA rated for leakage less than 4 cfm per ft<sup>2</sup> (21 l/s per m<sup>2</sup>) against 4" w.g. (1,000 Pa) static pressure differential. Dampers exposed to outside air or used as exterior isolation dampers shall be equal to TAMCO Series 9000. Dampers for return or recirculating air shall be AMCA rated for leakage less than 10.3 cfm per ft<sup>2</sup> (52 l/s per m<sup>2</sup>) against 4" w.g. (1,000 Pa) static pressure differential. Dampers shall be equal to TAMCO Series 1000.
- 2.11.2 Mixing dampers of parallel blade construction arranged to mix streams.
- 2.11.3 Dampers have less than 0.5% leakage and be equal to Ruskin CD-36.

**2.12 Damper Operators**

- 2.12.1 Piston or gear driving type damper operators with spring return to "fail-safe" in normally open or normally closed position. Non-mechanical forms of fail-safe operation are not acceptable.

- 2.12.2 Damper actuators shall be electronic direct-coupled over the shaft. Actuators shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator. Mechanical end switches and magnetic clutches are not acceptable.
- 2.12.3 Proportional actuators shall accept a 0-10 VDC or 0-20 mA control input signals and shall provide a 2-10 VDC or 4-20 mA position feedback signals. Pulse width modulating control is acceptable.
- 2.12.4 All modulating actuators shall have an external built-in switch to allow the reversing of direction of rotation.
- 2.12.5 Damper operators used for emergency and life safety systems shall be fail-safe closed on power failure for all VAV boxes associated with the smoke evacuation systems.

**2.13 Variable Air Volume Terminal Unit Digital Controllers**

- 2.13.1 Digital controllers shall be configurable, stand alone, networked direct digital controllers consisting of a microprocessor, power supply, actuator, integral dead-ended differential pressure transducer and operation/application system software in a single integrated package complete with manual positioning. The digital controllers shall utilize proportional plus integration algorithm for the space temperature control drops.
- 2.13.2 Digital controllers shall comply with ASHRAE Standard 90.1 and shall include compliant interface for ASHRAE Standards 62.1 -2007.

**2.14 Air Compressor and Receiver**

- 2.14.1 Provide duplex, belt-driven air compressor and tank unit complete with starters, overloads, belt guards, silencers, flexible connections, air cleaner, automatic and manual drain assemblies, oil and particle filter 0.5 microns and pressure reducing and pressure relief valves. Each compressor to be sized for 100% of system demand.
- 2.14.2 Combined size of one compressor and storage tank shall limit compressor starts at six maximum per hour and 1/3 running time.
- 2.14.3 The DDC system shall be set to operate each compressor alternatively with provision for the second compressor to cut in on demand. Cycle compressors through pressure switch. If one compressor fails, the other automatically maintains 100% system pressure.
- 2.14.4 Provide refrigerated, non-cycling air dryer, complete with automatic drain trap assembly and capacity to lower dewpoint to 5°F (-15°C) at 20 psi (140 kPa). Mount unit in discharge air line from tank.
- 2.14.5 Provide all regulators, controls and switching devices required to provide for a night setback control system.

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## 2.15 Air Piping

- 2.15.1 Piping, Type "K", hard or soft drawn copper or polyethylene plastic tubing. Plastic tubing must meet current FR requirements.
- 2.15.2 Use copper for all control air lines where:
- .1 Lines are subject to damage or temperatures in excess of 93°C.
  - .2 Lines are run adjacent to heating pipes.
  - .3 Lines are not readily accessible.
  - .4 Life support or warning systems (control air-to-fire and smoke dampers) are to be controlled.
  - .5 Lines are exposed in boiler and fan rooms.
- 2.15.3 In fan and boiler rooms, bundled plastic tubing or single plastic tubing in tray or conduit with suitable junction boxes may be used.
- 2.15.4 Run exposed piping only in storage rooms and similar areas; install in neat manner with proper support.
- 2.15.5 Install **pressure gauges** on branch lines to each controller and signal lines at each transmitter except individual room controllers.
- .1 CO sensor to be used in parkade and garages.
  - .2 Combustible gas sensor to be used in electrical room located in parkade and in mechanical rooms where propane is used.
  - .3 Oxygen sensor to be used in refrigeration m/c rooms.

## 2.16 Special Gas Monitoring System

### 2.16.1 CO/Hydrogen Sensors

- .1 General: Dual channel, self-contained gas detection system for the monitoring of carbon monoxide and propane/gasoline vapours, housed in a wall mount, drip-proof PVC enclosure with hinged, secured door. System power shall be 24 VDC or 24 VAC (nominal). A CSA certified, totally enclosed step down transformer shall be supplied as required to reduce voltage from 120 V.
- .2 Sensors: The system shall have one integral electrochemical CO sensor and one remote analog transmitter with a solid-state combustible gas sensor. The measurement range shall be 0 – 200 ppm CO in air and 0-50% LEL C<sub>3</sub>H<sub>8</sub> (Propane) in air. Area of monitoring coverage shall be 5,000 ft<sup>2</sup> (464.51 m<sup>2</sup>) to 7,000 ft<sup>2</sup> (650 m<sup>2</sup>) per sensor.
- .3 *Monitors*: The monitor shall provide a tri-colour indicating light for power, low alarm, high alarm and fault condition, audible alarm with silence push-button and two SPDT dry contact alarm relays rated 5 amps at 240 VAC each. There shall be a LED digital display of concentration. The system

must meet WCB workplace hazardous gas exposure standards. System controller shall be capable of supporting up to 128 digital transmitters on a RS-485 communication bus. System shall support analog output modules (eight 4-20 mA outputs per module) and relay output modules (eight 5 A SPDT relays per digital network (two low voltage power wires and a twisted pair for the communication bus). System power requirement is 100 to 240 VAC, 47 to 63 Hz. The controller shall provide a circuit test button to allow the user to confirm system operation and exhaust fan control from the panel. The controller shall also provide a push-button to allow the user to override the system control and operate exhaust fans continuously for 15-minute segments to evacuate air from specific parts of the building. The controller shall automatically test the electrochemical CO sensor failure. The controller shall provide automatic "calibration due" notification to the end user. Connect to DDC system to provide alarms.

- .4 System Operation: System relays are normally energized in non-gas-alarm state so they act in fail-safe operation. Upon detection of 50 ppm CO in air or 10% LEL C<sub>3</sub>H<sub>8</sub>, the system shall illuminate the Low alarm LED and any relays programmed to respond to low gas alarm shall de-energize activating single-speed exhaust fans or low speed of 2-speed exhaust fans plus makeup air fans. Upon detection of 100 ppm CO in air or 20% LEL C<sub>3</sub>H<sub>8</sub>, the system shall illuminate the high alarm LED, the system audible alarm will be activated and any relays programmed to respond to high gas alarm shall de-energize activating high speed of 2-speed exhaust fans or remote alarm devices. Audible alarm can be silenced from the front panel push button. In the event of a fail condition, the system audible alarm shall be activated and the fail LED on the front panel shall flash red.

2.16.2 Provide QEL Model QTS-2000 CSA approved carbon dioxide gas monitoring system with remote solid state carbon dioxide sensors. The system shall consist of a central control monitor panel in a wall mount NEMA 12 enclosure with slide-out control modules and corresponding remote mount solid-state sensors completely with protective guard.

- .1 Acceptable Products: QEL, Armstrong Monitoring Corp.

2.16.3 Monitoring Panel

- .1 Panel shall be complete with:
  - .1 Dual alarm trip points.
  - .2 Relays for alarm actuation and control of ventilation fans and auxiliary alarms.

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- .3 Indicating light for power on, low/high alarms of failure and an audible alarm with silence button.
  - .4 Manual test capability by push button.
  - .5 Alarms shall have adjustable time delay from five to ten minutes before activation.
  - .6 Alarms shall have dead band to ensure CO, NO<sub>2</sub>, O<sub>2</sub> or gas levels have dropped below trip point before auto reset.
  - .7 Units shall operate on 120 volt AC power supply.
- 2.16.4 The remote sensor shall receive power from the control monitor panel and send:
- .1 4-20 mA signal corresponding to 0-500 ppm CO with an accuracy of 5 ppm,
  - .2 1-5VDC signal corresponding to 0-50% LEL combustible gas,
  - .3 4-20 mA signal corresponding to 0-25% O<sub>2</sub> to the control panel,
  - .4 4-20 mA signal corresponding to 0-2500 ppm CO<sub>2</sub> to the control panel; and,
  - .5 4-20 mA signal corresponding to 0-5 ppm NO<sub>2</sub> to the control panel.
- 2.16.5 The control panel shall provide status LED display and two levels of alarm for each sensor with the following alarms:
- .1 Low Carbon Monoxide Alarm set at 25 ppm CO.
  - .2 Low Combustible Gas Alarm set at 10% LEL.
  - .3 Low Oxygen Alarm set at 19% O<sub>2</sub>.
  - .4 Low Nitrogen Dioxide Alarm set at 0.7 ppm NO<sub>2</sub>.
  - .5 High Carbon Monoxide Alarm set at 100 ppm CO.
  - .6 High Combustible Gas Alarm set at 20% LEL.
  - .7 High Nitrogen Dioxide Alarm set at 1.0 ppm NO<sub>2</sub>.
  - .8 Sub-Normal Oxygen Alarm set at 17% O<sub>2</sub>.
  - .9 High Carbon Dioxide Alarm set at [ ] ppm CO<sub>2</sub>
- 2.16.6 The alarm signals shall activate the following relays to:
- .1 Energize exhaust fans when low CO, low O<sub>2</sub>, low NO<sub>2</sub> and low LEL alarms occur.
  - .2 Energize exhaust fans and audible alarm when high CO, sub-normal O<sub>2</sub>, high NO<sub>2</sub> and high LEL alarms occur.
- 2.16.7 The system shall energize the exhaust fans on sensing loss of signal from sensor and/or under range signal from the fail relay.
- 2.16.8 Sensors shall be warrantied for two years and sensor life shall be three years.

2.16.9 Install system in complete accord with Manufacturer's recommendations.

## 2.17 **Energy Meters**

2.17.1 BTU meters shall be tamper-proof and equal to ISTA Energy meter complete with building DDC system interface for monitoring heating and or cooling consumption. The system shall consist of temperature sensors, flowmeters and electronic calculating unit. System shall be rated for 3 VDC with power convertors connected to 24 VAC. Battery shall be rated for a minimum operating life of six years. Provide individual meter analogue output and trending for each meter

.1 Acceptable Products: Badger Meter, Kamstrup, Danfoss, Onicon.

2.17.2 Temperature sensing thermal element shall be made out of platinum for fast response time with resistance at 500 ohms at 32°F (0°C) and 700 ohms at 212°F (100°C).

2.17.3 Flow meters shall be multi-wing turbine type with pulse output and rate for 250 psi (1,720 kPa) at 205°F (96°C), with a minimum accuracy requirement of ±1.0% at low end of flow range.

2.17.4 Electronic calculating units shall be solid state fluid density compensated calculation module, complete with non-resettable LCD display and stepping switch for flow, temperature and kwhr [BTU] readings.

2.17.5 Energy meters shall be calibrated and commissioned in accordance with the Government of Canada Weights and Measures Requirements, and comply with EU Standard EN1434.

2.17.6 Energy and Sub-Metering Schedule

TAG METER #	SERVICE	TYPE	RANGE	OUTPUT UNITS	NOTES

2.17.7 Energy Dashboard

.1 Provide a minim 44" (1,100 mm) flat screen monitor complete with energy dashboard graphics software, energy reporting software and organized trendlogging of electricity, water, gas, in breakdowns as described by the Energy/Flow/House Metering Schedule above. Provide a minimum of three (3) years of database storage capability based on a maximum of five (5) minute sampling rate of all points and metering.



- .2 Compare generation and consumption for electrical, gas and water resources.
- .3 Instantly translate energy and water use into dollars and CO<sub>2</sub> emissions and savings.
- .4 Showcase building green features alongside real-time resource use date.
- .5 Show real-time weather conditions.
- .6 Display introductory or explanatory text and Client/Owner logo welcoming visitors to the dashboard.
- .7 Display photographs pertaining to the building featured in the dashboard.
- .8 Automatically and randomly transition between photographs at specified intervals, ensure that the dashboard is constantly changing during every visit.
- .9 Compare current consumption with past consumption on the same screen.
- .10 Display 50 automatically rotating, randomly displayed green “tips” (with an input from the Owner). Green “tips” will be short, to-the-point messages accompanied by a large image relevant to the feature “tip” Green “tips” will focus primarily on the building related resource use, but will also include references to land, transpiration, and waste related environmental concerns.
- .11 Showcase building and building’s green features via the dashboard.
- .12 Enable users to selected from intuitive thumbnail-based menu screen, or display features by automatic rotation.
- .13 Showcase the HVAC systems, lighting and day-lighting controls, electrical district heating and water consumption, landscaping and building envelope design.

## **2.18 Alarm Annunciator**

- 2.18.1 Provide alarm panel with individual indication, horn, silence acknowledge switch and test switch. Alarm panel to be hardware in addition to software alarms as specified in this section. At alarm condition indicator light shall flash and alarm sound. Depressing acknowledge switch shall stop horn, but alarm condition indicated by continuous light until trouble condition cleared. Should second alarm occur before first has cleared, sound alarm again.
- 2.18.2 Locate panels in locations as described below to serve duplicate functions of primary alarms:
  - .1 Building Managers Office
- 2.18.3 Provide alarm points complete with required initiating equipment for signalling to alarm panel for the following conditions:

- .1 No water (glycol) flow.
  - .2 Low air temperature.
  - .3 Controls compressor failure.
  - .4 Sump pumps (high level).
  - .5 Boiler failure (common point for multiple boilers).
  - .6 Low heating water (glycol) temperature.
  - .7 Cooling tower dump (overridden by auto-dump switch).
  - .8 Condensate tank (high and low levels, one or both; if both are separate, alarms required).
  - .9 Low humidity.
  - .10 High humidity.
  - .11 Expansion tank low level/low pressure/high pressure.
  - .12 No flow on air systems (air heating systems).
  - .13 Off normal temperature.
- 2.18.4 Provide dry contacts for common alarm initiating point for use by others.
- 2.18.5 Alarm panel wiring shall be in tray or neatly placed and securely fastened.

**2.19 Carbon Dioxide Monitoring and Detection System for Indoor Air Quality (ISO-9002 Certified Sensors)**

- 2.19.1 Provide UL and CSA labelled Vulcan VA-201T series Model 90DM3 infrared cell type carbon dioxide transmitter with LCD Display and connected to DDC system. Provide one sensor per VAV control box as indicated on the drawings or **two sensors shall be installed for each office floor**. Allow for connection of sensor to DDC system architecture and provide 24 volt transformer and low voltage wiring from nearest VAV or fan coil unit electrical junction box.
- 2.19.2 The remote sensor shall receive 24 volt power and send 4-20 mA signal corresponding to 0-2000 ppm CO<sub>2</sub> to the DDC system.
- 2.19.3 Sensor shall be warrantied for five years.
- 2.19.4 Install system in complete accord with Manufacturer's recommendations. Manufacturer's agent shall provide complete commissioning of sensors.

**3 . FACILITIES MANAGEMENT SYSTEM (DDC SYSTEM)**

**3.1 General Description**

- 3.1.1 The facilities management system shall be comprised of a distributed control network of independent standalone digital controllers (DDC) interconnected in a communicating network to provide facility wide access and sharing of information.

- 3.1.2 The distributed network shall be a modular design. Network expansion shall be accomplished by adding standalone control modules to the network.
- 3.1.3 A local area network (LAN) shall be provided for high-speed data transmission.
- 3.1.4 At each building entry and exit point, the wire communications trunk wiring shall be protected with a transient surge protection device. Transient surge protection is not necessary if the communication trunk, external to the building, is fibre optic in nature.

### **3.2 Communications**

- 3.2.1 The local area network (LAN) shall be a peer-to-peer, token passing network, utilizing packetized transmissions, error checking and distributed error recovery. Single or multiple standalone control panel failures shall not cause loss of communication between active control panels connected on the LAN. Full communications shall be sustained as long there are at least two operational standalone control panels active on the LAN.
- 3.2.2 Each LAN-connected control panel shall be equipped with a communications watchdog to automatically shut-down the control panel in the event that it is monopolizing communications. Removal of a control panel from the LAN shall be annunciated and logged to as an exception report. Error recovery and communication initialization routines shall be resident in each connected device.
- 3.2.3 The primary local area network shall be capable of operating at data transmission rates greater than 10MB Ethernet between primary mechanical system controller and the operator interfaces. Unitary controllers may run on RS 485 or MS/TP network.
- 3.2.4 Network communications with video display terminals, host computers, printers and auto-answer/auto-dial telephone shall be provided through a RS-232C standard interface port.

### **3.3 Software**

- 3.3.1 Provide standalone panel containing a complete software development system. The software development system shall consist of a graphical programming language containing complete libraries of control algorithms for DDC, Energy Management and Facilities Management functions. These resident libraries of algorithms shall be drawn from for the creation of the application programming of each individual standalone control panel. The programming environment shall provide context-sensitive help menus and instructions for all operations and applications.
- 3.3.2 Multi-level user access shall be provided with user access codes available at each level.

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- 3.3.3 Point names shall be defined using alphanumeric characters expandable to 32 characters to provide an English language description to the point function.
  - 3.3.4 All point names shall be acceptable to the operating personnel.
  - 3.3.5 The stand alone control panel shall be capable of generating sorted alarm, trend log, energy management, maintenance time reminder and exception log reports on a prioritized basis. Segregated report generation shall be invoked by manual request, time of day, calendar, accumulated run time or event occurrence.
  - 3.3.6 Provide enough data storage and memory capacity in the operator workstation to accommodate a minimum of **6 months** worth of trend logs for all rooms, main HVAC plant equipment and special points as listed in the sequence of operation or as listed below:
    - .1 Change room temperatures
    - .2 Fans, Pumps, Boilers, Chillers
    - .3 Room Temperature
    - .4 Main hydronic supply and return temps
    - .5 Main AHU SAT and OAT temps.
  - 3.3.7 All licensing and firmware upgrades required to edit create, and modify graphics, programing, and configuration.
  - 3.3.8 All software to be installed with the latest version or as specified by the owner.
  - 3.3.9 All software shall be maintained at N-1 at the time of substantial completion of work through to the end of the warranty period. Updates shall be included and considered as a standard part of the upkeep of the BAS system during the warranty period to maintain this N-1 integrity.
  - 3.3.10 Use new products the manufacturer is currently manufacturing and selling for use in new installations.
  - 3.3.11 Project sites shall not be used as product test sites for beta testing or otherwise, unless explicitly approved in writing by the owner. The contractor to confirm in writing that spare parts will be made available for at least five years after completion of this contract.
  - 3.3.12 All building automation system installations require an Electrical Safety Authority inspection.
  - 3.3.13 Provide disaster recovery plan that will allow systems to remain operational in case of building automation system failure. To be reviewed during submittal review.
  - 3.3.14 All hardware points (input and output) must have installed capability of being manually overridden at the front end or at the local controller.

- 3.3.15 Integrate hardware and software override operations, including override panels, as outlined in points list. To be approved by the Region of Peel.
- 3.3.16 Contractors are responsible for verifying that site equipment (i.e., HVAC, lighting, etc.) that is connected to the building automation system is operational in an unchanged state from its original operation. Consultant must verify that equipment testing has occurred prior to and at the completion of the installation.
- 3.3.17 The Tridium Controller (JACE) shall be licensed to the Region of Peel for an initial 5-year period.
- 3.3.18 All BAS controllers shall incorporate the Niagara Framework (THE MOST RECENT EDITION)™ platform with Niagara Tridium with Jace controller being the front end of the BAS.
- 3.3.19 The data base shall be stored on the Niagara Tridium Controller which serves as the Graphical User Interface. The EC-BOS Controller is a Distech Tridium Based Controller.
- 3.3.20 Installer must be licensed TRIDIUM system integrator. License shall be OPEN and on the name of the Region of Peel.
- 3.3.21 BAS controllers shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft) and is subject to change as radio technology evolves in the facilities.
- 3.3.22 BAS controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage.

#### **3.4 DDC Control**

- 3.4.1 The network of standalone control panels shall individually perform setpoint reset, ramping functions, 2-position ON/OFF control, PID loop control, linear sequencing, rotating sequencing, binary sequencing, HI/LO/AVE selection, energy dead band and thermostat controls as required to control their connected systems of equipment.

#### **3.5 Energy Management Control**

- 3.5.1 The network of standalone control panels shall individually perform time of day scheduling, optimum start/stop, enthalpy optimization and all control optimization strategies, such as supply air reset and soft start ramp-up, for their connected systems of equipment.
- 3.5.2 Coordination of strategies involving multiple systems of equipment shall be performed by sharing of necessary data between the standalone control panels on the communicating network.

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**3.6 Facilities Management Control**

- 3.6.1 The Owner shall be provided the ability to read-out temperature and other values and to adjust specific items from localized, as well as remote centralized location.
- 3.6.2 Maintenance time reminders based on totalized run time, calendar date, exception occurrence or manual request.
- 3.6.3 Facility Diagnostics: The facilities management system shall provide diagnostic reports of the following types, for specific systems of equipment as specified:
- .1 *Alarm Occurrence Status*: When specified alarm conditions occur, provide a report printout listing the status of specific items associated with the equipment generating the alarm. Report shall be routed to a specific printer or combination of printers. Report shall record the time the status information was taken and shall allow operational personnel to use this information to diagnose the alarm situation.
  - .2 *Alarm Occurrence Development Report*: For specific systems of equipment the facilities management system shall record a continuous log of the values of selected variables. Upon occurrence of an alarm, or some specific combination of performance conditions, the report will be printed, showing the status of each of these variables for each of the 15 minutes immediately prior to the occurrence of the triggering condition.
- 3.6.4 Telecommunications Support
- .1 The entire facilities management system network shall be able to share one or multiple auto-dial/auto-answer modems for automatic dial out reporting of alarms, exception and report information via the dial up telephone network.
  - .2 Provide and implement an auto-dial/auto-answer modem in the system of control panels for purposes of remote diagnostics and notification of desired exceptions and alarms. Dial-up telephone line shall be provided by the Owner. Modem shall provide for the following functions:
    - .1 Access to the entire facility control system by the Contractor to provide service and diagnostic support.
    - .2 Access by the Owner from off-site for similar purposes and for remote operation, monitoring and adjustment of facility functions.
    - .3 Auto-dial-out of desired exceptions to a remote site, or to an Owner-specified set of phone numbers for business-hours or off-hours reporting.

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**3.7 Distributed Access**

- 3.7.1 The Owner shall be provided with facilities management system information through the following methods:
- .1 Simultaneous multi-user operation.
  - .2 Distributed access – at every control panel.
  - .3 Distributed documentation.
  - .4 Historical documentation logging-printer or disk for exceptions.
  - .5 Facility-wide access-LAN connected standalone control panels.
  - .6 Facility operation documentation.
  - .7 Overrides logging.
  - .8 System log-in documentation.
  - .9 System database modification documentation.
  - .10 Local historical alarm documentation.

**3.8 DDC Database Upload/Download**

- 3.8.1 The system shall have the capability of uploading and downloading the entire facilities Management System database on the system hard drive. This shall be accomplished via direct connection or a modem link.
- 3.8.2 The information shall be easily uploaded to the controllers in the event of a catastrophic memory failure. Database uploads shall be easily accomplished through menu selections and shall NOT require the operator to understand this system's operating system.
- 3.8.3 Downloading of database information shall be accomplished in the same manner as a database upload.
- 3.8.4 Monitor: Point values, current status, time schedules and any other definable point attribute such as setpoint, throttling range, etc. shall be accessible and displayable on the CRT.
- 3.8.5 Change: Current states, setpoint and any other definable point attribute shall be accessible and have the capability of being changed using the computer keyboard.
- 3.8.6 Provide a 'Coppercube' historian software and enough storage media to accommodate up to 1000 trend logs of at least 2 weeks duration. **The historian package must be fully compatible with the delta inteliweb system.**

**3.9 Override**

- 3.9.1 Setting: Current states and setpoints shall have the capability of being overridden for a certain user defined time periods by a user with the correct access level. The override period shall be user selectable to start/stop at any time up to one year in advance. The

user shall have the ability to program multiple overrides for the same or different zones or points. Overrides shall be verified (in real time) and read back to the user to positive confirmation of the setting.

- 3.9.2 Call-back: The user shall have the option of entering a telephone number for each individual override where the system can call to confirm the expiration of the override. This feature shall allow the user the option of extending the override interval without interruption of equipment operation or comfort levels.

### 3.10 Graphics Software

- 3.10.1 The system shall be provided with a complete user-friendly graphics interface system for each mechanical unit on DDC control. Provide Owner with one registered copy of the graphics software.

- 3.10.2 The Colour CRT Library: Shall contain Contractor prepared, dynamically updated displays for each schematic and each control systems' program flowchart included in the point schedule. A library of standard symbols shall be included with the following as a minimum:

Chiller	Pump	Boiler
Convertor	2-way control valve	3-way control valve
Damper	Check Valve	Motor
Fan	Coil	Filter
Damper motor	Pipe	Duct
Switch	Sensor	Air measuring device
Air quality sensor	Average duct sensor	Temperature sensor

- 3.10.3 Dynamic Updating: Online data displayed as an integral part of a schematic shall be updated not less than every five seconds with the exception of alarm/'change of state information, which shall be updated upon its receipt at the operator's terminal. Critical alarms shall be annunciated at the operator's terminal with both an audible alarm and a "pop-up" graphical display which interrupts the current operation.

- 3.10.4 Information Screen Display: Individual schematics and control, program flowcharts shall include where applicable:

- .1 Status of monitored and controlled on/off points.
- .2 Current value of analog input.
- .3 Current value of the setpoint and the DDC output for each control loop.
- .4 Identification for each point.
- .5 Current state of each control loop (computer auto/computer manual).
- .6 Schematic and systems identification.
- .7 Alarm/normal indication.



- .8 Point alarm lock-out status.
  - .9 Equipment symbolic information (pump, fan, etc.).
  - .10 All points pertinent to one system shall be show on one screen.
  - .11 Symbols shall have the ability to change colour depending on the status.
- 3.10.5 Online Directory: A directory of schematics and symbols shall be available to the operator.
- 3.10.6 Trending: Shall be provided to collect and store samples of the value of a point (i.e., temperature). The operator shall be able to create up to 250 trend logs containing up to 4 points. The sample frequency shall be selectable for each trend log between 15 seconds and 99 hours. The ability to graphically display up to 8 points on the screen simultaneously, print a log or store on disk in an ASCII format that can be imported into a standard spreadsheet program shall be provided. The ability to indefinitely retain the contents of a trend log in the controller or automatically transfer the contents of a trend log to a disk storage or printer shall be provided.
- 3.10.7 Command from Graphic: Shall be provided to directly issue commands to a point identified by a mouse on the graphics screen.
- 3.10.8 Provide interface with City water meter to DDC system for water flow measurement.

### 3.11 web-based operator interface

- 3.11.1 It is the desire of the Owner to achieve seamless integration with selected building system and subsystems on a TCP/IP high speed bandwidth network which must be able to receive BACnet information from the control system BACnet server. IN this regard it will be the responsibility of the Division 15 Controls Contractor to include all needed equipment, material, software, installation and programming, start-up and debugging labour for a fully functioning DDC acting as the integrating head end with the following minimum functions and capabilities as part of the base tender price.
- 3.11.2 For building operator interface, the DDC shall provide a web-based graphical interface that allows operator access to the DDC data via the Internet, Extranet or Intranet. The interface shall use the HTML based ASP pages to send and receive data from the DDC to the browser. Tenant interface (unique to each user) shall be provided through activation of a desktop application dialogue (DAD) residing on the taskbar in the system tray which connects to the web server providing the following features:
- .1 Zone temperature and zone setpoint adjustments.
  - .2 Zone fan coil unit override capability including enabling primary plant (chillers, pumps, ventilation controls system

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- associated to the floor in which the floor is being implemented).
- .3 On/off control of lighting in the overridden zone as an expandable option.
  - .4 Automatic calculation and display of the Tenant's billing amounts which will be charged by the Landlord for implementation of the Tenant's override command. Tenant to be prompted to "Proceed" or "Cancel Request" before implementing override function.
- 3.11.3 The web server pages will use the same graphics for the server database. The web server HTML web pages shall not be created separately.
- 3.11.4 A separate web server computer will be supplied. The web server shall use Microsoft's IIS server 4.0 with Windows NTS, or IIS 5.0 with Windows 2000 and support browser access via Microsoft Internet Explorer 5.0 (or higher), or Navigator Netscape 6.0 (or higher).
- 3.11.5 A separate web server computer, similar to the minimum requirements as specified under 3.5 "Central Server" to be provided.
- 3.11.6 All information exchanged over the Internet shall be optionally encrypt and secure via SSL.
- 3.11.7 Access to the web interface must be password protected. A user's rights and privileges to points and graphics will be the same as those assigned at the DDC workstation. An option will exist to only allow users "read" access via the web browser, while maintaining "command" privileges via the DDC workstation.
- 3.11.8 Commissioning of the web interface shall not require modifications or creation of HTML or ASP pages. All graphics available at the DDC graphical workstation shall be available to users via a web browser.
- 3.11.9 The web-based interface shall provide the following functionality to users, based on their access and privilege rights as a minimum:
- .1 Logon Screen: Allows the user to enter their user name, password and domain name for logging into the web server, thus providing fully integrated security access and privileges with DDC workstation.
  - .2 Alarm Display: A display of current DDC alarms to which the user has access will be displayed. Users will be able to acknowledge and erase active alarms and link to additional alarm information including alarm messages, and informational and memo text. Any alarm acknowledgements initiated through the web interface will be written to the DDC central workstation activity log.
  - .3 Graphic Display: Display of system graphics available in the DDC workstation will be available for viewing over the web

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- browser. Software that requires creation of “web” graphics in order to display them via the browser interface will not be acceptable. A graphic selector list will allow users to select any graphics to which they have access. Graphic displays will automatically refresh the latest change of values. Users will have the ability to command and override points from the graphic display as determined by their user accounts rights.
- .4 Point Details: Users will have access to point detail information including operational status, operational priority, physical address and alarm limits, for point objects to which they have access rights.
- .5 Point Commanding: Users will be able to override and command points they have access to via the web browsers interface. Any commands or override and command points they have access to via the web browser interface. Any commands or overrides initiated via the web browser interface will be written to the DDC central workstation activity log.
- 3.11.10 The web server licensing options will allow concurrent use by minimum 100 but expandable to 500 browsers connections.
- 3.11.11 Internet connections, IS services, shall be provided by the Owner as required to support the web access feature.
- 3.11.12 THE TCP/IP NETWORK: It is unknown at this time if the Owner wishes the DDC Web server to reside on their TCP/IP company Internet/Intranet network. Therefore, the Tendering Controls Contractors are to show a separate credit for possible exclusion of the TCP/IP network. In the event that the Owners do provide this network for the Controls Contractors to utilize, it will not absolve this Contractor from assuming full responsibility for achieving systems integration functionality as herein specified:
- .1 The TCP/IP network shall include a PC Windows 2000 service complete with PC 600 MHz processor, 512 MB Ram, 300 MB plus of publishing space, all CAT 5 cabling, in all Routers, 3COM or Cisco Hardware Firewall, Network 100 MB + Bandwidth 100 MB Active Hub with expansion capabilities (to handle PCs on system).
- .2 No more than 20 Workstation Clients per subnet.
- 3.11.13 CAPABILITIES OF INTEGRATION: Subject to the building systems and subsystems and equipment selected by the Owner, it will be possible as a minimum for the integrated DDC system to establish (locally or remotely via the web) Lighting Schedules, execute on/off lighting control, or to observe lighting status. Security access system will be able to exercise zone lighting or HVAC equipment run times by simply swiping a card. View digital CCTB images of selectable locations. The DDC web interface will be able

to create transactional logs for Tenant billing purposes based on equipment run times and usage allocations. Connected to the buildings' energy meter, run utility consumption text and graphical generate reports for direct tenant billings.

- 3.11.14 Given the large volume of information integrated systems generated; provide a comprehensive software method of automatically managing the collection, sorting and purge of historical relational systems' information. If this capability is not normally provided within the functionality of the base DDC tender, then provide this capability as part of the standalone PC software subsystem connected to the TCP/IP network.

#### **4 . EXECUTION**

##### **4.1 General**

- 4.1.1 Check and verify location of exposed control sensors with the drawings and room finish details before installation.
- 4.1.2 All temperature control and interlock wiring shall be installed in conduit unless otherwise noted on the plans. Power or interlock wiring shall be run in separate conduit from sensor and communications wiring.
- 4.1.3 Control sensors or thermostats located in public areas, change rooms or washrooms shall be a bland stainless steel cover type. Where noted, thermostats in suites shall have concealed setpoint adjustment without thermometer.
- 4.1.4 Low limit and freeze protection thermostats shall be hardwired to the fan motor starter. The vapour tension element shall be installed in a serpentine pattern across the complete coil face. For larger coil areas use two thermostats wired in series.
- 4.1.5 All thermostat bulbs in water lines shall be installed in separable wells, packed with heat conductive compound.
- 4.1.6 Install damper motors on the outside of the ducts. Do not install motors in the air stream.
- 4.1.7 Install line filters on all DDC control panel power supplies.
- 4.1.8 Provide a standalone DDC controller for each mechanical system (each air handling unit, boiler system, etc.).

**END OF SECTION**

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## 1. **GENERAL**

### 1.1 **Related Documents**

- 1.1.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 **Summary**

- 1.2.1 This Section includes refrigerant monitors and notification appliances.

### 1.3 **Definitions**

- 1.3.1 AEL: Acceptable Environmental Level.  
1.3.2 BMS: Building Management System (DDC System)  
1.3.3 LCD: Liquid-crystal display.  
1.3.4 LED: Light-emitting diode.  
1.3.5 TLV: Threshold Limit Value.

### 1.4 **System Description**

- 1.4.1 Provide a refrigerant gas detection system where indicated and as required for indoor chiller and refrigerant devices rooms, containing a series of detection points located in areas where refrigerant from a leak is likely to accumulate and / or be sensed. Include analyzer, sequencer and interface control panels(s), filters, sensors, alarm signaling devices, piping and all components necessary for a complete operational system.
- 1.4.2 System shall provide various stages of alarming and control chiller room mechanical ventilation in accordance with sequence of operation at values not to exceed specified TLV. System shall be capable of detecting the presence of the refrigerants(s) actually used on this project. System shall be capable of detecting, indicating, alarming, shutting down equipment, interfacing to building automation and security systems, as specified below, on contract documents, and per applicable codes, standards, and regulations.
- 1.4.3 Under circumstances directed by regulations for mechanical equipment room design, refrigerants requiring LEL monitoring below 4% by volume, shall employ the appropriate sensing technology and conform to Class 1, Division 2, Electrical Code requirements. When refrigerant groups A2, A3, B2 other than NH3, and B3 are used, follow appropriate guidelines indicated in regulations concerning area classification requirements.

1.4.4 Monitoring shall be employed to provide minimum two (2) points of area sampling and (1) point of relief vent monitoring for each chiller. Additionally, monitoring shall be provided for any pit areas located in the chiller mechanical room. Diluted samples due to ventilation air flow currents shall employ multi-point monitoring techniques strategically located according to regulation guidelines. System design considerations shall also incorporate leak detection monitoring sensing locations for early warning indication to prevent a major loss of refrigerant without alarm, should a leak occur. Where multiple refrigerant types are used, it is the system suppliers' responsibility to properly select the quantity and type of refrigerant detectors and multi-point sequential sampling systems required to safely monitor the equipment room. Provide components and system safety and interface logic as outlined following without exception. Provide number of sampling points as indicated on plans with 20% spare sample point capability on analyzer and expansion module.

## **1.5 Submittals**

### **1.5.1 Product Data:**

- .1 For each type of refrigerant monitor, include refrigerant sensing range in ppm, temperature and humidity range, alarm outputs, display range, furnished specialties, installation requirements, and electric power requirement.

### **1.5.2 Shop Drawings:**

- .1 Air-Sampling Tubing: Size, routing, and termination including elevation above finished floor.
- .2 Wiring Diagrams: Power, signal, and control wiring.

1.5.3 Coordination Drawings: Include machinery-room layout showing location of monitoring devices and air-sampling tubing with filter/inlet locations in relation to refrigerant equipment.

1.5.4 Product Certificates: For monitoring devices, signed by product manufacturer.

1.5.5 Field quality-control test reports.

1.5.6 Operation and Maintenance Data: For refrigerant monitoring equipment to include in emergency, operation, and maintenance manuals.

## **1.6 Coordination**

1.6.1 Coordinate refrigerant detection and alarm system with refrigerant contained in refrigeration equipment for compatibility.

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**1.7 Extra Materials**

- 1.7.1 Provide all necessary calibration gas and hardware for two years operation in a portable case. Turn over to Owner after successful system start up.

**2. PRODUCTS**

**2.1 Manufacturers**

- 2.1.1 Subject to compliance with requirements, provide products by one of the following:
- .1 Ino-Tek, Romeo, Michigan.

**2.2 Control Panel and Control Panel Equipment**

- 2.2.1 Analyzer: Provide NEMA 4 wall mount enclosure. Analyzer shall employ infrared sensor macro light pipe gas cell technology, to provide sensing down to one (1) part per million (ppm) and shall be compound specific and calibrated for refrigerant as specified below or required per chiller manufacturer's requirement. Analyzer shall have capability to be switched to monitor, at a future date, another refrigerant type by changing one part and recalibration. (i.e. CFC-11 to HCFC-123, etc.) Provide menu driven microprocessor based electronics with user friendly programming allowing operator to select alarm setpoints, auto zero frequency, latched or unlatched alarms, and to program sample distance in feet for each sample point. Analyzer shall automatically select sequencing and sample dwell time based on programmed distance to each sample point. First level warning alarm shall comply with recommended AEL of 10 ppm +/- 1 ppm. Base analyzer unit shall be capable of monitoring one (1) or four (4) sample points with expansion capability to four (4), seven (7) or eleven (11) sample points. LCD digital display shall show concentration levels from all four sample points simultaneously. Readout for seven (7) or eleven (11) point monitoring systems shall sequence with sample point being monitored. Flashing alarm LCD indication shall be provided for alarm level #1, #2, #3, malfunction, flow loss, and zero cycle. Auto zero calibration can be initiated manually at the monitor or automatically at preprogrammed user selectable intervals, or remotely from a dry contact input. Analyzer shall automatically zero by drawing air from an uncontaminated air source. Include built in sample pump. Differential pressure flow loss indication will occur when flow goes below 500 ml/min. Analyzer outputs available shall be Common Alarm Level 1, 2, and 3 contacts, Malfunction, (4) 4-20 mADC analog signals (1 for each channel) and a RS-485 output of refrigerant level available for input into BMS. Analyzer inputs shall be external zero initiate and external alarm reset. Contact rating 240 vac, 5 amp resistive or 2 amp inductive. Power requirements 75

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watts. Unit shall be insensitive to vibration and shall provide for a continuous sample. Intermittent dump and purge, batch type sampling with long response times shall not be acceptable. Response time shall be twenty (20) seconds to ninety-nine (99%) percent minimum. Malfunction relay is de-energized on heater out of control, chopper failure, pump flow loss, analyzer low flow or malfunction alarm. Provide expansion card with three (3) alarm contacts for each channel. Group common alarm contacts so as to make most common operating sense. Common alarm output signal shall be provided for relief vent monitoring. All sample points shall have individual alarm setpoint adjustment capability whether standard common alarms or individual expansion board is used.

2.2.2 Local Interface Panel: Include all alarm logic, system interlocks, interface relays, alarm reset with remote capability, alarm test, trouble relay, etc. as outlined below and on drawings. All control system interlocks and logic shall be provided in local interface panel.

2.2.3 System shall be configured to provide additional dry contact alarm contacts and output signals for control or for interface as follows and noted on drawings:

- .1 With building management system:
  - .1 Maintenance dry alarm contact.
  - .2 AEL level; low leak warning dry alarm (first level) contact.
  - .3 TLV - TWA level; high level danger dry alarm (second level) contact.
  - .4 STEL level; high level danger dry alarm (third level) contact available; use only when noted.
  - .5 (1) 4-20 ma/dc process concentration signal for each channel.
  - .6 On systems greater than four (4) channels (1) 4-20 ma/dc signal shall provide for continuous ppm readout and (1) 4-20 ma/dc signal shall provide for stepped channel indication.
  - .7 RS - 485 signal.
  - .8 Common chiller relief vent alarm as grouped per analyzer.
- .2 With chiller room ventilation system direct interlock required:
  - .1 Direct interlock to Purge Air Supply and Exhaust Fan starter control circuit. Purge Mode.
  - .2 Direct interlock to Purge Mode damper controls.
- .3 With combustion equipment located in chiller room direct:
  - .1 Direct interlock to shut down at TLV-TWA level.



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- 2.2.4 Alarms shall be provided at the AEL and TLV-TWA level, and also for malfunction. At the AEL level, the system shall actuate the warning amber beacon and the audible horn and an alarm signal shall be sent to Physical Plant Central Control. At the TLV-TWA level, the system shall activate the purge ventilation system, energize the red beacon, sound the refrigerant leak audible alarm, shut down area combustion equipment, and send an alarm signal to contact Facilities Manager and Building Security Office via page. If a system malfunction shall occur, a blue beacon shall be energized at the locations indicated on the drawings and at the interface panel with no audible alarm at this level, and an trouble alarm signal shall be sent to Physical Plant Central Control. Provide dry alarm contacts for each alarm level for interface to the BMS. All control system interlocks and logic shall be provided in local interface panel. Where indicated; third level contacts shall be used to initiate area ventilation prior to TLV level so as to prevent shutdown of combustion equipment. Relief vent alarm shall indicate via common contact to the BMS and provide for local alarm horn only at interface panel and interface panel pilot light indication. No alarm beacons shall be energized on relief vent alarm. Analyzer display shall indicate which channel is in alarm.
- 2.2.5 Purge Ventilation: Upon system reset, the alarm beacons shall be deactivated only if the area monitored has returned to a safe condition. The purge ventilation system shall remain activated for 30 minutes after the alarm condition has cleared. A panel mounted pilot light shall indicate that the purge ventilation system is still activated. Provide a manual selector switch for "Auto - Manual On" purge fan control.
- 2.2.6 Alarm Relays: Provide plug in type, two (2) per channel (level 1 & 2) wired to DPDT isolated 5 amp terminal. Relays shall be de-energized during normal operation and shall energize upon alarm. Alarm contacts shall be available for each point of alarm from each sensing point back to the BMS and shall be used to energize various devices and equipment as outlined above and on the drawings. Alarm levels shall be field adjustable. Alarms will be provided at the AEL level, TLV-TWA level, and for malfunction from the interface panel.
- 2.2.7 Alarm Reset: Provide push button reset switch on front of interface control panel to acknowledge and silence or reset the self-latching alarm circuit. The alarm beacons and horns shall remain on until the system is reset from the panel face or from remote reset pushbutton. The alarms shall stay latched to prevent them from automatically resetting when the toxic condition goes away. This control logic shall be provided for in the interface panel.
- 2.2.8 Alarm Test: Provide push button switch inside interface control panel to test alarm circuitry and panel indicators. During test

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function, output signals to the BMS and combustion shutdown shall be disabled.

- 2.2.9 Trouble Relay: Provide one (1) common malfunction relay for system interface to building security or BMS. Relay shall be energized in normal operation, de-energized due to malfunction at any channel.
- 2.2.10 Pilot Light Indication: Provide panel indication for power on, zone alarm status where applicable, alarm status for relief vent alarms, and purge fan status.
- 2.2.11 Power Supply: Provide terminals for dedicated 115 vac, 60 Hz. input power supply. Power all alarm and warning devices and remote indication control panel from this control panel circuit. All remote field devices associated with this system shall be 120 vac or as indicated.
- 2.2.12 Tagging: Provide "Lamacoid" tag, red background with ½" (12 mm) high white letters at each remote visual and audible device. Anchor tag to wall adjacent to wall mounted devices, suspend with brass security chain adjacent to ceiling mounted devices.
- 2.2.13 Tags located inside and outside mechanical room shall be inscribed as follows:
- .1 DANGER - REFRIGERANT R-\_\_\_\_
  - .2 BLUE - REFRIGERANT LEAK DETECTION MALFUNCTION.
  - .3 AMBER - CAUTION - REFRIGERANT LEAK DETECTED.
  - .4 RED - DANGER - REFRIGERANT LEAK DETECTED. UNSAFE TO ENTER ROOM WITHOUT PROPER BREATHING APPARATUS.
  - .5 NOTIFY BUILDING ENGINEER OR SECURITY IMMEDIATELY UPON INDICATION OF ANY ALARM.
- 2.2.14 Tags located near horn inside mechanical room shall be inscribed as follows:
- .1 DANGER - REFRIGERANT R-\_\_\_\_
  - .2 LEAVE ROOM IMMEDIATELY IF HORN SOUNDS.
  - .3 NOTIFY BUILDING ENGINEER OR SECURITY IMMEDIATELY UPON INDICATION OF ANY ALARM.
- 2.2.15 Balance of tag information must comply with CFR requirements and provide emergency action required upon entering or leaving the premises. Indicate on tag the remote reset pushbuttons. All tag information shall be provided by the system supplier.
- 2.2.16 Provide alarm horns and beacons equal to Federal Signal brand/type where indicated on drawings. Beacons shall be strobe, three color; blue, amber, and red in mechanical room; amber and red in areas outside mechanical room and outdoors. Alarm beacons

shall be located at each entrance to mechanical room and in clear view in event of alarm. Beacon assemblies outdoors shall be NEMA 4 rated. Where pilot lights are used for annunciation purposes use Allen - Bradley; push-to-test or equal.

- 2.2.17 Remote Reset: Provide minimum (1) remote reset pushbutton assembly at main entrance to mechanical room and additional where indicated on drawings to allow reset / silence from safe location. Remote pushbutton station shall be compatible with room decor. Signs at remote reset assembly shall denote a safe and unsafe response action relating to local beacons and entrance to monitored area upon depressing remote reset pushbutton. Upon reset, if the area monitored has been purged to a safe level the beacons shall be deactivated and safe entry shall be permitted.
- 2.2.18 Calibration Gas 3-Way Valve Assembly: Provide between analyzer and sequencing assembly or sample line when all analyzer sample lines are utilized, clearly identified and tagged, to allow admission of calibration zero and span gas directly into analyzer without disconnecting sample tubing.
- 2.2.19 Portable Leak Check Stations: System shall be supplied with device to pinpoint specific refrigerant leak location after system has alarmed and identified leak has occurred. Device shall allow maintenance personnel to pinpoint exact location of refrigerant leak to perform required repairs. One (1) portable leak check station shall be mounted at each chiller and at locations as indicated on drawings. Provide portable leak check station device Model #LC-10 as manufactured by Ino-Tek, Romeo, MI or approved equal.
- 2.2.20 Filters: Inlet sample filter shall be mounted at each area sample point and each relief vent sample point. Provide two (2) years of spare filter elements figuring one (1) element per sample point for every (3) months of operation. Provide wall or uni-strut mountable filter bracket assembly with sample filter and direct compression fitting connection to installer supplied 1/4" (6 mm) o.d. copper sample line as indicated on the drawings.

### **3 . EXECUTION**

#### **3.1 Installation**

- 3.1.1 Comply with ASHRAE 15, Technical Standards & Safety Authority (TSSA) requirements, and Workplace Safety and Insurance Board (WSIB) Standards.
- 3.1.2 Install air-sampling inlets, or diffusion type monitors in pits, tunnels, or trenches in machinery room that are accessible to personnel.
- 3.1.3 Floor mount diffusion-type monitor, sensor/transmitters, or air-sampling inlets on slotted channel frame 12" (300 mm) to 18" (450

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- mm) above the floor in a location near the refrigerant source or between the refrigerant source and the ventilation duct inlet.
- 3.1.4 Wall mount air-sampling multiple-point monitors with top of unit 60" (1,525 mm) above finished floor.
- 3.1.5 Run air-sampling tubing from monitor to air-sampling point, in size as required by monitor manufacturer. Install tubing with maximum unsupported length of 36" (915 mm), for tubing exposed to view. Terminate air-sampling tubing at sampling point with filter recommended by monitor manufacturer.
- 3.1.6 Install air-sampling tubing with sufficient slack and flexible connections to allow for vibration of tubing and movement of equipment.
- 3.1.7 Purge air-sampling tubing with dry, oil-free compressed air before connecting to monitor.
- 3.1.8 Number-code or color-code air-sampling tubing for future identification and service of air-sampling multiple-point monitors.
- 3.1.9 Extend air-sampling tubing from exhaust part of multiple-point monitors to outside.
- 3.1.10 Extend air-sampling tubing from outdoors to outdoor inlet connection of NDIR monitors. Terminate air-sampling tubing at outdoor inlet location with filter recommended by monitor manufacturer.
- 3.1.11 Place warning signs inside and outside each door to the refrigeration equipment room. Sample wording: "AUDIBLE AND VISUAL ALARM SOUNDING INDICATES REFRIGERANT DETECTION - ENTRY REQUIRES SCBA."
- 3.1.12 Audible Alarm-Indicating Devices: Install at each entry door to refrigeration equipment room, and position not less than 6" (150 mm) below the ceiling. Install horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- 3.1.13 Visible Alarm-Indicating Devices: Install adjacent to each alarm horn at each entry door to refrigeration equipment room, and position at least 6" (150 mm) below the ceiling.
- 3.1.14 System supplier shall have turnkey responsibility to provide mechanical and electrical installation, provide on-site installation supervision, and properly locate sampling points after review of chiller room air flow and ventilation patterns.
- 3.1.15 Sample locations indicated on drawings are approximate and must be field verified by system manufacturer with air flow profile tests. Air flow profile tests shall be turned over to owner as part of the safety certification documentation. Final location of sample points shall be determined after all chiller room ventilation systems and equipment have been installed, and properly balanced. It is the

system suppliers responsibility to insure that enough sample points exist to properly monitor air samples both under normal ventilation conditions and under purge ventilation conditions. Air profile test should indicate air flow pattern prior to alarm and after alarm to insure that safe monitoring exists under both conditions.

- 3.1.16 Install equipment in accordance with applicable codes and manufacturer's printed instructions. Route conduits and tubing as required to make neat and operating system. Sample inlet tubing shall be 1/4" o.d. rigid copper, properly supported, and run neatly parallel with, or at right angles to building construction. Tubing shall be void of kinks, sags and other irregularities. All bends shall be made with a tube bender.

### **3.2 Field Quality Control**

#### **3.2.1 General**

- .1 Prior to project completion and when directed by Owner's Representative, manufacturer factory trained representative shall program, start up, thoroughly test and calibrate, set alarm threshold levels, and verify that system is in compliance with operational sequence. Should corrections be required to any system, and after corrections have been completed, system shall be re-tested.
- .2 Assist Security Office and Physical Plant Maintenance Department in development of emergency procedures.
- .3 Tests shall be witnessed by Owner or his designated representative and a letter shall be submitted certifying system performance.

#### **3.2.2 Safety Certification:**

- .1 Furnish Owner with written report certifying that work has been accomplished with results. Provide Safety Certification documentation to the owner including the following: Air Flow Profile Report for each sample point location, Calibration Report with before and after results of each analyzer, Alarm / Interface Report stating all threshold levels, alarm and interface action at each level of alarm with field verification report, Safety Training Checklist, and List of all owner attendees.
- .2 Near end of warranty period of operation, provide similar service as described above complete with written report. Should a control or device be suspect in its operation or function, this deficiency shall be reported to operating personnel, documented in report, and replaced.

- 3.2.3 Post Construction On Site Service: Each six months after final acceptance until warranty expires, systematically inspect, examine, clean and adjust when necessary, detector, panels, relays, self-

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contained breathing apparatus, and accessories pertaining to system. Provide updated pertinent reports.

**3.3 Demonstration**

- 3.3.1 Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain refrigerant detection devices. Refer to requirements in Division 01 Section "Demonstration and Training."

**END OF SECTION**

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## 1. GENERAL

### 1.1 Related Work

1.1.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

### 1.2 Definitions and Abbreviations

1.2.1 The following are abbreviations used throughout the section defining computerized control systems specified herein or defined on plans:

- |     |            |   |
|-----|------------|---|
| .1  | BAS        | Building Automation System  |
| .2  | SAP        | Stand Alone Panel – generic term that applies to BC, AAC, ASC       |
| .3  | DI         | Digital Input   |
| .4  | DO         | Digital Output  |
| .5  | AI         | Analog Input  |
| .6  | AO         | Analog Output   |
| .7  | HVAC       | Heating, Ventilation, Air Conditioning                              |
| .8  | MCC        | Motor Control Centre  |
| .9  | DDC        | Direct Digital Control  |
| .10 | LAN        | Local Area Network  |
| .11 | OS         | Operating System  |
| .12 | OT         | Operating Terminal  |
| .13 | PC         | Personal Computer   |
| .14 | OWS        | BACnet Operator Work Station – same as B-OWS                        |
| .15 | Native     | Native BACnet   |
| .16 | BC         | BACnet Building Controller – same as B-BC                           |
| .17 | AAC        | BACnet Custom Application Controller – same as B-AAC                |
| .18 | ASC        | BACnet Application Specific Controller – same as B-ASC              |
| .19 | SS         | BACnet Smart Sensor – same as B-SSEthernet – BACnet TCP/IP Ethernet |
| .20 | MS/TP      | BACnet Master-Slave/Token Passing                                   |
| .21 | PTP        | BACnet Point-to Point Protocol                                      |
| .22 | Gateway    | BACnet Gateway  |
| .23 | Micropanel | Generic term that applies to AAC and ASC                            |

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**1.3 References**

- 1.3.1 Canadian Standards Association – CSA C22.2no.205-M1983, Signal Equipment.
- 1.3.2 Institute of Electrical and Electronic Engineers – IEEE 472, IEEE 587.
- 1.3.3 National Institute of Standards and Technology – NISTIR 6392 GSA Guide to Specifying Interoperable Building Automation and Control Systems Using ANSI/ASHRAE Standard 135-1995, BACnet.
- 1.3.4 Native BACnet – Native BACnet means that no translation software will be used internal to the OWS, BC, AAC, and ASC to convert from a proprietary protocol to BACnet Standard Object Types, Standard Application Services and devices. Gateways are not native BACnet.
- 1.3.5 BACnet Gateways.

**1.4 Scope of Work**

- 1.4.1 Supply, installation and mounting of all hardware (unless specifically stated otherwise).
- 1.4.2 Supply and mounting of sensor elements and associated hardware, wiring or piping connecting sensors to SAPs.
- 1.4.3 Wiring connecting to SAPs to transducers, fire alarm and smoke control.
- 1.4.4 Supply and wiring connection of solid state relays and relays to terminal connections at MCCs and to SAPs.
- 1.4.5 Supply and installation of SA's comprising of BC's, AAC's, and ASC's.
- 1.4.6 The Controls Sub-Contractor will do the complete installation of all sensors, associated control panels, relays, transducers, actuators, flow switches, gauges, air receivers, SAP computer board, associated power supplies, conduit, wiring, tubing, and all other control devices including isolation room panels, and all terminations.
- 1.4.7 The Controls Sub-Contractor will participate and provide coordination required between the Client, the Consultant, and other Sub-Contractors where controls are involved and the Commissioning Agent.
- 1.4.8 The Controls Sub-Contractor will provide verification and commissioning as follows:
  - .1 End to end continuity checks will be performed on all wiring and control tubing.
  - .2 All sensors, transducers, relays, actuators, control valves and dampers will be calibrated and operationally checked by this Sub-Contractor.
  - .3 Provide a point checkout sheet for verification of system. This Sub-Contractor to initial each point as it is verified.



- 1.4.9 The controls Sub-Contractor will test the SAP computer hardware and operator consoles.

## **2 .      PRODUCTS**

### **2.1      System Description**

- 2.1.1 A complete, fully tested, commissioned and operational Native BACnet Building Automation Systems (BAS) utilizing fully electronic Direct Digital Control (DDC\_ to meet the requirements described herein and in complete accordance with applicable codes and ordinances.
- 2.1.2 The system software and control devices shall be fully compatible with the System programs and hardware, latest BACnet versions.
- 2.1.3 Unless specified otherwise, provided proportional plus integral electronic components.
- 2.1.4 The design, installation, supervision and labour services, calibration, software programming and de-bugging, checkout and commissioning required for the BAS.
- 2.1.5 Supply and installation of electronic packaged zone controllers for terminal unit control.
- 2.1.6 Devices, components, wiring and materials as required for a fully operating control system.
- 2.1.7 Include full graphics operating package with modification of existing site graphics and navigation sequences via customized software programming.
- 2.1.8 Instruction to the Facility's maintenance and operating personnel.
- 2.1.9 Complete system documentation including:
- .1 As-built site diagrams showing location of wiring and panels and system architecture.
  - .2 Operating and Maintenance Manuals.

### **2.2      Cable**

- 2.2.1 Primary Data transmission cable shall be CAT 5 Ethernet cable.

### **2.3      Electronic Terminal Equipment (AAC) Controllers**

- 2.3.1 Each zone controller will be microprocessor-based, multi-tasking, real-time digital control processor. The zone controllers will monitor space temperature sensors and control operation of terminal air valves, air valve reheat coils, fan coil units, and perimeter radiant panels in the corresponding zone.
- 2.3.2 Each zone controller will have sufficient memory to support its own operating system and data base including:

- .1 Control functions.
- .2 Energy management applications.
- .3 Interface with operator portable personal computer.
- 2.3.3 Zone controller panels will have the following features:
  - .1 Setpoint adjustments
  - .2 Modify gain and offset constants.
  - .3 Program parameter adjustments
  - .4 Trend log displays edit/create trend logs through DDC system main panels.
- 2.3.4 Zone controllers shall NOT be mounted in ceiling spaces.

## **2.4 Electronic Air Valve Controls, Sensors & Actuators.**

- 2.4.1 Control Sub-Contractor shall include for the supply and installation of pressure sensors, operators and standalone controllers for the air valves.
- 2.4.2 Control components shall be pre-assembled for testing and performance verification prior to arrival on site.
- 2.4.3 Multipoint cross flow sensors shall be supplied by air valve Manufacturer.
- 2.4.4 Flow transducer shall be a full differential pressure unit not hot wire or thermister type.
- 2.4.5 Electronic operators shall be provided for air valve dampers with piston or gear driven type damper operators.
- 2.4.6 Air valve damper motors shall be Belimo LM24-T floating control or approved equal.
- 2.4.7 Damper operators shall operate with floating point signal for full modulation.
- 2.4.8 Damper operators shall be rigidly attached to the support structure and linkage shall have no "slop".
- 2.4.9 These control components shall be field tested with air valve for testing and performance verification.
- 2.4.10 Submit written test data for the terminal unit controllers for each size of air valve and fan coil unit.
- 2.4.11 Supply air temperature measurement shall be provided on each air valve with reheat coils.

## **2.5 DDC System Functions**

- 2.5.1 The DDC system shall utilize "BACnet open architecture" and have as proven Operator Control Language (OCL), which will be capable of reading the value, and/or status of all control devices from any other user defined combination of calculations and logical expressions.

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- 2.5.2 All Sap's and BACnet Gateways shall conform to the BACnet Protocol Implementation Conformance Specification.
- 2.5.3 Other mandatory monitoring and control features of the DDC system are:
- .1 Levels of Access:
    - .1 Include administrative process for full editing, creating, and modifying abilities. Permissions structure for users.
    - .2 The Region of Peel must be provided the ability to create profiles or roles to operate the system.
    - .3 All default passwords and administrator passwords must be provided to the Supervisor, Technical Services, RPAM:
      - .1 Administrator- Full access, includes adding, editing, deleting other users.
      - .2 Specialist- Editing, Modifying all control points. Creation of trending, and general reports.
      - .3 Operator- Modifying limited control points.
      - .4 Users - Read only access.
    - .4 Level 1: To allow assignment of Level 1 and Level 2 passwords. Creation of new system operators, ability to create, delete and modify system components, modify selected system components, and alarm levels, and generally full system access. – This is granted to Administrator and Specialist
    - .5 Level 2: To allow command and override of system components, alarm acknowledgement, monitor system, display information including alarm messages, graphics, points log, help menus. – This is granted to Operator and Users.
  - .2 Operator defined digital and analog alarms and automatic alarm condition reporting.
  - .3 Auto lockout of alarms when alarmed system is shut-down.
  - .4 Direct keyboard override of all digital and analog outputs, with an indication of the display of any point that is operating under keyboard override.
  - .5 Addition, detection, definition and modification of points and point types from operator keyboard.
  - .6 Trend log graphing of user selected points and times.
  - .7 Run time totalization.
- 2.5.4 The DDC system shall have the capability to be taken off line in the event of failure or for maintenance and returned to operation without the need for entering any portion of the software program manually. To accomplish this, an off-line disk storage device shall be utilized to provide software backup and reload.

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- 2.5.5 On-site backup and verification of the entire system, with full applications software, shall be less than 10 seconds per SAP.
  - 2.5.6 The DDC system shall be provided with automatic protection from any power failure of up to 72 hours duration.
  - 2.5.7 The protection shall at a minimum include continuous real-time clock operation and automatic system restart-upon power return. System will be tested to confirm rated hours.
  - 2.5.8 Panel replacement shall be possible without any hardware notification. Describe replacement procedure in technical data submitted.
  - 2.5.9 Any panel malfunction shall not affect the operation of the multi-panel system.
  - 2.5.10 Indicate how points located on one panel can be accessed and utilized by another panel. Explain any limitations of the above.
  - 2.5.11 Each BC and AAC standard panel proposed shall have enough random access memory for all of the following:
    - .1 Trend Logs – two for each input and output point connected to the panel with 100 samples each.
    - .2 Controllers – two for each output point connected to the panel.
    - .3 Variables – three for each output point connected to the panel. Variables are “virtual points” (as opposed to physical points) but which have all the attributes of real or physical points.
    - .4 Operator Control Language (OCCL) – twenty syntactically correct lines each with at least 4 operators, for each output point connected to the panel, or TEN (1) syntactically correct lines, each with at least four operators, for each output point connected to the panel, if the OCL has the ability to call common routines or use wild card commands.
    - .5 Descriptor – one for each user definable point, real or virtual, in the panel. In addition, on multi-panel systems, every descriptor in the system must be accessible from a single I/O port.
    - .6 Time Schedules – one set for every 3 output points connected to the panel.
    - .7 Totalizers – one for each digital point in the panel.
  - 2.5.12 Processing Speed
    - .1 Effective Panel Processing Speed – Maximum permissible executions time is half a second. Execution time is defined as the time it takes the stand alone panel CPU to execute all application software in the panel, from some point in the software back to the same point, assuming full memory

usage, while simultaneously responding to operator or terminal display requests and carrying out normal inter-panel communications averaged over a one – minute period. This will be done by setting up a counter in each panel and monitoring the counting rate.

- .2 Effective System Processing Speed – This applies to multi-panel systems only. System processing speed is intended to address inter-panel communication and will be checked by evaluating system display response. This will be done by setting up a display of all panel counters and checking how frequently each countered update on the refreshed display.
- .3 Displays shall load real time current values, not stored values, within ten seconds. Every counter shall show an updated value on the display within sixty seconds at the previous update appearing. Provide confirmation that required system processing speed will be achieved.

#### 2.5.13 DDC System Igniter-Panel Communication

- .1 Means shall be provided to ensure communication integrity. Provide detail of the system.
- .2 To prevent damage to the system, each data highway line shall be provided with a means of isolation, either optically or by some other means. Provide detail of protection system in proposal.

#### 2.5.14 Sensors and Associated Equipment

- .1 BAS shall be supplied with all sensors, relays and associated equipment to fully connect the listed DDC points. Field point installation shall be performed in a neat and orderly fashion with all components marked or labelled to correspond with the making or labelling in the as-built drawings.
- .2 All sensors and controllers shall be of commercial grade and shall be installed according to the Manufacturer's recommendations. Provide full details of all sensors and controllers proposed, including their range and accuracy.

## 2.6 System Structure

2.6.1 The Building Automation System (BAS) architecture shall consist of the following installed in communication and main mechanical rooms:

- .1 Standalone DDC system main panels.
- .2 Standalone DDC system terminal equipment (zone) controllers.
- .3 Provide plug-in access for remote or lap-top computer at each panel using the same software as resides on the central workstation.

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## 2.7 DDC System Panels

### 2.7.1 References:

- .1 National Institute of Standards and Technology – NISTIR 6392 GSA Guide to Specifying Interoperable Building Automation and Control Systems Using ANSI/ASHRAE Standard 135-1995, BACnet.

### 2.7.2 DDC Panel Types:

- .1 BC minimum capabilities equivalent to the BACnet Building Controller (B-BC).
- .2 AAC Local Control Unit minimum capabilities equivalent to the BACnet Custom Application Specific Controller (B-AAC).
- .3 ASC Terminal Control Unit minimum capabilities equivalent to the BACnet Application Specific (B-ASC).
- .4 AAC Room Control Unit minimum capabilities equivalent to the BACnet Custom Application Specific Controller (B-AAC).
- .5 SS Smart Sensor minimum capabilities equivalent to the BACnet Smart Sensor (B-SS).

### 2.7.3 DDC Panel Applications – This section describes the mechanical systems that shall be connected to the different DDC panel types.

- .1 BC main function is to provide direct control of all main central mechanical systems such as chillers, cooling towers, heat exchangers, domestic hot water, fan systems etc. The BC's shall directly reside on the primary Ethernet LAN.
- .2 AAC function is to provide control for miscellaneous HVAC components in remote mechanical rooms such as rooftop units, fan coils, unit ventilators, VAV, etc., AAC's shall reside on the secondary RS485 MS/TP network.
- .3 All DDC panels shall meet the minimum requirements set out in this section.

## 2.8 BC BACnet Overview

### 2.8.1 A BC (B-BC) is a native BACnet, general purpose, field programmable controller capable of carrying out a variety of building automation and control tasks. It enables the specification of the following:

- .1 Data Sharing:
  - .1 Ability to provide the values of any of its BACnet objects.
  - .2 Ability to retrieve the values of BACnet objects from other devices.
  - .3 Ability to allow modification of all of its BACnet objects by another device.
- .2 Alarm and Event Management:

- 
- .1 Generation of alarm / event notifications and the ability to direct them to recipients.
  - .2 Maintain a list of unacknowledged alarms / events.
  - .3 Notification of other recipients that the acknowledgement has been received.
  - .4 Adjustment of alarm / event parameters.
  - .3 Scheduling:
    - .1 Ability to schedule output actions, both in the local device and in other devices, both binary and analog, based on date and time.
  - .4 Trending:
    - .1 Collection of delivery of (time, value) pairs.
  - .5 Device of Network Management
    - .1 Ability to respond to information about its status.
    - .2 Ability to respond to requests for information about any of its objects.
    - .3 Ability to respond to communication control messages.
    - .4 Ability to synchronize its internal clock upon request.
    - .5 Ability to perform re-initialization upon request.
    - .6 Ability to upload configuration and allow it to be subsequently restored.
    - .7 Ability to command half-routers to establish and terminate connections.
  - 2.8.2 Provide sufficient number of BC's to fully meet all requirements of this specification plus specified spare point capacity. An Ethernet gateway connecting the WAN to the building BC is NOT acceptable.
  - 2.8.3 BC to be standalone intelligent controller, BC panel to:
    - .1 Be microprocessor based, multi-tasking, multi-user, real-time digital control processors capable of supervising other low level programmable controllers through secondary networks.
    - .2 Consist of modular hardware with plug-in processors, communication controllers, power supplies, I/O modules.
    - .3 Provide MS/TP BACnet LAN port for local AAC/ASC network.
    - .4 Provide on-board LAN interface for Ethernet BACnet peer-to-peer communication between BC's and at least **[1]** RS-232C serial data communication ports to support simultaneous operation of multiple operator I/O devices such as industry standard printers, lap-top work-stations, PC work-stations and BC-mounted or portable OT's. One

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- RS-232C data port will support point-to-point PTP BACnet protocol.
- .5 Allow temporary use of portable devices without interrupting normal operation of permanently connected modems, printers, OT's.
  - .6 Interface field sensors via local I/O terminations located on BC located in processor cabinet.
  - .7 In standalone mode execute programmable logic control (direct digital or closed loop process control) of associated HVAC equipment without interacting with other processors or OWS's.
- 2.8.4 Dial-up Communications:
- .1 Auto-dial/auto-answer communications to allow BC/s to communicate with remote OW's on non-contributions basis via telephone lines.
  - .2 To analyze and set priorities for all alarms to minimize of calls. Non-critical alarms to be buffered in memory and reported as group or until operator manually requests upload of alarms.
- 2.8.5 Spare Capacity
- .1 Provide 20% spare point capacity on panels with greater than 32 I/O and 10% spare capacity on panels with less than 32 I/O.
- 2.8.6 Programming and Energy Management Routines:
- .1 Time of day scheduling.
  - .2 Calendar based scheduling.
  - .3 Holiday scheduling.
  - .4 Temporary schedule overrides.
  - .5 Optimal start.
  - .6 Optimal stop.
  - .7 Supply air reset.
  - .8 Duty cycling.
  - .9 Night setback.
  - .10 Chilled water and condenser water reset.
  - .11 Heating water reset.
- 2.8.7 All programs to be executed automatically without need for operator intervention.
- 2.8.8 Programming languages:
- .1 Shall meet requirements specified in Custom Programming Capability Specification Section.
- 2.8.9 Priority Level:
-



- .1 BC shall provide for 16 levels of priority from all outputs. The priority levels shall conform to the BACnet object specifications.

2.8.10 Trend Logging:

- .1 All trend log information shall be stored at BC and not at OWS.

## 2.9 **AAC BACnet Overview**

2.9.1 An AAC (B-AAC) is a general purpose, field programmable controller capable of carrying out a variety of building automation and control tasks. It enables the specification of the following:

- .1 Data Sharing:
  - .1 Ability to provide the values of any of its BACnet objects.
  - .2 Ability to retrieve the values of BACnet objects from other devices.
  - .3 Ability to allow modification of all of its BACnet objects by another device.
- .2 Alarm and Event Management:
  - .1 Generation of alarm / event notifications and the ability to direct them to recipients.
  - .2 Maintain a list of acknowledged alarms / events.
  - .3 Notifying other recipients that the acknowledgement has been received.
  - .4 Adjustment of alarm / event parameters.
- .3 Scheduling:
  - .1 Ability to schedule output actions, both in the local device and in other devices, both binary and analog, based on date and time.
- .4 Trending:
  - .1 Collection and delivery of (time, value) pairs.
- .5 Device and Network Management:
  - .1 Ability to respond to information about its status.
  - .2 Ability to respond to requests for information about any of its objects.
  - .3 Ability to respond to communication control messages.
  - .4 Ability to synchronize its internal clock upon request.
  - .5 Ability to perform re-initialization upon request.
  - .6 Ability to upload its configuration and allow it to be subsequently restored.

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- .7 Ability to command half-routers to establish and terminate connections.
  - 2.9.2 Provide sufficient number of AAC's to fully meet all requirements of this specification plus specified spare point capacity.
  - 2.9.3 AAC to be stand-alone intelligent controller. AAC panel to:
    - .1 Be microprocessor based, multi-tasking, multi-user, real-time digital control processors capable of supervising other lower level programmable controllers through secondary networks.
    - .2 Consist of modular hardware with plug-in processors, communication controllers, power supplies, I/O modules.
  - 2.9.4 Provide MS/TP BACnet Lan port for local ASC network.
  - 2.9.5 Provide on-board LAN interface for MS/TP BACnet peer-to-peer communication between AAC's and at least [1] RS-232C serial data communication port to support operation of operator I/O devices such as industry standard printers, lap-top work-stations, PC work-stations and AAC-mounted or portable OT's. RS-232C data port, will support point to point PTP BACnet protocol.
  - 2.9.6 Allow temporary use of portable devices without interrupting normal operation of permanently connected modems, printers, OT's.
  - 2.9.7 Interface field sensors directly to I/O terminations located on AAC in processor cabinet.
  - 2.9.8 In standalone mode execute programmable logic control (direct digital or closed loop process control) of associated HVAC equipment without interacting with other processors or OWS's.
  - 2.9.9 Spare Capacity:
    - .1 Provide 10% spare point capacity for each AAC without additional cards, terminals or a minimum of one spare input and one spare output.
    - .2 If AAC is used for unitary equipment then no spare capacity is required unless identified on points list.
  - 2.9.10 Programming and Energy Management routines:
    - .1 AAC to provide the following energy management routines:
      - .1 Time of day scheduling.
      - .2 Calendar based scheduling.
      - .3 Holiday scheduling.
      - .4 Temporary schedule overrides.
      - .5 Optimal start.
      - .6 Optimal stop.
      - .7 Supply air reset.
      - .8 Duty cycling.

.9 Night setback.

2.9.11 All programs to be executed automatically without need for operator intervention.

2.9.12 Programming languages:

.1 Shall meet requirements specified in Custom Programming Capability Specification Section.

2.9.13 Priority Level:

.1 AAC shall provide for 16 levels of priority from all outputs. The priority levels shall conform to the BACnet object specifications.

2.9.14 Trend Logging:

.1 All trend log information shall be stored at AAC and not at BC or OWS.

## 2.10 ASC BACnet Overview

2.10.1 ASC BACnet overview: An ASC (B-ASC) is a controller with limited resources relative to an AAC. It is intended to use in a specific application and supports limited programmability. It enables specification of the following:

.1 Data Sharing:

.1 Ability to provide the values of any of its BACnet objects.

.2 Ability to allow modification of some or all of its BACnet objects by another device.

.2 Alarm and Event Management:

.1 None

.3 Scheduling:

.1 None

.4 Trending:

.1 None.

.5 Device and Network Management:

.1 Ability to respond to information about its status.

2.10.2 ASC to be standalone intelligent controller. ASC panel to:

.1 Be microprocessor based, real-time digital control processors.

.2 Consist of modular hardware with communication controllers, power supplies, I/O modules.

.3 Provide on-board LAN interface for MS/TP BACnet peer-to-peer communication between ASC's and at least **[1]** RSS-232C serial data communication port to support operation of operator I/O devices such as industry standard printers, lap-

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- top work-stations, PC work-stations and ASC-mounted or portable OTs.
- .4 Allow temporary use of portable devices without interrupting normal operation of permanently connected modems, printers, OTs.
  - .5 Interface field sensors directly to I/O terminations located on ASC in processor cabinet.
- 2.10.3 In standalone mode execute programmable logic control (direct digital or closed loop process control) of associated terminal equipment without interacting with other processors or OWS's.
- 2.10.4 Spare Capacity:
- .1 Provide 10% spare point capacity for each ASC without additional cards, terminals.
  - .2 If ASC is used for terminal equipment then no spare capacity is required unless identified on points list.
- 2.10.5 Programming and Energy Management Routines:
- .1 ASC to provide for the following energy management routines:
    - .1 Temporary schedule overrides.
    - .2 Supply air reset.
    - .3 Night setback.
  - .2 All programs to be executed automatically without need for operator intervention.
  - .3 Programming languages:
    - .1 Firmware based application specific program utilizing full BACnet objects and functionality.
- 2.10.6 Priority Level:
- .1 ASC shall provide for 1 level of priority from all outputs.
- 2.10.7 Trend Logging:
- .1 All trend log information shall be stored at AAC or BC not ASC.

## **2.11 Custom Programming Capability**

### **2.11.1 Programming Languages:**

- .1 All GCL General Control Language software to be programmed in general control type or high-level control language supporting full BACnet objects and functionality.

**END OF SECTION**

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## 1. **GENERAL**

### 1.1 **Summary**

1.1.1 Detailed narrative description of Sequence of Operation of each system.

- .1 Control Description Logic (CDL) for each system.
- .2 Input/Output Point Summary Tables for each system.

### 1.2 **References**

1.2.1 Public Works and Government Services Canada (PWGSC) / Real Property Branch / Architectural and Engineering Services.

- .1 MD250005-2009 200, Energy Management of Control Systems (EMCS) Design Manual, English.
- .2 Shared Services BC Client Comfort Design Manual (CCS Manual) – See SSBC Integrated Workspace Solutions (IWS) Standards and Manuals.

### 1.3 **Sequencing**

1.3.1 This section defines the sequence of operation for the mechanical systems that are to be executed by the DDC system and shall be read in conjunction with the Controls DDC Section 25 05 01.

1.3.2 The control sequences contain a general description of the intent of the operation of the systems to be controlled. The Contractor shall review individual systems to ensure equipment and life safety interlocks are not overridden.

1.3.3 The control sequences shall be interpreted in conjunction with the respective system configuration schematics, layout and details shown on the drawings.

1.3.4 The relationships between the points, systems and building are described in the control sequences.

1.3.5 Not all points are shown on the drawings. All points, sensors and transmitters required to implement the control sequences described herein and/or listed in the drawings, are to be provided regardless of whether shown or not.

1.3.6 Review with the Consultant during the shop drawing stage to finalize control sequences for each system.

### 1.4 **Standard Routines**

1.4.1 On a power interruption at a control panel, the equipment controlled by that panel shall turn-off as if to signal to stop equipment had been given. On a return from power failure, the equipment shall restart in an orderly fashion with time delays between each major system.

During power failure, the emergency generator starts, power shall be directed to specific equipment. Refer to motor list for mechanical equipment that requires emergency power. Life and safety system shall start first.

- 1.4.2 If the power interruption has been to multiple control panels, equipment start-up shall be delayed between control panels.
- 1.4.3 Control sequences shall be executed if the associated equipment is running, whether the sequence is initiated manually (for example, an operator is positioning a motor starter in the hand position) or the DDC system.
- 1.4.4 The DDC System shall not override any safety interlocks.

#### **1.5 Alarm and Event Messages**

- 1.5.1 System error occurs when the status point does not correspond to the commanded status (or is outside of accepted deviation from setpoints) and generation of an alarm message is required.
- 1.5.2 When the DDC system identifies a sensor as “failed” it shall disable the input point and place all outputs dependent on the disabled input to a safe state. An alarm message shall be output for each occurrence at the alarm printers.
- 1.5.3 Coordinate with the Engineer on the wording of event messages to be generated. Provide an alarm data DDC system sheet and complete the specified columns providing information on the point name, alarm type, high limit, low limit and alarm reference conditions.

#### **1.6 Setpoints, Schedules and Hours of Operation**

- 1.6.1 The setpoints, schedules and hours of operation indicated in the sequences of operation are for initial set-up of the system. During the commissioning process and building operation the setpoints and schedules are to adjusted as deemed necessary to optimize system operation.
- 1.6.2 All setpoints, schedules and hours of operation shall be operator on-line definable.

#### **1.7 Motor Control**

- 1.7.1 When points are utilized for motor run time totalization, either to generate a maintenance alarm or for equipment switchover, a virtual point shall be used and reset to zero after the specified run time.
- 1.7.2 Programming the Sequence of Operation
  - .1 For operating sequences, the Contractor shall provide an outline of the proposed programming approaches and examples to the Engineer for review.

- .2 Where hydronic pumps are controlled from variable speed drive(s), the minimum speed of the pump shall be  $\pm 40\%$  of rated full speed RPM, or as directed by the pump supplier and balancing agent to meet minimum system flow and pressure requirements.

## 2. **BUILDING SPECIFIC SEQUENCE OF OPERATIONS**

### 2.1 **CONTRACTOR REVIEW OF SEQUENCES**

- 2.1.1 As part of the control's submittal process, the DDC Contractor shall formally state "The sequences shall be programmed as written" or it shall describe any deviations. In particular, the contractor shall annotate any:
  - .1 Apparent errors in the sequence logic
  - .2 Control logic which might lead to equipment damage or violate manufacturer warranties
  - .3 Control logic elements which cannot be implemented due to the equipment submitted on by others.
  - .4 Limitations due to VE, phasing, or owner requirements which could conflict with the design intent on the contract documents.

### 2.2 **SEQUENCE MODIFICATIONS DUE TO EQUIPMENT OR OEM CONTROLS LIMITATIONS**

- 2.2.1 Typically, the equipment specified is open to competition and as a result, there can be slight variations among various manufacturers that may impact the sequence of operations. It is common for there to be with limitations of OEM controls or slight discrepancies in the points provided.
- 2.2.2 If minor specifics of the OEM controls differ slightly but still meet the design intent, then the following applies:
  - .1 Network architecture, where provided by the EOR takes precedence over specific points. Substations of serial network comm where ethernet is designed is not acceptable. Note: topology variations through use of routers/repeaters/servers or manufacturer specific network products to best suit project conditions are the means and methods of the DDC contractor.
  - .2 Specified precision or particular attributes of OEM sensors may be relaxed or amended on limited, case by case basis to accommodate what the factory feels is best to run their equipment.
  - .3 The absence of sensors whose function is vital to the execution of the sequence of operations is not considered

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acceptable. Contractor to provide additional DDC controller to supplement the OEM controls if required to execute the sequence. This is particularly applicable for:

- .4 Central plant equipment, air source heat pumps, and all associated CHW & HHW pumps.
- .5 DOAS, ERV, fan coils
- .6 Trench fan coil units.
- .7 This must be brought the attention of the EOR during submittal process so that it can be properly approved.
- .8 Approved changes need to be incorporated into the as-builts as the final sequence of operations. Functional and performance tests are then to be an accurate reflection of the OEM controls sequence as implemented for this specific project.

#### 2.2.3 Zone Groups

- .1 Each system shall be broken into separate Zone Groups composed of a collection of one or more zones served by a single air handler.
- .2 Each Zone Group shall be capable of having separate occupancy schedules and Operating Modes from other Zone Groups.
- .3 All zone groups are subject to owner approval.
- .4 All zones in each Zone Group shall be in the same Operating Mode at all times. If one zone in a Zone Group is placed in any mode other than Unoccupied Mode (due to override, sequence logic, or scheduled occupancy) all zones in that Zone Group shall enter that mode.
- .5 A Zone Group may be in only one mode at any given time.

#### 2.2.4 Zone Group Assignments

- .1 As a default, all VAV terminal units served by an DOAS shall be in a zone group. Further subdivision by floor, or wing could be necessary for a given project.
- .2 Each zone served by a fan-coil or single-zone air handler shall be its own Zone Group.
- .3 All networking closets, mechanical and electrical rooms served by the air handler shall be a single Zone Group.
- .4 Each radiant manifold and associated temperature sensors are considered a zone group.
- .5 Each ERV is considered its own zone group.
- .6 VRF or VRV FCU may be in groups or considered independent. Contractor to send RFI if the nature of the branch selector or CU is not clear.



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- .7 Operable & manual window groups or natural ventilation zones may or may not coincide with mechanical equipment. Contractor to send RFI for all instances for proper verification of priority and overlap.
- 2.2.5 Building Operating Modes
- .1 Occupied Mode:
    - .1 This is set based on user adjustable schedule.
    - .2 A thermostat with an override input may initiate occupied mode outside of the pre-set schedule.
    - .3 Schedule shall accommodate user provided holidays.
  - .2 Morning Warm-Up Mode:
    - .1 The design intent is for the BMS to begin warming the building so that it can be comfortable at the start of occupied mode.
    - .2 The start time of warmup mode is initiated by user provided schedule.
    - .3 Zones where the window switch indicates that a window is open shall be ignored.
    - .4 During morning warm up, set all zone setpoints to initial setpoint of 76°F (adj) OR an alternative approach is to set all terminal unit dampers to full open.
    - .5 Enable the DOAS and HHW plant to run.
    - .6 Allow economizer(s) to provide for 100% recirculation air if OAT < RAT.
  - .3 Morning Cool-Down Mode:
    - .1 The design intent is for the BMS to begin cooling the building so that it can be comfortable at the start of occupied mode.
    - .2 The start time of warmup mode is initiated by user provided schedule.
    - .3 Zones where the window switch indicates that a window is open shall be ignored.
    - .4 During cool down mode, set all zone setpoints to initial setpoint of 69°F (adj) OR an alternative approach is to set all terminal unit dampers to full open.
    - .5 Enable the DOAS and CHW plant to run.
    - .6 Allow economizer(s) to provide for 100% recirculation air if OAT > RAT.
  - .4 Freeze Protection Mode (as applicable):

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- .1 During Unoccupied Mode, if any single zone falls below 38°F, the Zone Group shall enter Morning Warm-Up Mode until all zones are above 45°F.
  - .5 Night Flush Mode (as applicable) only where motorized control for the Windows are available:
    - .1 The design intent is for the BMS to begin cooling the building so that it can be comfortable at the start of occupied mode.
    - .2 This mode will run to a manually schedule set by the owner and enabled for operation automatically by the BMS. Full sequence details of building cooling anticipation is described elsewhere in this sequence.
    - .3 100% outside is to be used to pre-cool the thermal mass of the building. CHW or mechanical cooling equipment to remain locked out.
    - .4 Air side equipment with access to outside air to run a fan best efficiency point as described on the manufacturer submittal data.
    - .5 All terminal units to open to full position.
    - .6 All zones intended to benefit from this sequence to be given an initial setpoint of 65°F (adj).
    - .7 When all night flush participating zones have achieved their target setpoint for 2 hours (adj) then night flush is completed, and all equipment can return to normal unoccupied mode.
  - .6 Night setback mode:
    - .1 Off-business hours based on user provided schedule.
    - .2 The unit will run at relaxed setpoints as the expectation is that afterhours staff (cleaning/ janitorial) will have jackets or other non-business attire. Typical zone setpoints of 72°F should have 10°F (adj) added/subtracted from occupied mode setpoints. SF & RF to run as normal.
  - .7 Unoccupied Mode:
    - .1 When the Zone Group is not in any other mode.
    - .2 For the purposes of this document, Unoccupied Mode assumes the building is unpopulated AND it is favorable for the maximum amount of equipment to be off.
    - .3 However, for many buildings, unoccupied mode may need to be essentially like occupied mode with very relaxed setpoints. This is particularly relevant in extreme climates or where central plant sizing does not

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- lend itself to quick morning warm-up or cool-down times.
- .4 Example: the weekend setpoints in Alaska over the weekend may need to be set to 45°F to prevent freeze related damage, and so that the morning warmup mode has a chance to function as intended.
- .5 For clarification purposes regarding this project: Unoccupied Mode is intended to refer to a mode where equipment may be safely turned off fully. DDC contractor to use discretion and apply sequences as required.
- .8 Control Loops
- .1 Unless otherwise indicated, control loops shall be enabled and disabled based on the status of the system being controlled to prevent wind-up.
- .2 When a control loop is enabled or re-enabled, it and all its constituents (such as the proportional and integral terms) shall be set initially to a Neutral value.
- .3 A control loop in Neutral shall correspond to a condition that applies the minimum control effect, i.e. valves/dampers closed, VFDs at minimum speed, etc.
- .4 The term “control loop” or “loop” is used generically for all control loops. These will typically be PI loops. Proportional plus integral plus derivative gains are not required on all loops. Do not use the derivative term on any loops unless field tuning is not possible without it.
- .5 Unless specifically indicated otherwise, the following guidelines shall be followed:
- .6 To avoid abrupt changes in equipment operation, the output of every control loop shall be limited by a user adjustable maximum rate of change, with a default of 25% per minute.
- .7 All setpoints, timers, deadbands, PID gains, etc. listed in sequences shall be adjustable by the user with appropriate access level whether indicated as adjustable in sequences or not. Software points shall be used for these variables. Fixed scalar numbers shall not be embedded in programs except for physical constants and conversion factors.
- .8 All hardware points, not just inputs, should be capable of being overridden for purposes of testing and commissioning. For example, the commissioning agent should be able to command damper positions, valve

positions, fan speeds, etc. directly through BMS overrides.

- .9 Trim & Respond (T&R) Setpoint Reset Logic
  - .1 Trim & Respond setpoint reset logic and zone/system reset Requests where referenced in sequences shall be implemented as described below.
  - .2 A “Request” is a call to reset a supply pressure or supply temperature setpoint. These are typically generated by equipment downstream of central service equipment; such as terminal units requesting pressure from an DOAS supply fan.
  - .3 For each type of request, there must be complimentary variables to augment its use.
  - .4 Requests can be amplified or negated with an Importance Multiplier. Multiply the number of Requests by the Importance Multiplier and send to the system/plant that serves the zone/system. A value of zero causes the requests from that zone or system to be ignored. A value greater than one can be used to effectively increase the number of requests from the zone/system based on the critical nature of the spaces served. Importance Multiplier (default = 1)
  - .5 Request-Hours accumulates the integral of requests (prior to adjustment of Importance Multiplier) to help identify zones/systems that are driving the reset logic. Rogue zone identification is particularly critical in this context, since a single rogue zone can keep the Trim & Response loop at maximum, and prevent it from saving any energy.
  - .6 Request-Hours. Every x minutes (default 5 minutes), add x/60 times the current number of Requests to this request-hours accumulator point. The request-hours point is reset to zero upon a global command from the system/plant serving the zone/system – this global point simultaneously resets the request-hours point for all zones/systems served by this system/plant.
  - .7 Cumulative%-Request-Hours. This is the zone/system Request Hours divided by the zone/system run-hours (the hours in any Mode other than Unoccupied Mode) since the last reset, expressed as a percentage.
  - .8 For each upstream system or plant setpoint being controlled by a T&R loop, define the following variables. Initial values are defined in system/plant sequences below. Values for trim, respond, time step, etc. shall be tuned to provide stable control.

Variable	Definition
Device	Associated Equipment or System
SP0	Initial setpoint
SPmin	Minimum setpoint
SPmax	Maximum setpoint
Td	Delay timer
T	Time step
I	Number of Ignored Requests
R	Number of Requests from zones/systems
SPtrim	Trim amount
SPres	Respond amount (must be opposite in sign to SPtrim)
SPres-max	Maximum response per time interval (must be same sign as SPres)

- .9 Note that it is recommended that  $|SPres| > |SPtrim|$  so that the reset logic does not get stuck at a value, as can happen if SPres and SPtrim are equal in absolute value. The number of Ignored Request (I) should be set to zero for critical zones or air handlers.
- .10 Trim & Respond logic shall reset setpoint within the range SPmin to SPmax. When the associated device (e.g. fan, pump) is off, the setpoint shall be SP0. The reset logic shall be active while the associated device is proven on, starting Td after initial device start command. When active, every time step T, trim the setpoint by SPtrim. If there are more than I Requests, respond by changing the setpoint by  $SPres * (R-I)$ , (i.e. the number of Requests minus the number of Ignored Requests), but no more than SPres-max. In other words, every time step T:
  - .11 Change setpoint by SPtrim
  - .12 also change setpoint by  $(R-I)*SPres$  but no larger than SPres-max

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- .13 Where multiple DP sensors are placed in the system, requests shall be aggregated according the DP they are associated with.
  - .14 Example, if a building has East and West risers, these would have requests that correspond to different exposures. It would not make sense to reset the West wing DP based on requests made by the East wing, or vise versa.
  - .15 DDC contractor to create T&R logic for each resettable setpoint, then use comparator logic so that the highest output of those logic sets shall be mapped to the equipment providing service (supply fan, pump, etc).
  - .16 Note: each of these branch or riser setpoint ranges need to be determined by the air and water balancer as they will all be unique. Example: a roof of multiple DOASs with very high gpm rates could span 5-20 psi while a lobby radiant manifold that also has to be served would only require 3-8psi. These will run at very different times for very different reasons, the requests of each type need to be correctly applied to their respective ranges.
- .10 Alarms
- .1 Levels of alarm in order of priority
    - .1 Level 1: Critical/life safety
    - .2 Level 2: Significant equipment failure
    - .3 Level 3: Non-critical equipment failure/operation
    - .4 Level 4: Energy conservation monitor
    - .5 Level 5: Maintenance indication, notification
  - .2 All alarms generated by the BMS shall include at least the following information:
    - .1 Date and time of the alarm
    - .2 Level of the alarm
    - .3 Description of the alarm
    - .4 Equipment tags for the units in alarm
    - .5 Possible causes of the alarm, if provided by the fault detection routines
    - .6 The Source which serves the equipment in alarm
- .11 Outdoor Air Temperature Sensing
- .1 When there are multiple outdoor air temperature sensors, the system shall use the valid sensor that most accurately represents the outdoor air conditions at the equipment being controlled.
  - .2 Outdoor air temperature sensors at air handler outdoor air intakes shall be considered valid only when the

supply fan is proven on and unit is in Occupied Mode or any other Mode in which the economizer is enabled.

- .3 The outdoor air temperature used for graphics display, optimum start, plant lockout, and other global sequences shall be the average of all valid sensor readings. If there are four or more valid outdoor air temperature sensors, discard the highest and lowest temperature readings.
  - .4 If the control drawings indicate a weather station is to be provided, this is to be used as a global point that will be passed as a virtual point to all equipment. Note: this global point would not take the place of a hardwired OAT sensor being used to control an economizer. The weather station shall be displayed on the front end and trended on 15 min intervals. These trends to be auto-exported monthly in .csv format to the email of an admin user.
- .12 Equipment Staging and Rotation
- .1 Automatic Even Wear Rotation
  - .2 The automatic even wear rotation presented in the following section is written using the basis of equipment run time to determine position in the queue for staging and is triggered only during a stage up or stage down event. These sequences will provide the most even run time across multiple pieces of equipment.
  - .3 Lead/lag: Unless otherwise noted, parallel staged devices (such as pumps, towers) that are not redundant shall be lead/lag alternated when more than one is off or more than one is on so that the device with the most operating hours is made the later stage device and the one with the least number of hours is made the earlier stage device.
  - .4 For example, assuming there are three devices, if all three are off or all are on, the staging order will simply be based on run hours from lowest to highest. If two devices are on, the one with the most hours will be set to be stage 2 while the other is set to stage 1; this may be the reverse of the operating order when the devices were started. If two devices are off, the one with the most hours will be set to be stage 3 while the other is set to stage 2; this may be the reverse of the operating order when the devices were stopped.
  - .5 Lead/standby: Unless otherwise noted, parallel devices (such as pumps, towers) that are 100% redundant shall be lead/standby alternated when more than one is off

so that the device with the most operating hours is made the later stage device and the one with the least number of hours is made the earlier stage device.

- .6 For example, assuming there are three devices, if all three are off, the staging order will be based on run hours from lowest to highest. If devices run continuously, lead/standby shall switch at an operator-specified runtime; standby device shall first be started and proven on before former lead device is changed to standby and shut off.
- .13 Exceptions
  - .1 Operators with appropriate access level shall be able to manually command staging order via software points overriding the Even Wear or Periodic Rotation logic above, but not overriding the In Alarm or Hand Operation logic below.
  - .2 In Alarm: If the lead device has a fault condition or has been manually switched off, a Level 2 alarm shall be generated and the device shall be set to the last stage position in the lead/lag order until alarm is reset by operator. Staging position of remaining devices shall follow the prevailing (Even Wear or Periodic Rotation) logic. A device in alarm can only automatically move up in the staging order if another device goes into alarm. Fault conditions include the following:
    - .1 Variable Speed Fans and Pumps
      - .1 VFD critical fault is ON
      - .2 Status point not matching its on/off point for 3 seconds after a time delay of 15 seconds while the device is commanded on, or
      - .3 Supervised HOA at control panel in OFF position, or
      - .4 Loss of power (e.g. VFD DC Bus voltage = zero)
    - .2 Constant Speed Fans and Pumps
      - .1 Status point not matching its on/off point for 3 seconds after a time delay of 15 seconds while the device is commanded on, or
      - .2 Supervised HOA at control panel in OFF position
    - .3 Hand Operation: If a device is on in Hand (e.g. via an HOA switch or local control of VFD), the device shall be set to the lead device and a Level 4 alarm shall be generated. The device will remain as lead



until the alarm is reset by the operator. Hand operation is determined by:

- .4 Variable Speed Fans and Pumps
  - .1 Status point not matching its on/off point for 15 seconds while the device is commanded off.
  - .2 VFD in local "hand" mode
  - .3 Supervised HOA at control panel in ON position
- .5 Constant Speed Fans and Pumps
  - .1 Status point not matching its on/off point for 15 seconds while the device is commanded off.
  - .2 Supervised HOA at control panel in ON position
  - .3 Chillers: Chiller is manually turned on as indicated by the status of the local/auto switch from chiller gateway.
- .14 Air Economizer High Limits
  - .1 Economizer shall be disabled whenever the outdoor air conditions exceed the economizer high limit setpoint as specified by local code. Setpoints vary by energy standard, climate zone, and economizer high limit control device type.
- .15 Damper/Valve Position
  - .1 Knowledge of damper and valve position are required for proper generation of Trim & Respond reset requests.
  - .2 The following are acceptable methods for determining position:
  - .3 Analog actuator. Position may be assumed to be equal to AO signal sent to actuator.
  - .4 Floating actuator. Provide position feedback via analog input.
- .16 VFD Speed Points
  - .1 The speed analog output sent to VFDs shall be configured such that 0% speed corresponds to 0 Hz and 100% speed corresponds to maximum speed configured in the VFD.
  - .2 Minimum speed setpoints for all VFD-driven equipment shall be determined in accordance with the test and balance specifications. Controls contractor shall coordinate with balance contractor.

- .3 For each piece of equipment, the minimum speed shall be stored in a single BMS software point. In case of a hard-wired VFD interface, the minimum speed shall be the lowest speed command sent to the drive by the BMS.
- .17 Miscellaneous
  - .1 The term “proven” (i.e. “proven on”/ “proven off”) shall mean that the equipment’s measured feedback point matches the state set by the equipment’s command point.
  - .2 Values for all points, including real (hardware) points used in control sequences shall be capable of being overridden by the user with appropriate access level (e.g. for testing and commissioning). If hardware design prevents this for hardware points, they shall be equated to a software point and the software point shall be used in all sequences.

## 2.3 **DOMESTIC HOT WATER**

- .1 Domestic hot water storage tank heating pumps P-1 and P-2 shall operate continuously. Three-way mixing valves on heating water to each tube bundle shall be modulated to maintain a domestic water temperature in storage tanks hwt-1 and hwt 2 of 145°F (62.5°C).
- .2 The DDC shall monitor the status of all circulators through a current tap and issue alarm if failure is detected.
- .3 The DDC system shall monitor the run time on the circulating pumps and generate maintenance time reminders at the Manufacturers’ recommended frequency levels.

## 2.4 **HEAT PUMP SYSTEMS**

- .1 Water Loop System
- .2 The heat pump is normally enabled from the DDC. The source side and load side circulation pumps are started first through DDC. Upon proof of water flow in the respective source side and load side loops the heat pump is enabled.
- .3 Heat Pump Operation
- .4 The heat pump operates in cooling-mode or in heating mode only.
- .5 Depending on the cooling/heating demand, the heat pump operates to meet the “load side” primary loop

supply water temperature setpoint as calculated by DDC.

## **2.5 DOAS – GLYCOL – DEHUMIDIFICATION/HUMIDIFICATION**

### **2.5.1 General**

- .1 All programming performed by custom DDC controller.
- .2 DOAS SF will control to duct supply pressure.
- .3 DOAS RF will control to building pressure.
- .4 Heat exchanger core dampers will allow 100% OSA when conditions are favorable or re-direct air flow through the heat exchanger when heat recovery or pre-cooling is favorable.
- .5 Coils provide tempered air.

### **2.5.2 Modes**

- .1 Occupied mode – business hours based on user provided schedule. Default value 7am to 5pm, mon-Friday.
- .2 Morning warm up mode – not applicable
- .3 Morning cool down – not applicable
- .4 Night flush – not applicable
- .5 Night setback mode – The unit will run at relaxed setpoints as the expectation is that afterhours staff (shipping/receiving, janitorial, stocking) will have jackets or other non-business attire. Typical zone setpoints of 72°F should have 10°F (adj) added/subtracted from occupied mode setpoints. SF & RF to run as normal.
- .6 Unoccupied Mode - When the Zone Group is not in any other mode. For the purposes of this document, Unoccupied Mode assumes the building is unpopulated AND it is favorable for the maximum amount of equipment to be off. This is true for the majority of buildings in milder climates such as Ashrae climate zone 1. Enter this mode based on user provided schedule to turn the unit completely off.

### **2.5.3 Exhaust & outdoor air dampers**

- .1 The exhaust and outdoor air dampers shall be fully open when the unit is enabled to run and fully closed when the unit is disabled.
- .2 Building pressurization control is not with EA dampers.

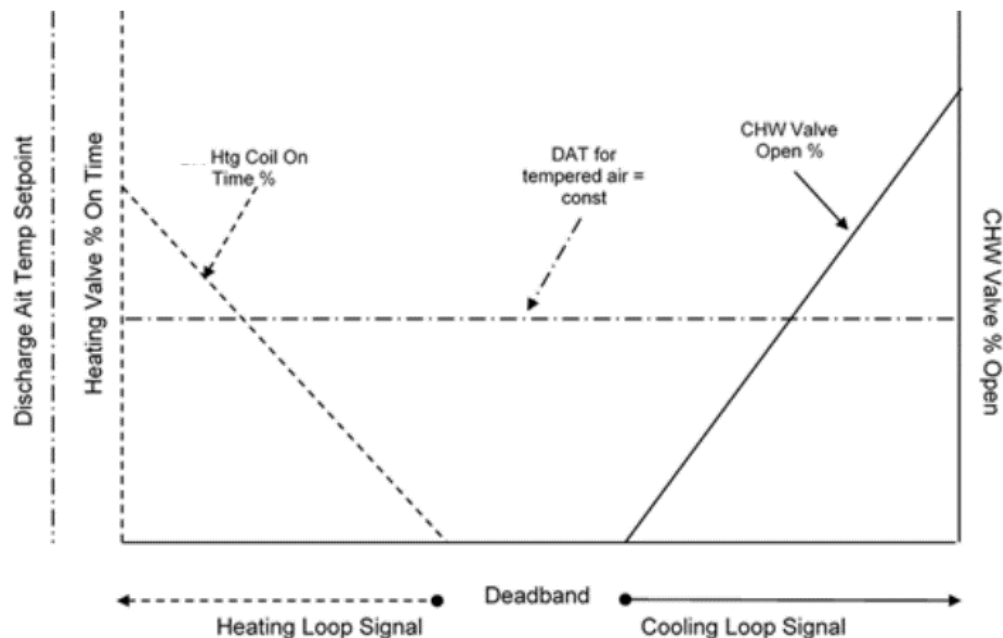
### **2.5.4 Supply fan operation**

- .1 For DOAS with VAV, maintain .5" duct static with PI loop control.
- .2 DOAS will always control to supply duct dp.

### **2.5.5 Demand control ventilation**

- .1 Note: applicable for DOAS with IAQ or space CO2 sensors. This SOO is separate from VAV with space CO2.
- .2 Design intent is to influence potentially uncomfortable indoor air quality levels in the space. Direct control for a space of this nature deemed unfeasible.
- .3 DDC contractor to establish a baseline for ambient space CO2. Default value of 400 ppm (adj).
- .4 When the space CO2 has reached 400 ppm (adj) above ambient, use a P only loop to begin resetting the DOAS supply cfm setpoint higher in 10% increments.
- .5 Full DOAS cfm setpoint should correspond to 1500 ppm (adj).

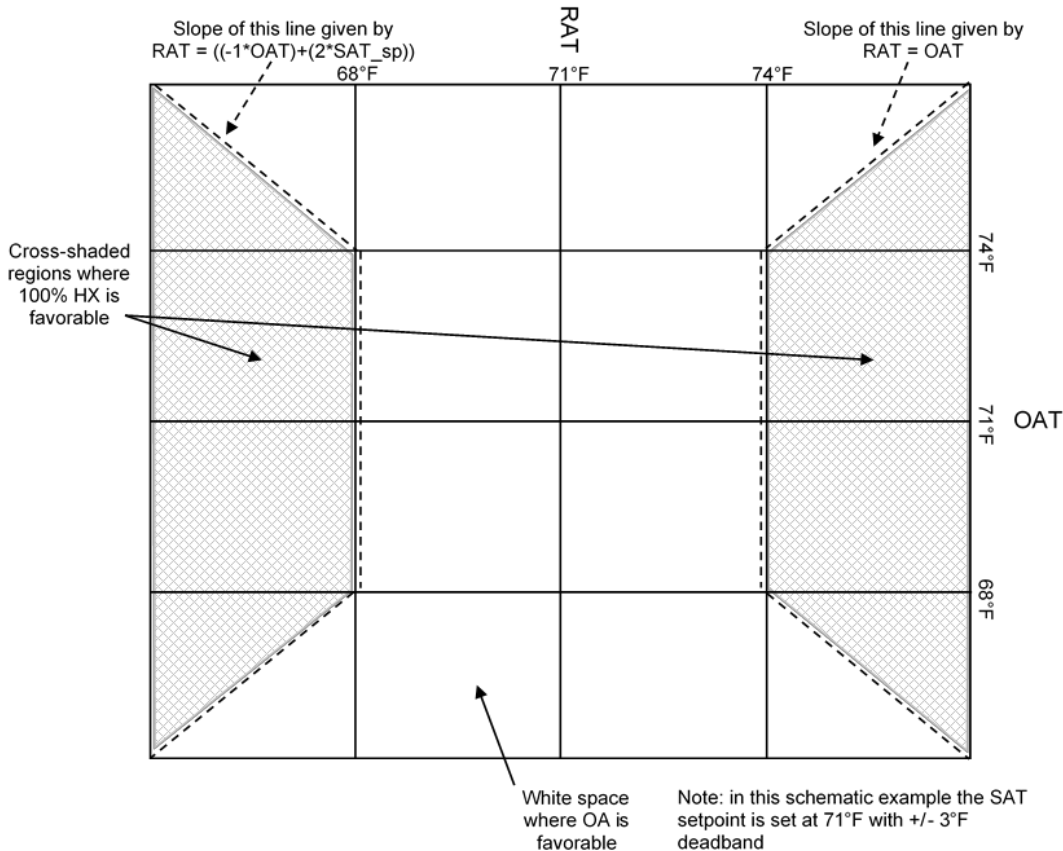
#### 2.5.6 Supply air temp control



- .1 Figure above: the axis and corresponding lines have similar dash types. As the heating and cooling loop signals increase the CHW and Heating valves will open more or be on longer to maintain a constant tempered air setpoint.
- .2 Use a PI loop to modulate the CHW control valve to maintain discharge air temp at setpoint across the range of supply cfm. Controls contractor to provide tuning for stable operation across the range of supply fan air flows.
- .3 Heating valve may use pulse width modulation to achieve a discharge air temp setpoint with dead band of  $\pm 1.5^{\circ}\text{F}$  (adj).

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- .4 Use pressure sensor downstream of coil as a safety to prevent excessively low pressure from entering return line.
  - .5 Refer to mechanical schedule for tempered air setpoints.
  - .6 Supply air temp setpoint subject to user adjustable setpoints corresponding to each building mode.
- 2.5.7 Glycol pump control
- .1 When the CHW valve is open more than 5% enable the pump to run.
  - .2 Pump controls to maintain constant differential pressure across the valve farthest DOAS valve.
  - .3 Refer to manufacture data for pump min speed to prevent surging.
  - .4 Disable pump immediately if pressure differential raises above 25 psi (adj).
  - .5 The pumps are redundant, not staged. Pumps shall rotate as described in the general section of the sequence.
  - .6 Note: see CO2 HX control section for associated details with that equipment.
- 2.5.8 Humidifiers
- .1 When fan is running and air flow switch proves air flow, line voltage room humidistat reset from outdoors maintains humidity level of 30 percent by cycling unit fan two-way steam valve.
  - .2 When supply fan is running air flow switch proves air flow, humidistat located in return air, reset from outdoors modulates normally closed humidifier valve. Set outdoor reset to 50 percent relative humidity at 21 degrees C (70 degrees F) and 30 percent relative humidity at minus 20 degrees C (minus 30 degrees F).
- 2.5.9 Exhaust fan operation
- .1 Note: see mechanical schedule for application.
  - .2 Exhaust fan for DOAS 1 shall control with PI loop for exhaust duct pressure.
  - .3 As the large entry doors are expected to be use quite frequently, programmer may use rolling average of building pressure sensor on 2 min (adj) intervals OR ramp rate programming blocks at their discretion to dampen the response of the exhaust fans.
  - .4 Default building pressure initially set to .03" (adj).
  - .5 Cap the exhaust fan speed to be no more than the supply fan speed at all times.
- 2.5.10 Economizer hx & bypass operation

- .1 During non-economizer operation the bypass damper shall remain open and the face damper closed to bypass the HX core.
- .2 The economizer HX will provide heat recovery when conditions are favorable for the desired supply air temp setpoint. Favorable conditions diagramed schematically below:



- .3 Figure above: x-axis is OAT, y-axis is RAT, with ideal supply air temp centered (SAT\_sp) at 71°F (adj). 100% RA through HX core is shown in cross hatch shaded regions. White space indicates 100% OA provided.
  - .4 Anytime OA is in the ideal moderate temp range of 68°F < OAT < 74°F, use 100% OAT. (alternatively stated as SAT\_sp = 71°F with 3°F deadband).
  - .5 RA should be passed through the HX core when OA & RA conditions are inside of the cross shaded regions
- .1 Sample Boolean logic for binary open/close dampers is provided below. It essentially breaks the graph above into quadrant areas, which then only need one additional comparator to know the correct choice as the

hatched space is either above or below the slope of a lines intersecting at the SAT\_sp.

- .2 Variables:
  - .1 OAT = outdoor air temp
  - .2 RAT = return air temp
  - .3 SAT\_sp = supply air temp setpoint
  - .4 db = deadband
- .3 IF  $OAT > (SAT\_sp + db)$ , AND  $RAT > SAT\_sp$ , AND  $RAT < OAT$ , then close bypass dampers to send RA through the hx core, else use 100% OA.
- .4 IF  $OAT > (SAT\_sp + db)$ , AND  $RAT < SAT\_sp$ , AND  $RAT > ((-1 * OAT) + (2 * SAT\_sp))$ , then close bypass dampers to send RA through the hx core, else use 100% OA.
- .5 IF  $OAT < (SAT\_sp - db)$ , AND  $RAT > SAT\_sp$ , AND  $RAT < ((-1 * OAT) + (2 * SAT\_sp))$ , then close bypass dampers to send RA through the hx core, else use 100% OA.
- .6 IF  $OAT < (SAT\_sp - db)$ , AND  $RAT < SAT\_sp$ , AND  $RAT > OAT$ , then close bypass dampers to send RA through the hx core, else use 100% OA.

#### 2.5.11 Cooling Coil Valve:

- .1 The controller shall measure the supply air temperature and modulate the cooling coil valve to maintain its cooling setpoint.
- .2 The cooling shall be enabled whenever:
  - .1 Outside air temperature is greater than 60 °F (adj.).
  - .2 AND the supply air temperature is above cooling setpoint.
  - .3 AND the fan status is on.
- .3 The cooling coil valve shall open to 50% (adj.) whenever the freezestat is on.

#### 2.5.12 Heating Coil Valve:

- .1 The controller shall measure the supply air temperature and modulate the heating coil valve to maintain its heating setpoint.
- .2 The heating shall be enabled whenever:
  - .1 Outside air temperature is less than 65 °F (adj.).
  - .2 AND the supply air temperature is below heating setpoint.
  - .3 AND the fan status is on.

- .3 The heating coil valve shall open to 100% (adj.) whenever the freezestat is on.

#### 2.5.13 Resets

- .1 When the majority of FCU that are served by the same DOAS are working full speed to provide cooling, the building could be better served by resetting the DOAS SAT down.
- .2 However, because the DOAS supply air will also be sent directly to the space, the reset may not go too low or there will be reheating.
- .3 Each FCU to generate an SAT reset request based on fan speed. When the fans reach 95% speed generate a temp reset request. Release the request when fan speed drops below 75%. When the sum of the requests represent that 75% of the FCUs are essentially maxed out, reset the DOAS SAT down but 2°F.
- .4 Requests are to be reset at the end of every day.
- .5 REQUESTS
- .6 When the CHW valve opens more than 5%, send request for cooling to the glycol HX for CHW production.
- .7 When the heating coil valve opens, send request for heating to the CO2 skid.

#### 2.5.14 Alarms

- .1 Maintenance interval alarm when fan has operated for more than 1,500 hours. Reset interval counter when alarm is acknowledged.
- .2 Fan alarm is indicated by the status being different from the command for a period of 60 seconds, send alarm.
- .3 If the measured supply air flow rate varies from the desired air flow rate by more than 10% (adj) for more than 5 min (adj) a supply air flow rate alarm will be sent.
- .4 When filter DP is above high limit setpoint for more than 1 hour (adj) send alarm.
- .5 If air is passing through economizer hx when conditions are not favorable, send alarm at front end.
- .6 If dampers do not match their commanded state, send alarm at front end.
- .7 If supply air temp is more than 3°F (adj) outside of setpoint for more than 15 min (adj), send alarm at front end.
- .8 When any valve does not match its commanded state, send alarm at front end.
- .9 If refrigerant (not normal space CO2) leak detectors rise above their trigger threshold, send highest level of alarm.

#### 2.5.15 Trends



- .1 The following trends should be made on 15min intervals and auto-exported to an admin user in .csv or .xml format:
  - .1 Discharge, return, outside air temp
  - .2 Bypass and face dampers command and feedback
  - .3 Supply fan speed, remote DP, SF cfm, KEF status.
  - .4 Return fan speed, building pressure
  - .5 OA relative humidity, DX dehumidification valve position, DX heating valve position
  - .6 SAT, CHW valve position
  - .7 All IAQ sensor

## 2.6 AIR TERMINAL UNITS

### 2.6.1 Application

- .1 This section applies to all single zone systems and sub-zones of air handling systems, such as VAV boxes, and VAV diffusers, etc.

### 2.6.2 Occupancy schedule

- .1 Control contractor to obtain in written occupancy schedules from the Owner for each zone group. The Owner must approve the final schedules prior to controls completion.
- .2 The default schedule shall be 8AM – 8PM.

### 2.6.3 Outdoor air ventilation requirements

- .1 The minimum outdoor airflow for each zone shall be scheduled on the drawings. This applies to Vocc-min and Varea-min.
- .2 Vocc-min: Zone minimum outdoor airflow for occupants, ASHRAE 62.1 prescribed CFM-per-occupant requirements.
- .3 Varea-min: Zone minimum outdoor airflow for building area, ASHRAE 62.1 prescribed CFM-per-ft2 requirements.

### 2.6.4 Minimum outdoor air

- .1 For every zone that requires mechanical ventilation, the zone minimum outdoor airflows and setpoints shall be calculated depending on the governing standard or code for outdoor air requirements. Zones that do not require mechanical ventilation may disregard this section.
- .2 Outdoor air setpoints shall be calculated as follows:
  - .1 Note: also see zone ventilation requirements section.
  - .2 For each zone in Occupied Mode, calculate the zone minimum outdoor air setpoints, which are used at the DOAS level for minimum outdoor air control.
  - .3 Zone-Abs-OA-min is equal to

- .1 Varea-min if the zone has a CO2 sensor.
- .2 Varea-min if the zone has an occupancy sensor and is unpopulated.
- .3 Zero if the zone has a window switch and the window is open.
- .4 Zone-Des-OA-min otherwise.
- .4 CO2 Setpoints
  - .1 Setpoints assume an ambient concentration of 400 ppm; if the system includes an ambient CO2 sensor, subtract 400 from these setpoints and add the ambient CO2 sensor reading.

#### 2.6.5 Zone temperature setpoints

- .1 Each zone shall have separate occupied and unoccupied heating and cooling setpoints.
  - .1 The software shall prevent:
    - .1 The heating setpoint from exceeding the cooling setpoint minus 1°F (i.e. the minimum difference between heating and cooling setpoints shall be 1°F).
    - .2 The unoccupied heating setpoint from exceeding the occupied heating setpoint.
    - .3 The unoccupied cooling setpoint from being less than the occupied cooling setpoint.
  - .2 Where the zone has a local setpoint adjustment knob/button
    - .1 The setpoint adjustment offsets established by the occupant shall be software points that are persistent (e.g. not reset daily), but the actual offset used in control logic shall be adjusted based on limits and modes as describe below.
    - .2 The adjustment shall be capable of being limited in software.
      - .1 As a default, the active occupied cooling setpoint shall be limited between 72°F and 80°F.
      - .2 As a default, the active occupied heating setpoint shall be limited between 65°F and 72°F.
  - .3 The active heating and cooling setpoints shall be independently adjustable, respecting the limits and anti-overlap logic described above. If zone thermostat provides only a single setpoint adjustment, then the adjustment shall move both the active heating and cooling setpoints upwards or downwards by the same amount, within the limits described above.

- .4 The adjustment shall only affect occupied setpoints in Occupied Mode, and shall have no impact on setpoints in all other modes.

#### 2.6.6 Demand limiting

- .1 A final approved demand control strategy must be approved by the governing utility company before implementation; DDC contractor responsible for understanding the contents of such plan as it relates to the contract documents. DDC Contractor is responsible to check all contract documents and Owner provided requirement to verify additional specifics concerning demand control for this project. In the event that discrepancies exist, Contract for RFI EOR or relevant governing body for clarification(s).
- .2 The system shall be capable of receiving demand limiting signals from the local utility. This section is a thermostat-based reset only and should not be confused as being the final or complete demand strategy for this project. Demand control strategies outside of the BMS, such as lighting, could exist for this project and not covered in this section.
- .3 Cooling Demand Limit Setpoint Adjustment: The active cooling setpoints for all zones shall be increased when a demand limit is imposed on the associated Zone Group. The operator shall have the ability to exempt individual zones from this adjustment through the normal BMS user interface. Changes due to demand limits are not cumulative.
  - .1 At Demand Limit Level 1, increase setpoint by 1°F.
  - .2 At Demand Limit Level 2, increase setpoint by 2°F.
  - .3 At Demand Limit Level 3, increase setpoint by 4°F.
- .4 Heating Demand Limit Setpoint Adjustment: The active heating setpoints for all zones shall be decreased when a demand limit is imposed on the associated Zone Group. The operator shall have the ability to exempt individual zones from this adjustment through the normal BMS user interface. Changes due to demand limits are not cumulative.
  - .1 At Demand Limit Level 1, decrease setpoint by 1°F.
  - .2 At Demand Limit Level 2, decrease setpoint by 2°F.
  - .3 At Demand Limit Level 3, decrease setpoint by 4°F.
- .5 At the onset of demand limiting, the local setpoint adjustment value shall be frozen. Further adjustment of the setpoint by local controls shall be suspended for the duration of the demand limit event.

#### 2.6.7 Hierarchy of setpoint adjustments

- .1 The following adjustment restrictions shall prevail in order from highest to lowest priority:

- 
- .1 Setpoint overlap restriction
  - .2 Absolute limits on local setpoint adjustment
  - .3 Window switches
  - .4 Demand limit
  - .5 Occupancy sensors: Change of setpoint by occupancy sensor is added to change of setpoint by any demand limits in effect.
  - .6 Local setpoint adjustment: Any changes to setpoint by local adjustment are frozen at the onset of the demand limiting event and remain fixed for the duration of the event. Additional local adjustments are ignored for the duration of the demand limiting event.
  - .7 Scheduled setpoints based on Zone Group mode
- 2.6.8 After hours local override
- .1 When thermostat override buttons are depressed, the call for Occupied Mode operation shall be sent up to the Zone Group control for 60 minutes.
  - .2 This is to be an optional feature subject to owner approval. This need not be applied to all thermostats, only those of the owner's choosing. If not specifically mentioned in the sequence of operations or elsewhere in the project documents, this is not a required feature.
- 2.6.9 Zone alarms
- .1 Zone temperature alarms
  - .2 High temperature alarm
    - .1 If the zone is 3°F above cooling setpoint for 10 minutes, generate Level 3 alarm.
    - .2 If the zone is 5°F above cooling setpoint for 10 minutes, generate Level 2 alarm.
  - .3 Low temperature alarm
    - .1 If the zone is 3°F below heating setpoint for 10 minutes, generate Level 3 alarm.
    - .2 If the zone is 5°F below heating setpoint for 10 minutes, generate Level 2 alarm.
  - .4 Suppress zone temperature alarms as follows:
    - .1 After zone setpoint is changed
    - .2 While Zone Group is in Warm-up or Morning Cool-Down Modes.
  - .5 For zones with an importance multiplier of zero for its static pressure reset, SAT reset, or Hot Water reset Trim & Respond loops.
-

- .6 For zones with CO2 sensors:
  - .1 CO2 sensors: If the CO2 concentration is less than 300 ppm, or the zone is in Unoccupied Mode for more than 2 hours and zone CO2 concentration exceeds 600 ppm, generate a Level 3 alarm. The alarm text shall identify the sensor and indicate that it may be out of calibration.
  - .2 If the CO2 concentration exceeds setpoint plus 10% for more than 10 minutes generate a Level 3 alarm.

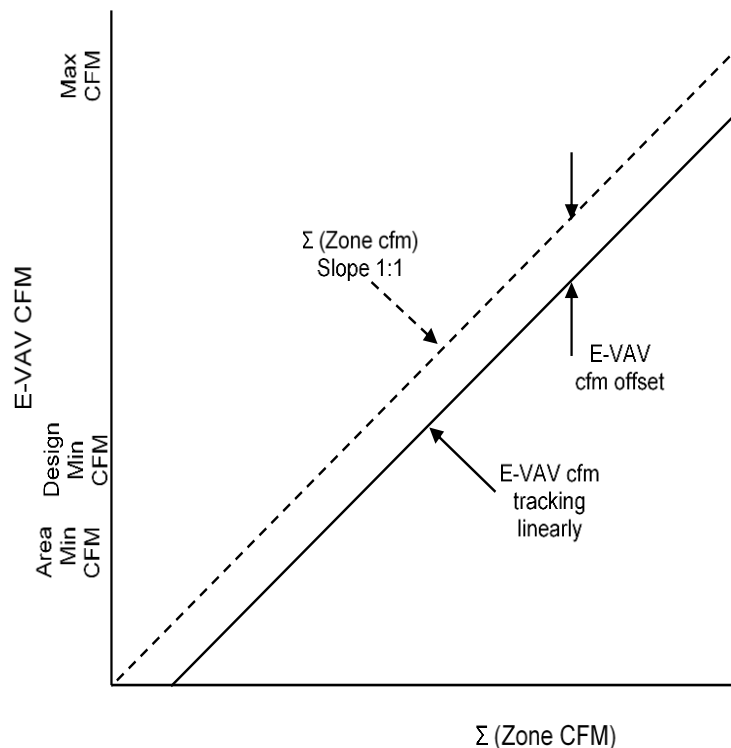
#### 2.6.10 Testing/commissioning overrides

- .1 As applicable for the project commissioning needs, provide the ability to individually command all control outputs to demonstrate proper functionality.
- .2 VAV Examples:
  - .1 Force zone airflow setpoint to max/zero, Vcool-max, Vmin, Vheat-max
  - .2 Force reheat coil valve full open/closed
- .3 Fan Coil Unit examples:
  - .1 Force fan to full speed, min speed, max cool
  - .2 Force CHW valve full open/closed
  - .3 Force HHW valve full open/closed
- .4 VAV Box Controllable Minimum (as applicable)
  - .1 There is the potential for the VAV minimum cfm to be lower than what the VAV flow ring or DDC controller can measure. This is particularly common when demand control is in use and the area minimum cfm is lower than the cfm that the terminal unit can reliably measure.
  - .2 For these instances, it is acceptable to use partial on/off control of the VAV sometimes referred to as time averaged control.
  - .3 Over a 10min period, the average of the VAV on time should equal the scheduled cfm.
  - .4 Example: if the controllable minimum is 200cfm and the box is meant to deliver 100cfm, the VAV could be in open at 200cfm for half the time in 10 min period so that the average cfm over 10 min is 100cfm.
  - .5 Assistance of the TAB contractor may be required to determine what the controllable minimum of the VAV is if manufacturer data is not available.

## 2.7 EXHAUST-VAV UNIT/ EXHAUST VAV DAMPER

### 2.7.1 General

- .1 The Exhaust-VAV regulates the exhaust cfm to track the sum of the supply terminal units serving the zone.
- .2 They do not control the heating/cooling load in the space.
- 2.7.2 Control logic and schematic
  - .1 Control logic is depicted schematically in the figure below and described in the following sections.



- .2 Figure above: the solid line for the E-VAV is plotted with offset next to an imaginary dashed line with 45deg slope. Design intent is for the E-VAV to track linearly with the sum of the supply terminal unit cfm.
- .3 The VAV damper shall be modulated by a PI control loop to maintain the measured airflow at the ventilation cfm setpoint.
- 2.7.3 Alarms
  - .1 Low airflow. If the measured airflow is less than 70% of setpoint while setpoint is greater than zero for 5 minutes, generate a Level 3 alarm.
  - .2 Airflow sensor calibration. If the fan serving the zone has been off for 10 minutes and airflow sensor reading is above 20 CFM, generate a Level 3 alarm.

- .3 Leaking damper. If the damper position is 0% for 10 minutes and airflow sensor reading is above 50 CFM while the fan serving the zone is proven on, generate a Level 4 alarm.

#### 2.7.4 System requests

- .1 Air Pressure Requests (as applicable)
- .2 If the damper position is greater than 85%, send 1 Request until the damper position is less than 75%,
- .3 Else if the damper position is less than 75%, send 0 Requests.

#### 2.7.5 Trends

- .1 The following trends should be made on 15min intervals and auto exported to an admin user in .csv or .xml format:
  - .1 Damper position
  - .2 Cfm & cfm setpoint

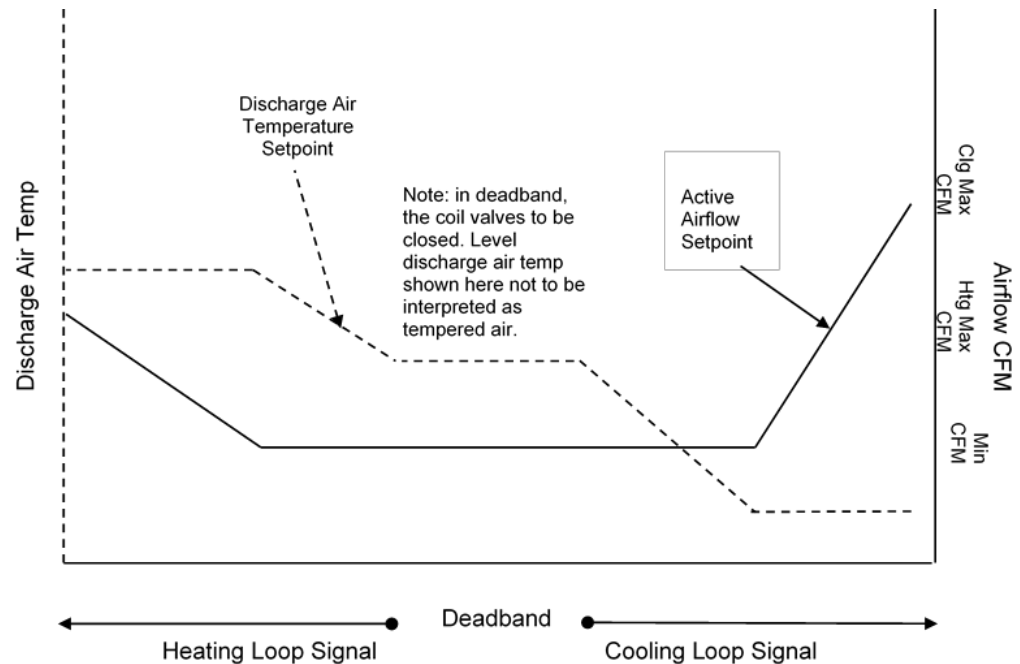
### 2.8 **FAN COIL UNITS – CHW& HHW**

#### 2.8.1 General

- .1 The hydronic FCU will provide heating and cooling in 2 stages.
- .2 The first stage is to raise/lower the discharge air temp to the max/min as shown on the mech dwg schedules.
- .3 If the zone still cannot be satisfied, then the FCU will ramp up fan speed while maintaining the max/min DAT to provide additional heating/cooling.

#### 2.8.2 Supply fan and air temperature control

- .1 Supply air temperature shall be controlled to setpoint using a control loop whose output is mapped to sequence the hot water valve and/or chilled water valve as shown in the diagram below.



- .2 Figure above: there are two axes on the graph above. The line style of the axis corresponds to the associated line on the graph. The dashed line corresponds to the FCU DAT. The solid lines correspond to the FCU cfm.
- .3 The design airflow setpoints for each zone shall be scheduled on the drawings for cooling max, heating max, and design min cfm. TAB support to determine what speeds provide the appropriate cfm may be required if any kind of AFMS or flow ring is not shown on the controls diagrams.
- .4 The HHW and CHW valve(s) shall be modulated with a PI loop to maintain the discharge temperature at setpoint across the range of air flow.
- .5 When the zone is in cooling, the cooling loop shall maintain space temperature at the heating setpoint as follows:
  - .1 From 0% - 50%, the cooling loop output shall reset the discharge air temperature from the current thermostat setpoint to the min discharge air temp as shown on the mech dwgs.
  - .2 From 51% - 100%, if lowering the discharge air temperature to the min setpoint is not enough to satisfy the zone, the cooling loop output shall reset the active airflow setpoint from the min airflow setpoint to the max cooling airflow setpoint.



- .6 When the zone is in deadband, the active airflow setpoint shall be the min airflow setpoint and all coil valves shall be closed.
- .7 When the zone is in heating, the heating loop shall maintain space temperature at the heating setpoint as follows:
  - .1 From 0% - 50%, the heating loop output shall reset the discharge air temperature from the current thermostat setpoint to the max discharge air temp as shown on the mech dwgs.
  - .2 From 51% - 100%, if raising the discharge air temperature to the max setpoint is not enough to satisfy the zone, the heating loop output shall reset the active airflow setpoint from the min airflow setpoint to the max cooling airflow setpoint.
- .8 When lighting control system determines that the zone is unpopulated for more than 15min, thermostat setpoints shall revert to relaxed values that are +/- 4°F (adj) from prior setpoint. If the DOAS or overall building mode is in cooling, then 4°F added, if the DOAS or overall building mode is in heating then 4°F subtracted.

#### 2.8.3 Alarms

- .1 Generate a maintenance alarm when fan has operated for more than 1500 hours or as recommended by the product manufacturer. Reset interval counter when alarm is acknowledged.
- .2 High space temperature: if thermostat rises more than 5°F above setpoint for 10 minutes, send alarm.
- .3 If supply fan fails to reach commanded state for more than 5 min, send alarm.
- .4 Generate an alarm if drip pan sensor for fan coil units senses excessive water is in the drip pan.
- .5 Generate a maintenance alarm when the filter DP has exceeded threshold of .2' w.c. (adj).

#### 2.8.4 System requests

- .1 HHW Pressure Requests
  - .1 If the HHW valve position is greater than 85%, send 1 Request until the HHW valve position is less than 75%
  - .2 Else if the HHW valve position is less than 75%, send 0 Requests.
- .2 CHW Pressure Requests
  - .1 If the CHW valve position is greater than 85%, send 1 Request until the CHW valve position is less than 75%
  - .2 Else if the CHW valve position is less than 75%, send 0 Requests.

2.8.5 Trends

- .1 The following trends should be made on 15min intervals and auto-exported to an admin user in .csv or .xml format:
  - .1 Discharge air temp & setpoint
  - .2 CHW & HHW valve position
  - .3 Fan speed & setpoint
  - .4 Space thermostat temp & setpoint

2.8.6 Window contacts (as applicable, see controls diagrams)

- .1 For FCU with manually operable windows, if any window opens in the space, disable the unit from running until window is closed.
- .2 If windows are automatically controlled, refer to automated window control sequence for integration to shut down associated zones.

2.8.7 Occupancy sensor or integration (as applicable, see controls diagrams)

- .1 For FCU if all the zones associated with an FCU are unoccupied, set back the thermostats to a relaxed setpoint +/- 4 deg (adj) from present value.

**2.9 ELECTRICAL ROOMS AND TELEPHONE ROOMS**

- 2.9.1 On room temperatures above 25 degrees C (77 degrees F) turn on Fan Coil Unit that is designed for the Electrical rooms and telephone rooms.
- 2.9.2 Modulate chilled water valve to maintain room temperature setpoint
- 2.9.3 On room temperatures above 32 degrees C (90 degrees F), signal alarm at BMS.

**2.10 ELEVATOR MACHINE ROOMS**

- 2.10.1 On room temperatures above 25 degrees C (77 degrees F) turn on Fan Coil Unit that is designed for the Electrical rooms and telephone rooms.
- 2.10.2 Modulate chilled water valve to maintain room temperature setpoint
- 2.10.3 On room temperatures above 32 degrees C (90 degrees F), signal alarm.

**2.11 EXHAUST FAN – DDC SCHEDULE CONTROLLED**

- 2.11.1 Unless noted otherwise, all exhaust fans will have a minimum of schedule control through the BMS.
- 2.11.2 Exhaust fan shall run at Max Speed when the air handler that serves the space (directly or by transfer air) is in Occupied Mode and the air handler supply fan is proven on.

2.11.3 Janitor's closet, Copy Room, Restrooms, and Pavilion restroom and vending exhaust fans shall be connected to BMS for time schedule control. They shall initially be given independent schedule capability. The initial schedule shall be set to match building occupancy schedule.

2.11.4 Alarms

- .1 Generate a Level 5 maintenance alarm when fan has operated for more than 3000 hours. Reset interval counter when alarm is acknowledged.
- .2 Fan alarm is indicated by the status input being different from the output command after a period of 15 seconds after a change in output status.
  - .1 Commanded on, status off: Level 2
  - .2 Commanded off, status on: Level 4

**2.12 UNIT HEATERS**

2.12.1 Single temperature electric room thermostat maintains constant space temperature of 68 °F (20 °C) by cycling unit fan motor.

2.12.2 Single temperature thermostat on return heating water line from floor mounted cabinet heaters de-energizes unit on temperatures below 95 °F (35 °C).

2.12.3 Integral thermostat continues fan operation until element temperature falls below 38 degrees C (100 degrees F).

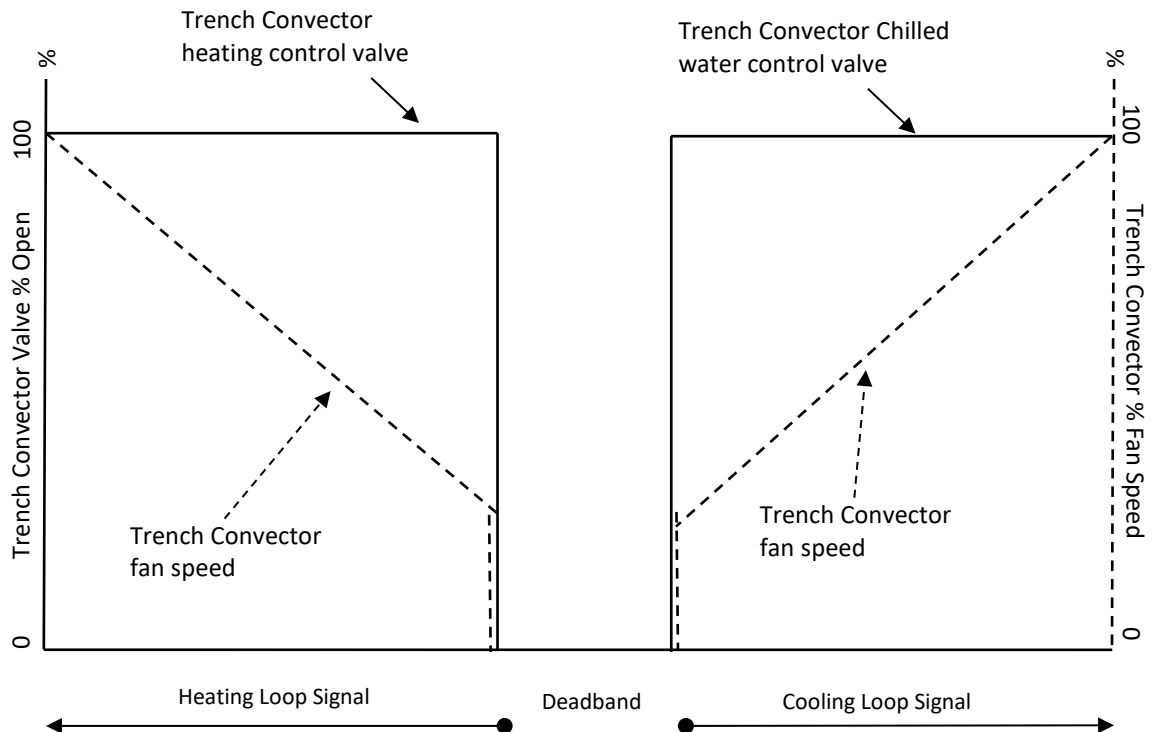
**2.13 TRENCH CONVECTORS – CHW/HHW**

2.13.1 General

- .1 The perimeter trench convector shall have its own thermostat and modulate independently to satisfy the perimeter zones.
- .2 Adjacent trench convectors to be grouped together to operate in unison. Refer to zone diagram on the floor plans.

2.13.2 Control logic is depicted schematically in the figure below and described in the following sections.

- .1 When the Zone is in heating/cooling, the heating/cooling loop output shall maintain space temperature at setpoint as follows:
  - .1 Trench convector control valve shall be fully open.
  - .2 From 0% - 100%, the heating/cooling loop output shall modulate the trench convector fan speed to satisfy the perimeter thermostat.



- .2 When the zone is in deadband, the fan shall be off, and all valves shall be closed.
- .3 If change over valves are shown on the controls diagram, these must all be normally closed when the fans are off to prevent excessive bypass of the supply to the return.
- .4 Trench convectors shall be locked out from operation when any manual or automatic windows are proven open.

#### 2.13.3 Alarms

- .1 Maintenance interval alarm when fan has operated for more than 1,500 hours. Reset interval counter when alarm is acknowledged.
- .2 Fan alarm is indicated by the status being different from the command for a period of 60 seconds, send alarm.
- .3 If space temp is not met for more than 10 min (adj) send alarm.
- .4 Drip pan overflow sensor (provided with trench convectors): if this sensor in the condensate pan detects switches on, lock out the cooling valve and send a high 3 alarm. Release the cooling coil lockout when overflow is no longer detected at the sensor.

#### 2.13.4 System Requests

- .1 None for this equipment.

#### 2.13.5 Trends

- .1 The following trends should be made on 15min intervals and auto-exported to an admin user in .csv or .xml format:
  - .1 CHW & HHW valve position
  - .2 Fan command & status (where applicable)
  - .3 Space thermostat temp & setpoint

### 2.14 **LIGHTING CONTROLS & ELECTRICAL VAULT MONITORING**

- 2.14.1 The electrical room monitor and lightening systems shall each be controlled by a standalone DDC control system communicating on a building automation system local area network.
- 2.14.2 The DDC shall provide outputs for two lighting circuits per floor on Levels 1 through to 20 with connection to electrical relay in the typical floor electrical room.
- 2.14.3 The DDC shall monitor kilowatt demand, power factor, amperage (by phase), volts (by phase), and transformer temperature and generate alarms when out of standard operating parameters as determined by Building operations.

### 2.15 **DOOR AIR CURTAIN HEATERS**

- 2.15.1 Door air curtains shall operate based on a door contact on the overhead doors.
- 2.15.2 If outdoor air temperature is about 50°F (10°C) door heater shall not operate.
- 2.15.3 Supply air temperature shall be controlled based on outdoor air temperature.
- 2.15.4 Provide status and alarm at BMS.

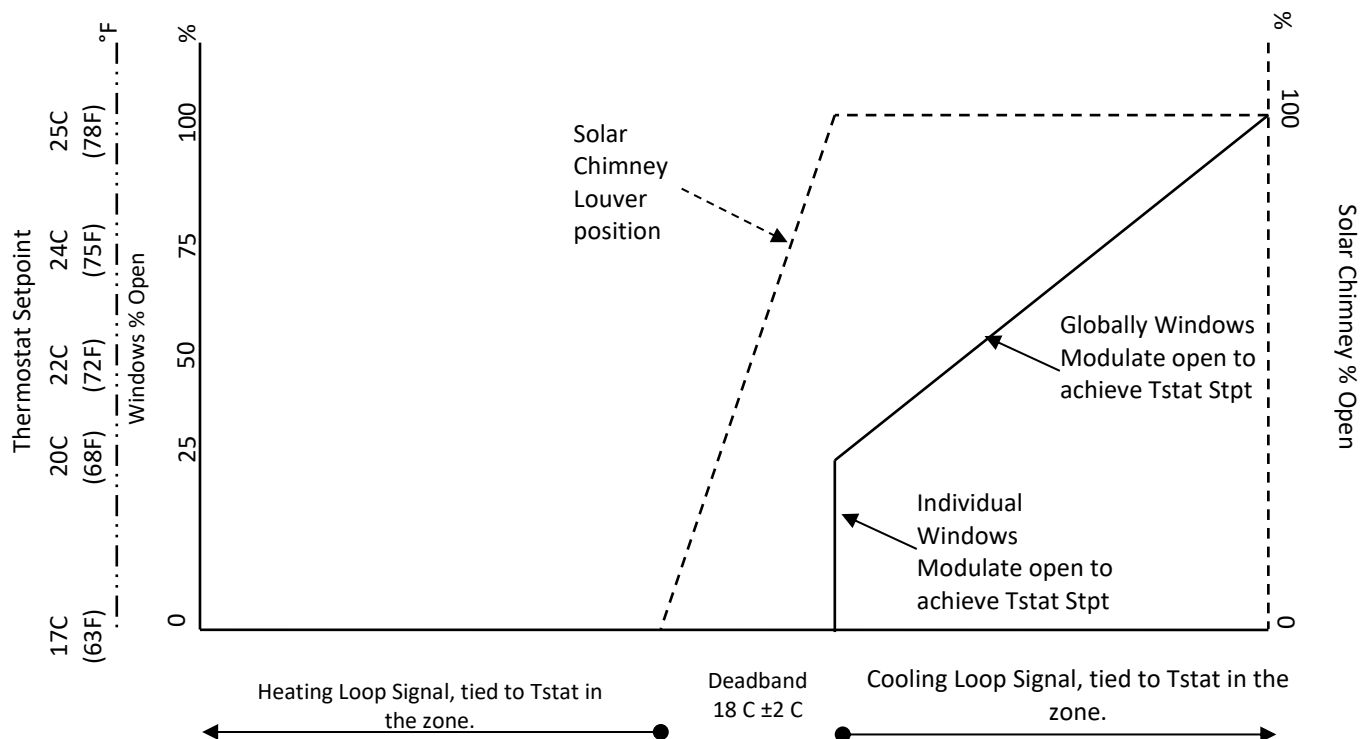
### 2.16 **NATURAL VENTILATION - MOTORIZED WINDOWS & SOLAR CHIMNEY**

- 2.16.1 Thermostats and other sensors in zones with motorized windows control shall be provided by the window masters with read only points connected to BMS.
- 2.16.2 Thermostats to have fully customizable touch screen and custom overlay to indicate the window control function.
- 2.16.3 Thermostat screen colour to change based on indoor air temperature (IAT) and outdoor air temperature (OAT) to inform users as to whether to open/close windows. Each thermostat to be programmable to different conditions.
  - .1 Green: IAT > 21°C and 10°C < OAT < 21°C
  - .2 Yellow: IAT > 18°C or 5°C < OAT < 27°C

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- .3 Red:  $18^{\circ}\text{C} > \text{IAT}$  or  $5^{\circ}\text{C} > \text{OAT} > 29^{\circ}\text{C}$  or when sensing rain or outdoor air high humidity with dew point above  $16^{\circ}\text{C}$ .
- 2.16.4 DDC to monitor and trend log if windows are open. For windows with actuators with position feedback window status can be taken for the actuator control system.
- 2.16.5 Window Master NV Embedded® shall be used for indoor climate control during the Natural Ventilation (NV) mode.
- .1 The BMS shall communicate all the weather station data point to the window master control panel and NV Embedded software interface as required. As an integrated part of a BMS, NV Embedded® will receive data from the BMS and control the operable windows based on the BMS data using KNX, BACnet and Modbus protocols.
- .2 The ventilated zones of the building are defined by the openable windows and thermostat zones as depicted on the drawings. Refer to architectural drawings for openable window schedule. All windows in a natural ventilation zone to operate in unison. There is no need have windows within a ventilation zone to operate individually.
- .3 Each NV zone shall have a manual override switch and internal temperature sensor with humidity and a CO2 sensor to validate minimum ventilation during NV operation both in the shoulder season and summer mode.
- .1 At regular intervals through the BMS, the sensors transmit the measured values for internal CO2, temperature and relative humidity (RH) to the NV Embedded® as well as the measurement readings from the weather station. If the changes in the measurement values are less than the specified limits, then NV Embedded® only performs new calculations and adjustments at the intervals to reposition the windows. Should the changes be larger than the specified limits, NV Embedded® will make an adjustment instantly.
- .2 The operable windows shall be automatically controlled by the NV Embedded® system and can be overridden by occupants for a defined period.
- .4 The manual override switches shall provide building occupants the opportunity to monitor their local indoor climate and to override the automatic control of the windows. The BMS through the NV Embedded® interface shall log data 24 hours a day for an entire annual cycle in each relevant zone in relation to thermal comfort and air quality. This data is to be correlated and tracked and displayed as a graphical summary of each space.

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- .5 Occupancy modes shall be determined by the BMS scheduling program and communicated to NV Embedded® to control the indoor climate in three different occupancy modes: 'Building Occupied'; 'Building Unoccupied Secured'; 'Building Unoccupied'.
- .1 A set of parameters, like temperature setpoints and limitation on the opening amount of the windows for security or weather shall be assigned to each of the building occupancy modes.
- .2 This shall also apply to things like night purge periods.
- .6 Window Master NV Embedded® shall be used for the automatic control of indoor climate control during the Natural Ventilation (NV) mode.
- .1 The NV Embedded® system shall use algorithms to automatically regulate the position of operable windows vents based on the following parameters: temperature, CO2 and humidity; wind speed, wind direction; wind pressure coefficients algorithms; and temperature difference between inside and outside BMS sensor measurements.
- .2 When outside conditions are favorable for cooling, window control system will modulate windows to provide natural ventilation automatically, users will not need manually open them.
- .1 Favorable conditions satisfied when all of the following conditions are met:
- .1 Building must be in occupied mode
- .2  $18 \text{ deg C (adj)} < \text{OSAT} < 24 \text{ deg C (adj)}$
- .3 Wind speed  $< 20 \text{ mph}$
- .4 No rain detected
- .2 BMS control system to display when conditions are favorable or unfavorable in every natural ventilation zone with a wall mounted LCD
- .3 The NV Embedded® system shall automatically define upper comfort limits based on the outdoor temperature. The comfort limit is based on the maximum allowable Air Change Rate (ACH) in the ventilated space. The ventilation schedule shall be based on occupied summer and shoulder season days to ventilate on a programable schedule or only when required, as well as the length of the venting and opening degree of the operable windows.
- .4 BMS shall operate the DOAS minimum winter ventilations system during the winter Heating season.

The BMS shall ensure through the interface with the NV Embedded® that the openable windows are not activated during the heating season. The exception to this is the fire alarm override smoke control when activated by the fire alarm panel.



- .5 The NV Embedded® system shall automatically control the window position system based on indoor, outdoor conditions for different specific weather scenarios. The control algorithm shall take into account Building Occupied'; 'Building Unoccupied Secured'; 'Building Unoccupied'; wind speed and direction; rain and wind conditions during rain.
- .6 The NV Embedded® system shall automatically control summer NV mode and the shoulder season NV mode.
  - .1 The automatically controlled operable windows will be regulated based on temperature control as apriority however, the system shall still account for factors such as air quality and humidity by regulating the temperature setpoint accordingly.
  - .2 During temperature control, the windows shall be opened based on the indoor temperature with an upper limit for the maximal allowable air change rate based on the outdoor temperature to ensure



good comfort while achieving ASHRAE ventilation standard. In demand for cooling, the actuated windows will automatically open to provide passive cooling.

- .1 When the temperature in the space reaches 20 deg, the windows will open to 25%
  - .2 When the temperature rises to 22 deg, the windows will open to 50%.
  - .3 When the temperature rises to 24 deg, the windows will open to 75%.
  - .4 If the temperature rises to 25 deg, the windows will fully open.
  - .5 As the temperature drops, the NV Embedded® system shall instruct automated openings to close in as per the same temperatures.
- .3 The rate at which the operable windows are opened shall depend on the applicable wind conditions (wind speed, wind direction and wind pressure coefficients). At higher wind speed the windows will open at a slower rate to avoid discomfort. The windows will close at a fast rate as it is more important to quickly reduce the window opening to avoid discomfort.
  - .4 During temperature control, the system shall account for the CO2 concentration in the ventilated space by reducing the temperature set point. The original setpoint shall be reduced by a parameter value multiplied with the current CO2 level, when the level rises above the CO2 threshold as defined by the relevant edition of ASHRAE Standard 62.1 – Ventilation for Acceptable Indoor Air Quality.
  - .5 During temperature control, the system shall account for the humidity in the ventilated space by reducing the temperature set point. The original setpoint shall be reduced by a parameter value multiplied with the current humidity level, when the level rises above the humidity threshold as defined by the relevant edition of ASHRAE Standard 62.1- Ventilation for Acceptable Indoor Air Quality.
  - .6 A minimum allowable ventilation temperature threshold shall be defined such that high CO2 and RH effects do not lower the temperature limit below ventilation requirements outlined ASHRAE Standard 62.1-2019 – Ventilation for Acceptable Indoor Air Quality

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- .7 Window actuators to be closed and locked out for 30 min (adj) by the window control system upon detection of rain.
- .7 The NV Embedded® system shall automatically control the NV comfort and minimum ventilations the shoulder season mode.
- .1 In the shoulder season mode, the ventilation will be regulated by a demand driven pulse control. Pulse ventilation means that the windows are opened for a short period of time and then closed again.
- .2 The ventilation is performed when the CO2 or humidity values exceeds the configured thresholds. The ventilation pulse duration and the interval between the pulses are calculated from the actual measured values and parameter settings. The maximum window opening is limited by the outdoor temperature and the wind speed.
- .3 The demand-driven pulse ventilation shall be used in combination with the HRV ventilation only when the system temperature requirements can be satisfied without the BMS utilizing the hot water heating system. As the two ventilation strategies are controlled entirely independent of each other the BMS shall be programmed to ensure when the demand pulse ventilation system working with the HRV is not utilized when hot water heating in any thermal zone is required. The BMS shall send a signal to disable the pulse ventilation and operate only the HRV ventilation only during a heating mode as per the relevant edition of ASHRAE 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .4 The demand-driven pulse ventilation when enabled shall operate if the CO2 and/or RH level is higher than the defined threshold. If the temperature exceeds the defined maximum temperature, the amount of ventilation is gradually increased. If the temperature drops below the defined minimum temperature, the windows are closed completely in one step. A maximum and minimum duration of the pulse ventilation during demand-driven pulse ventilation shall be established. The actual pulse ventilation duration shall calculate from the measured values and thresholds for CO2 and RH and influential parameters. If the desired CO2 and RH level is reached before the ending of the max. pulse limit, the windows will close.
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- .8 The NV Embedded® system shall automatically control the NV night cooling.
- .1 The night cooling shall be connected to the Unoccupied Secured mode. The window opening shall not be open more than 100 mm during the night purge mode.
  - .2 The night cooling shall be performed by defining setpoint-offsets for the summer mode. When the system enters the 'Unoccupied secure mode' outside working hours, it shall automatically activate the new setpoint generated by the defined offset to perform the night cooling. Night cooling setpoint =  $24^{\circ}\text{C} - 6^{\circ}\text{C} = 18^{\circ}\text{C}$
  - .3 In the shoulder season, the system can be in Winter mode during the night and summer mode during the day. This ensures that night cooling is not used during the night even though the system is in summer mode during the day.
  - .4 As an integrated part of a BMS, NV Embedded® shall receive a sensor data from the BMS and determine when to night cool.
    - .1 The design intent is to cool the slab passively as much as possible when cooling will be required the next day.
    - .2 BMS contractor to coordinate with security vendor to make sure open windows do not set off any intrusion detection alarms.
    - .3 The need for night flush is defined as following:
    - .4 If the day is between April and October (adj),
    - .5 AND, if the OSAT high for the present day is greater than 82 deg F (adj), then there is a very good chance tomorrow will also be solidly warm, so night flush will be beneficial.
    - .6 Provide admin user the ability to cancel or schedule night flush independent of the above logic.
    - .7 To execute night flush:
    - .8 If need for night flush is satisfied,
    - .9 AND there is no rain,
    - .10 And if  $40^{\circ}\text{deg} < \text{OSAT} < 65^{\circ}\text{deg}$ ,
    - .11 At 12am (adj) open all windows determined acceptable for night flush.
    - .12 When the slab temp sensor reaches 62 deg (Adj),
    - .13 OR if it the time strikes 4am (adj),
    - .14 Close the windows.

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- .15 If slab temp was not reached during the night flush time frame, send email alarm to the effect of "consider using longer night flush duration".
  - .9 The NV Embedded® system shall automatically control the manual override
    - .1 Occupants may be allowed to manually close windows through the NV Embedded manual override switch accessible in the ventilated zones.
      - .1 Users may be allowed to manually close windows through the manual override switch rather than a traditional wall switch in case noise, pollen, dust, or unforeseeable circumstances cause open windows to be undesirable.
      - .2 The user shall be able to manually command the windows to open or close to a set %opening, between 0% and 100% with 25% intervals. Motorized windows for manual control shall be grouped together in the ventilated zones.
      - .3 Users will not be allowed to manually override windows open at the room override switch if outside conditions are not favorable for natural ventilation as this does more harm than good.
      - .4 The user shall be able to select a 'window closed' function, which will shut the windows until the override control reinstates the automatic control
      - .5 After a defined period (30 min adjustable) the NV Embedded® system will override the manual control and regulate the operable openings based on the relevant conditions.
- 2.16.6 Window Control LCD display
- .1 BMS control contractor to provide wall mounted graphical electronic LCD display, location to be approved by Architect. Single graphical display shall include each natural ventilation zone (see drawings). Thermostat is not the preferred method of display for central control. LCD will also be for displaying all outdoor sensors and if the air conditions are favorable for natural ventilation. LCD will display the following:
    - .1 All weather station sensor present values from building mounted BMS weather station
    - .2 Wind speed present value from building mounted weather station
    - .3 Rain status present value from building mounted weather station
    - .4 Zone perimeter thermostat temp present value, and ability to set minimum on LCD

- .5 Zone interior thermostat temp present value, and ability to adjust on LCD
- .6 Zone average temp present value (virtual point)
- .7 Window % open present value, and ability to manually override (conditional logic applies)
- .8 Clearly visible, plain English indication to the effect of "good time to have the windows open"
- .9 Clearly visible, plain English indication to the effect of "window manually overridden closed"
- .10 Window shade position % open present value.

## **2.17 RADIANT SLAB - CHW/HHW – Work in Progress**

### **2.17.1 General:**

- .1 CHW/HHW plant send the heating and cooling water, distributing it to radiant manifolds. (See appropriate sequence section for control of that equipment.)
- .2 Each radiant manifold zone shall have 1 slab temperature sensor, using very simple deadband control with two-position valves.
- .3 Radiant slabs are slow to respond, so a pre-determined setpoint will have to be determined long in advance of occupancy. A lookup table for each zone based on the appropriate weather will set the slab's target value.
- .4 Note: for some projects with ceiling fans, night flush, or 2 pipe CHW/HHW plants, additional sequence logic could be necessary for a complete zone logic set.

### **2.17.2 Scheduling:**

- .1 Radiant system shall be enabled based on user provided schedule.
- .2 Occupied: Monday through Friday 6:00 AM to 6:00 PM.
- .3 Unoccupied: For all other times, and holidays. Consult Owner for how they determined.

### **2.17.3 Variables Used:**

- .1 Forecast OSAT High: forecast for tomorrow's OSAT high where tomorrow is an occupied day.
- .2 Actual OSAT High: what the high for an occupied day actually was
- .3 Present OSAT: live value from the building weather station or AHU duct temp. This is a virtual point maintained at the front end for all building equipment to use.
- .4 Zone Temp: as measured by a zone thermostat
- .5 Slab Temp: present value of slab temp

- .6 Slab Temp Setpoint: the desired slab temp
- .7 Max Acceptable Zone Temp: the highest temp a room should ever get when initial slab temp was appropriate for that zone. Initially 78 deg F for all zones.
- .8 Min Acceptable Zone Temp: the lowest temp a room should ever get when initial slab temp was appropriate for that zone. Initially 68 deg F for all zones.
- .9 Forecast Error: difference between forecast high OSAT and actual OSAT high.

2.17.4 Control Valve for Radiant Zone:

- .1 The two position valves will use deadband control to supply slab with CHW/HHW to meet the desired slab temp. Use initial deadband range of +/- 1 deg (adj). When the slab temp is outside of range, binary control valves will remain open until setpoint is reached and then close.
- .2 PI loops work better with low thermal mass systems like air and water but tend to wind up or cause further delays when applied to concrete.
- .3 Provide full port ball valves rather than traditional control valves without characterizing discs for radiant manifold control. These will provide better response time for cooling or heating. Overshooting setpoint for radiant slabs is virtually never an issue.
- .4 Controls contractor to be mindful of not providing too wide of a deadband, or the system may not recover in a reasonable amount time.
- .5 Allow any user to raise or lower slab temp setpoint from the local zone thermostat +/- 1 deg (adj). Caution: non-admin users should not be allowed to change their slab temp more than a few degrees. This could lead to erroneous CHW/HHW plant requests or unrealistic expectations in response time.
- .6 Slab return water temp is a monitoring / troubleshooting point only.
- .7 Provide full port ball valves rather than traditional control valves with characterizing discs for radiant manifold control.
- .8 Allow users to slightly raise or lower slab temp setpoint from the local zone thermostat +/- 1 deg (adj).
- .9 If zone temp is above 78 deg F for more than 30 min (adj) AND the zone is in heating mode, close the valves and lock out heating sequence for 30 min. Resume heating if space temp is no longer above acceptable heating range at the end of lockout.
- .10 If zone temp is below 68 deg F for more than 30 min (adj) AND the zone is in cooling mode, close the valves and lock

out cooling sequence for 30 min. Resume cooling if space temp is no longer below acceptable cooling range at the end of lockout.

- .11 If the slab temp meets setpoint but falls out of deadband and cannot return for the remainder of occupancy, send alarm to the effect of "CHW/HHW pump flow may be inadequate."
- .12 If return water temp for a radiant slab is within 2 deg (adj) of plant supply water, send alarm to the effect of "excessive pump flow could be causing low delta T".
- .13 If the slab temp meets setpoint but falls out of deadband and cannot return for the remainder of occupancy, send alarm.
- .14 If the slab temp never achieves setpoint for a given day, send alarm to the effect of "adjust optimal start routine."
- .15 If a valve actuator feedback does not match the commanded position, send alarm.

#### 2.17.5 Pre-Heating & Pre-Cooling Plant Startup:

- .1 Being slow to react, an initial slab temp must be selected far in advance of any occupied state. Pre-heating or pre-cooling durations of 6-8 hours are common. For seasons with harsh temperatures it is common practice to continue heating/cooling to a lesser extent over weekends to prevent having too great of a temperature to overcome. This time to pre-cool/pre-heat can be calculated in the following ways:
- .2 Traditional optimal start where the BMS directly measures heating/cooling rate and uses this derivative to reverse calculate for time to heat/cool based on present slab temp vs desired slab temp.
- .3 Providing an unoccupied setback of slab setpoints to prevent too great of a differential between present value and setpoint. Use initial unoccupied lower threshold of 65 during heating months and upper threshold of 78 during cooling months.
- .4 For moderate climates with simple or limited zoning AND with owner's written permission, the DDC contractor may simply provide admin user an hour timer for pre-heating/pre-cooling.

#### 2.17.6 Initial Slab Temp Setpoint Determination:

- .1 Because the radiant slab takes time to respond, every zone will need to have an initial slab setpoint determined far in advance of the next occupied day as opposed to reacting to present temp values.
  - .1 Note: see Pre-Heating/Cooling section to determine how far in advance to start the plant.)

- .2 Note: this is not a single building-wide lookup table, these values will be re-written by the BMS. See corresponding section below.)

2.17.7 There are two methods of determining the initial slab setpoint: with and without a weather forecast.

- .1 When a BMS integration to NOAA weather data exists and is reasonably accurate, then use the table below based on the forecast OSAT high to choose initial slab temp setpoint. "Reasonably accurate" can be defined loosely here as a forecast that is often within 5 degrees of actual OSAT high because the table is arranged in 5-10 degree increments. This is also possible because these lookup tables are at the zone level and will be refined as the BMS detects need to rewrite these values. See corresponding section below.
- .2 Times arise where the NOAA airport weather data exists and is NOT a reasonably good indicator of the microclimate the building is in, but it can be used to determine if there is a general heating/cooling trend. Example: airport is by the coast and building is inland, temperatures between them could differ by 20 degrees, however one can still know if tomorrow likely to be the same, hotter or colder. For these instances, BMS to perform the following:
- .1 IF forecast value for tomorrow OSAT high is within +/- 5 deg (adj) of today's forecast OSAT high, use same initial slab setpoint value as today.
- .2 IF forecast value for tomorrow is 5 deg (adj) hotter/colder than today's forecast, then use a table lookup value corresponding to building OSAT +/- 5 deg (adj).
- .3 OSAT high lookup table to be used with BMS connection to NOAA weather forecast.

OSAT high for tomorrow	Slab Temp Setpoint
≤35°F	85°F
≤45°F	82°F
≤55°F	78°F
≤65°F	74°F
≤67°F	74°F
≤68°F	73°F
≤72°F	73°F



≤73°F	72°F
≤80°F	67°F
≤85°F	65°F
≥85°F	65°F

- .1 Note: the lookup table is not linear through the entire range. Moderate weather OSAT calls for about the same slab temp (72°F -74°F). As weather gets progressively harsh, then slab temps will need to provide greater amounts of cooling/heating.
- .4 When there is no BMS connection to forecast weather data, then an admin user will manually enter a simplified version of tomorrow's forecast: colder, neutral or warmer.
  - .1 If the admin user inputs neutral, use the same as initial slab temp setpoint as yesterday.
  - .2 If the admin user inputs colder or warmer, then use a table lookup value corresponding to building OSAT +/- 5 deg (adj).
- .5 Manual Override Option: At the front end allow an admin user to manually select an initial slab temp setpoint for the building or a zone. In this way outlier zones which do not have similar heating/cooling needs can still be addressed.
- .2 Slab Setpoint Table Modifications:
  - .1 The slab temp initial setpoint lookup table is to be programmed at the zone controller.
  - .2 The slab temp lookup table values provided here are just initial, educated guesses with estimated loads for occupancy. Some specific zones could require fine tuning with time and will be rewritten by the BMS to match the specific needs of the exposure and space requirements.
  - .3 A zone may need to re-write values in the slab temp column if the thermostat in the zone indicates excessive deviation. Correction to the table for a given zone should be applied as follows:
  - .4 IF BMS weather forecast connection exists:
    - .1 AND the zone temp high for a day exceeds an acceptable high limit of 78 deg F (adj) or low limit of 68 def F (adj) for more than 30 min (adj),

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- .2 AND the actual OSAT high for the day would have lead the BMS to choose that same initial slab temp as the forecast OSAT high,
  - .3 THEN, the prediction was good, but the slab temp was not well suited. Adjust that zone's initial slab temp setpoint by +/-1 deg F for heating/cooling respectively for the row corresponding to the OSAT high for the day.
  - .4 ELSE IF, make no table adjustment.
  - .5 IF no BMS weather forecast connection exists:
    - .1 AND the zone temp high for a day exceeds an acceptable high limit of 78 deg F (adj) or low limit of 68 deg F (adj) for more than 30 min (adj),
    - .2 THEN, adjust the zone's initial slab temp setpoint table value by +/- deg F for heating/cooling respectively for the row corresponding to the OSAT high for the day.
  - .6 Calculate the error between forecast and actual OSAT high. Display on front end. Trend these daily values for 90 days before auto-exporting.
  - .7 Send low level alarm if zone is outside of acceptable range 68 deg F to 78 deg F.
  - .3 Slab Temp Safety Lock Outs:
    - .1 If there is a condensate sensor at the radiant manifold, and it detects the presence of water, send low level alarm that moisture potential for the tempered water is present (as often there is not as there would be with 40 deg chilled water).
      - .1 Note: Humidity comes from many sources that are outside the control of the BSM (such as doors and windows). This is not to be confused with a condensate sensor on the floor or roof as one would have with a chilled beam. The slab temp has a sizeable difference in temp than the manifold water.
    - .2 If radiant slab return water temp is below 55 deg (adj) then shut control valve and lock out valve from opening for 30 min (adj, then resume cooling sequence.
    - .3 Anti-Freeze: if the OSAT is below 32 for more than 1 hour initialize heating systems and run to 60deg slab temp for 4 hours or until occupied.
  - .4 If change over valves are shown on the controls diagram, these must all be normally closed when the fans are off to prevent excessive bypass of the supply to the return.

3 . EXECUTION

3.1 Not Applicable

END OF SECTION

**ACCEPTABLE  
MANUFACTURERS LIST**

<b>ITEM</b>	<b>APPROVED MANUFACTURERS</b>
Access Doors	Can-Aqua, Mifab, Milcor, Maxam, Van-Met, Nystrom, Van-Met, Acudor, E.H. Price, Steel Brothers, Nailor, Zurn, Wade
Automatic Air Vent	Sarco, Armstrong, Dole, Maid-O-Mist, Taco, Watson McDaniel, Caleffi
Air Curtains	Berner, Schwank, Biddle
Air Separators	Armstrong, Spirotherm, Taco, Spirotech Caleffi, Wessels, B&G (Xylem)
Air Handling Units/Make-up Air/DOAS Units (Institutional)	AnnexAir, Engineered Air, Haakon, Ingenia, Ventrol, Govern-Air, Scott Springfield, Swegon, Tempeff, Scott Springfield, SystemAire
Balancing	Air Balance Group, Air Audit, Clark, Aerodynamics, Pro-Air, Dynamic Flow Balancing, Air Velocities Control, Flowset, Designtest and Balance, VPG, Vital Canada, Technical Air Balancing,
Backflow Protection	Watts, Febco, Clayton, Beeco, Wilkins
Buffer Tanks	AO Smith, Bell & Gossett (Xylem), Taco, Armstrong
Air Source Heat pump	Aermec, Climavenata, JCI, Water Furnace, Bluebox
Coils, Water	Aerofin, Trane, McQuay, Carrier, Engineered Air, Heatcraft, JCI/York, RAE. Macon
Boiler	Petterson Kelly, Lochinvar, Fulton, Acme Slim, Viessman
Controls	Alerton by Advanced Energy management LTd.
Couplings	Victaulic, Grinnell
Damper - Low Leakage	Tamco, Ruskin, Nailor, EH Price, Greenheck, Arrow United, NCA
Domestic Hot Water Heaters	AO Smith, Ruud, Rheem, State, PVI, GSW, John Wood, Bosch, Bradford White
Domestic Hot Water-Tankless	AO Smith, Bosch, Tagaki, Rinnai, Eemax, Navien, Stiebl

	Ebtron, NTI
Expansion Joints	Flexonics, Hyspan, Uniroyal, Keflex, Mason, Goodall, Yarway
Expansion Tanks	Amtro/Extrol, Therm-x-trol, State, Sparco, Expanflex, Armstrong, B & G (Xylem), Clemmer, Taco, Zilmet H & G, Watts, Flexcon
Fan Coil Units	Carrier, Trane, Daikin, Williams, MultiAquaEngineered Air, Airtherm, Climatec, Unilux, Price, International Environmental, first co, IEC
Fans - Cabinet, Roof and Propeller	Loren-Cook, Penn, Jenn-Air, Greenheck, Carnes, American Cool-Air, Broan, Delta Breez, Nutone, Reversomatic, Panasonic, Air King, Lexton
Fans - Centrifugal/Plenum	Buffalo, Northern, Pace, Chicago, Twin City fans, Barry Blower, Trane, Flakt-Woods, Penn, New York Blower, Greenheck, Loren-Cook ,
Fans - Inline	Loren-Cook, Penn, Jenn-Air, Greenheck, Carnes, S & P
Fans – Roof/Wall Exhaust	Acme, Penn, Greenheck, Loren-Cook,
Filters - Air	Camfil-Farr, Continental, Cambridge, AAF, EH Price, Dayco, Dafco
Fire Dampers	Canadian Advanced Air, Maxam, Ruskin, Controlled Air, Nailor-Hart , NCA
Fire Protection - Cabinets	Wilson & Cousins, National, Viking, NFE
Fire Protection - Extinguishers	Flagg, National, Kidde
Fire Protection - Sprinklers	Grinnell, Viking, Star, Astra, Vipond, Tyco, Reliable
Force Flow Units/Unit Heaters/Convectors (Hot Water)	Trane, Firstco, Modine, Rosemex, Daikin Dunham Bush, Engineered Air, Sterling, Sigma, Airtherm
Gas Detection Systems	Vulcain. QEL, Enmet, MSL, Armstrong, Honeywell
Grilles and Diffusers	Price, Nailor, Titus, Krueger, Lindab, Seiho, Tuttle & Bailey,

	Metalaire, NAD- Klima
Grilles and Diffusers-Self-Modulating	E H Price, Titus
Heat Exchangers	Armstrong, AIC, Alpha Laval, B & G (Xylem), GEA, Sondex
Humidifiers-Absorption Self-Contained Type	Steam-O-Vap, Carel, neptronic
Insulation	Fiberglas, Knauf, Johns-Manville, Atlas, PPG, Manson, Armstrong, Owens Corning, Certainteed, Roul, Thermafibre, Therma-Cel, Armacell, Aerocell, K-Flex, Flex USA, Kingspan
Jacketing Material	Childers, Fiberglas, Johns-Manville
Louvres	Ventex, Airolite, Ruskin, Greenheck
Motors, Electric – Premium Efficiency	Century Electric, Baldor, Toshiba, Teco
Pipe Fittings and Flanges	Crane, Grinnell, Jenkins, Victaulic
Pipe Supports and Hangers	Crane, Unistrut, Myatt, L.E. Taylor, Grinnell, Sarco
Plumbing Drainage Accessories	Roto-Tech-Smith, Enpoco, Ancon, J.R. Smith, Zurn, Mifab, Watts
Plumbing Fixtures and Trim	K.I.L., Fiat, Kohler, Eljer, American Standard, AMP, Moen-Commerical, Williams, AristaNewman, Haws, Elkay, Aquarius, Swan, Bradley, Cambridge, Speakman, Valley, Hytec, Watrous, Briggs, Symmons, Sloan, Nepitek, Crane, Toto, Mifab, Grohe, Guardian
Pressure Gauges	Marsh, Moeller, Weiss, Ametek, Trerice, Winters
Pumps-Domestic Booster	Armstrong, B&G, Wilo, Plad, Grundfos, Patterson (Gorman Rupp)
Pumps-Domestic Hot Water Recirculation	B&G, Armstrong, Taco, Grundfos, Wilo
Pumps – Vertical-In-Line, Circulators	Bell & Gossett, Armstrong, Grundfos, Wilo, Taco, Patterson (Gorman Rupp), Pentair

Pumps – Fire	Aurora, Xylem (B & G), Armstrong, Plad, Peerless, Patterson (Gorman Rupp)
Pumps- Submersible	Hydro-Matic, Leader, Flygt, Patterson (Gorman Rupp), Myers, Zoeller, Barnes, Plad
Radiant Ceiling Panels- Hot Water/Chilled water	Lindner, Aquatherm, Messana, Airtex (Eng Air), Giacomini, Barcol-Air, TWA-Frenger, Armstrong Ceilings, Zehnder, Climacustic, Eurotherm
Radiant Slab Heating and Cooling System	Uponor, Heat Link, Rehau (Klimatrol), Watts Radiant, Giacomini
Relief Valves	Crosby, Sarco, Watts
Reverse Osmosis Unit	Filterco, Barnstead, Nimbus, Culligan
Roof Drains	Zurn, Jay R Smith, Wade, Watts, Ancon
Sound Attenuation (Silencers)	I.A.C., Vibron, Vibro Acoustics, VAW Systems, Flanders-CSC Corp, Kinetics
Strainers	Red & White, Crane, Armstrong, Kitz, Mueller, Plenty, Colton, Metraflex, Muesco, Spirax/Sarco, Toyo, Victaulic
Thermometers	Marsh, Moeller, Terice, Weiss, Weksler, Winters
Toilet Seats	Beneke, Bemis, Olsonite, Moldex, Centoco
Trench Fan Coil Units	Jaga, Kampmann
Unit Heaters (Hot water)	Engineered Air, Trane, Sigma,
VAV Boxes	EH Price, Nailor, Titus, Krueger, Metalaire, Tuttle and Bailey
Valves - Ball	Red & White, Grinnell, Watts, Newman Hattersley, Crane, Victaulic, Nibo, Kitz, Toyo
Valves - Gate & Globe	Red & White, Crane, Jenkins, Grinnell, Kitz, Newman Hattersley, Dezurik, Nibco, Victaulic
Valves - Butterfly	Centerline, Keystone, Grinnell, Crane, Victaulic, Crane, MA Stewart, Nibco, Keystone, Toyo, Kurimoto, Kitz

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Valves - Balancing	Armstrong, Tour and Anderson, Dezurik, Dahl, Toyo, Caleffi, Keystone, Ballcentric, Xylem, Victaulic, Wheatley, Overtrop, ESBE, Nexus
Valves - Check Spring Loaded	Mission, Moyes & Groves, Crane, Kitz, Newman Hattersley, Nibco, Toyo, Grinnell, Victaulic, Mueller, Conbraco, Durabla, Muessco, Centerline, Apco,
Valves- PICV	Belimo, Siemens
Valves – 6 way valves	Belimo, Siemens
Variable Speed Drives	ABB, AC Tech, Toshiba, Hitachi, Danfoss/Graham, Coyote, Armstrong, Reliance, Cerus (E.H. Price supplier).
Vibration Control Equipment	Vibro-Acoustics, Lo-Rez, Vibron, Korfund, Mason, Kinetics, EAR Grommets, American National Rubber, Unisource
Water Treatment & Pot Feeder	Suez (Campus Preferred)



**SPARE PARTS LIST**

<b>0</b>	<b>SPECIFICATION SECTION</b>	<b>WORK</b>	<b>DESCRIPTION FROM THE SPECS</b>
13	21 12 00	Fire-Suppression Standpipes & Fire Extinguishers	1.7.1 Section 01 78 23: Maintenance and extra material requirements. 1.7.2 Extra Stock Materials: Provide [two (2)] of hose nozzles and hoses.
14	21 13 00	Sprinklers	1.11.1 Extra Stock Materials: 1.11.1.1 Provide sprinkler cabinet with twelve (12) extra sprinkler heads. 1.11.1.2 Provide metal storage cabinet in Level 0 Mechanical Room. 1.11.2 Tools: Provide suitable wrenches for each sprinkler type.
15	21 30 00	Fire Pumps	1.10.1 Section 01 78 23: Maintenance and extra material requirements. 1.10.2 Extra Stock Materials: Provide one (1) set of gaskets/screens/seals for each pump type and model supplied.
16	22 42 01	Plumbing Specialties	1.7.1 Section 01 78 23: Maintenance and extra material requirements.
17	22 42 02	Plumbing Fixtures	1.7.1 Submit in accordance with Section 01 78 23 - Operation and Maintenance Manuals: Maintenance and extra material requirements. 1.7.2 Spare Parts: Supply two (2) sets of faucet washers flush valve service kits lavatory supply fittings shower heads toilet seats. 2 sets of washers 2 sets of flush 2 sets of service kits lavatory supply fittings 2 sets of shower heads 2 sets of toilet seats
18	22 47 00	Pumps	1.7.1 Section 01 78 23: Maintenance and extra material requirements. 1.7.2 Extra Stock Materials: Provide two (2) sets of pump seals for each pump. Provide two (2) sets of cartridges for each side-stream filter. 2 sets of pump seals

			2 sets of cartridges
19	23 05 16	Piping Expansion Compensation	1.6.1 Section 01 78 23: Maintenance and extra material requirements. 1.6.2 Extra Stock Materials: Provide two (2), 340 gm (12 oz.) containers of packing lubricant and cartridge style grease gun. Provide 2 - 340 gm (12oz) containers of packing lubricant. 2 Cartridge style grease gun.
20	23 05 19	Gauges & Meters	1.7.1 Section 01 78 23: Maintenance and extra material requirements. 1.7.2 Extra Stock Materials: 1.7.2.1 Provide two (2) bottles of red gauge oil for static pressure gauges. 1.7.2.2 Provide two (2) each, dial thermometers, pressure gauges with pulsation damper. 2 bottles of red gauge oil 2 dial thermometers 2 pressure gauges
21	23 21 00	Hydronic Piping	1.8.1 Section 01 78 23: Maintenance and extra material requirements. 1.8.2 Extra Stock Materials: Provide two (2) repacking kits for each size and valve type. 2 repacking kits for size 2 replacing kits Valve type
22	23 21 16	Hydronic Specialties	1.7.1 Section 01 78 23: Maintenance and extra material requirements. 1.7.2 Extra Stock Materials: Provide one (1) extra [4 L (1 gal)] [40 L (10 gal)] [205 L (55 gal)] drum of [propylene] [ethylene] glycol. 1 extra [ 4 L (10 gal)] [ 205 L (55 gal) ] drum of [ propylene ] glycol.
23	23 25 00	Chemical Treatment For Piping	1.7.1 Section 01 78 23: Maintenance and extra material requirements. 1.7.2 Extra Stock Materials: Provide sufficient chemicals for treatment and testing during warranty period. Chemicals for treatment & Testing
24	23 33 00	Duct Work Accessories	1.7.1 Section 01 78 23: Maintenance and extra material requirements. 1.7.2 Extra Stock Materials: Provide two

			(2) of each size and type of fusible link. 2 size of fusible 2 type of fusible
25	23 34 16	Commercial Fans	1.7.1 Section 01 78 23: Maintenance and extra material requirements. 1.7.2 Extra Stock Materials: Provide two (2) sets of belts for each fan. 2 sets of belts for each fan
26	23 36 00	Air Terminal Units	1.7.1 Section 01 78 23: Maintenance and extra material requirements. 1.7.2 Extra Stock Materials: Provide two (2) additional electric motors of each size. 2 additional Electric Motors Of each Size
27	23 40 00	Air Cleaning Devices	1.7.1 Section 01 78 23: Maintenance and extra material requirements. 1.7.2 Extra Stock Materials: Provide one (1) set of disposable panel filters. 1 Set of Disposable panel filters
28	23 52 39	Boilers-Condensing	1.7.1 Section 01 78 23: Maintenance and extra material requirements. 1.7.2 Tools: Provide wire brush and [hinged] [one-piece] handle for tube cleaning. 1 Wire Brush Hinged one piecehandle for tube cleaning
29	23 57 00	Heat Exchangers	1.7.1 Section 01 78 23: Maintenance and extra material requirements. 1.7.2 Extra Stock Materials: 1.7.2.1 Provide two (2) sets of replacement gaskets for each heat exchanger 1.7.2.2 Provide one (1) set of wrenches for disassembly of plate type heat exchangers. 2 sets of replacement gaskets 1 set of wrenches
30	23 73 23	Air Handling Units	1.7.1 Section 01 78 23: Maintenance and extra material requirements. 1.7.2 Extra Stock Materials: Provide one (1) set for each unit of fan belts and filters. 1 set for each unit of fan belts & filters
31	23 74 13	Conditioning Units - Packaged Roof Top	1.7.1 Section 01 78 23: Maintenance and extra material requirements. 1.7.2 Extra Stock Materials: Provide one (1) set of filters.

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			1 set of filters.
32	23 82 00	Terminal Heat Transfer Units	.7.1 Section 01 78 23: Maintenance and extra material requirements. 1.7.2 Extra Stock Materials: Provide two (2) sets of filters. 1 set Of filters

## 1. **GENERAL**

### 1.1 **Related Sections**

- 1.1.1 The General Conditions, Supplements and Amendments shall govern this Section (read in conjunction with Instructions to Tenderers/Bidders). This section covers items common to all Electrical sections and is intended only to supplement the requirements of Division 1.
- 1.1.2 Reference to "Electrical Divisions" shall mean all sections of Divisions 26, 27, 28, 33, 34, and 48 in the Master Format of the Canadian Master Specifications and/or Division 16 and 17 in the standard format.
- 1.1.3 Provide materials, equipment and plant, or specified design, performance and quality, and current models with published certified ratings for which replacement parts are readily available. Provide project management and on-site supervision to undertake administration, meet schedules, ensure timely performance, ensure coordination, and establish orderly completion and the delivery of a fully commissioned installation.
- 1.1.4 The most stringent requirements of this and other electrical sections shall govern.
- 1.1.5 All work shall be in accordance with the Project Drawings and Specifications and their intent, complete with all necessary components, including those not normally shown or specified, but required for a complete installation.
- 1.1.6 Provide seismic restraints for all required equipment, piping and ductwork.
- 1.1.7 Connect to equipment specified in other Sections and to equipment supplied and installed by other Trade Contractors or by the Owner. Uncrate equipment, move in place and install complete; start up and test. Include all field assembly of loosely/separately packaged accessories.
- 1.1.8 Refer to Section 23 05 13 3.12: Mechanical and Electrical Coordination of Responsibilities

### 1.2 **References**

- 1.2.1 Canadian Standards Association (CSA International)
  - .1 CSA C22.1, Canadian Electrical Code, Part 1 (current edition), Safety Standard for Electrical Installations.
  - .2 Comply with all electrical CSA standards and electrical bulletins.
  - .3 CAN/CSA-C22.3 (current edition), Overhead Systems.

- .4 CAN3-C235 (current edition), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- 1.2.2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
  - .1 EEMAC 2Y-1 (current edition), Light Gray Colour for Indoor Switch Gear.
- 1.2.3 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
  - .1 IEEE SP1122- (current edition), The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.
  - .2 University of Waterloo

### **1.3 Sustainable Requirements**

- 1.3.1 Materials and products in accordance with Sustainable Requirements: Construction.
- 1.3.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.
- 1.3.3 Waste Management and Disposal
  - .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
  - .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
  - .3 Place materials defined as hazardous or toxic waste in designated containers.
- 1.3.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:
  - .1 Construction Waste Management / Product Waste Recyclability.
  - .2 Recycled Content.
  - .3 Local and Regional Materials.
  - .4 Certified Wood.
  - .5 Construction Indoor Air Quality (IAQ) management.
  - .6 VOC/Low-Emitting Materials Compliance.
- 1.3.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

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**1.4 Design Requirements**

- 1.4.1 Operating voltages: to CAN3-C235 (current edition).
- 1.4.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
  - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- 1.4.3 Language operating requirements: provide identification nameplates and labels for control items in English.

**1.5 Definitions**

- 1.5.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.
- 1.5.2 The “Engineer” is defined as Introba LLP.
- 1.5.3 The “Trade Contractor” is defined as the supplier of the Scope of Work as defined in the Electrical Specifications sections in Division 26 (Division 16).
- 1.5.4 “Provide” is defined as “supply, install, test and commission.”
- 1.5.5 “Install” is defined as all work and materials necessary to place the specified item into full operation, securely fastened, and to give a presentable finished appearance. “Install” also includes all necessary connections and conductors.
- 1.5.6 “Coordinate” is defined as: to make all arrangements directly with agencies and individuals, confirm schedules, be in attendance at the time work is being carried out, and take full responsibility for having the work carried out correctly and in a timely manner to meet the construction schedule.

**1.6 Submittals**

- 1.6.1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.
- 1.6.2 Product Data: submit WHMIS MSDS in accordance with Section 01 47 15 - Sustainable Requirements.
- 1.6.3 Submit for review single line electrical diagrams in glazed frames and locate in Electrical Room.
  - .1 Electrical distribution system in main electrical room.
  - .2 Electrical power generation and distribution systems in power plant rooms.
- 1.6.4 Submit for review fire alarm riser diagram, plan and zoning of building in glazed frames and locate at fire alarm control panel and annunciator.

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1.6.5 Shop drawings:

- .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Ontario, Canada.
- .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
- .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
- .4 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
- .5 Submit number of copies indicated in Submittals Section 01 33 00 of drawings and product data to the authority having jurisdiction.
- .6 If changes are required, notify Engineer of these changes before they are made.
- .7 Submit a detail schedule of all shop drawings prior to the first progress draw. Schedule shall include specification section, equipment name, manufacturer's name, distance from site to final manufacturing location, percent recycled content and delivery date.

1.6.6 Quality Control: in accordance with Section 01 45 00 - Quality Control.

- .1 Provide CSA certified equipment and material.
- .2 Where CSA certified equipment and materials are not available, submit such equipment and material to inspection authorities for special approval before delivery to site.
- .3 Submit test results of installed electrical systems and instrumentation.
- .4 Permits and fees: in accordance with General Conditions of contract.
- .5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
- .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Engineer.

1.6.7 Manufacturer's Field Reports: submit to Engineer manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

1.6.8 Sustainable Requirements



- .1 All submittals shall include a completed copy of the DECLARE form. For the most recent version, refer to "Declare Product Declaration Form.docx" found at <http://www.declareproducts.com/for-manufacturers>.
- .2 All submittals shall include a completed copy of the JUST form. For the most recent version, refer to "Just Postcard" found at <http://living-future.org/node/764>.

## 1.7 **Quality Assurance**

- 1.7.1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- 1.7.2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Trade Contractor license in accordance with authorities having jurisdiction.
  - .1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
  - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.
- 1.7.3 Site Meetings:
  - .1 In accordance with - Construction Schedule.
  - .2 Site Meetings: Schedule site visits, to review Work, at stages listed.
    - .1 After delivery and storage of products, and when preparatory Work is complete but before installation begins.
    - .2 A minimum of twice during progress of Work at 25% and 60% complete.
    - .3 Upon completion of Work, after cleaning is carried out.
- 1.7.4 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 – Occupational Health and Safety.

## 1.8 **Delivery, Storage and Handling**

- 1.8.1 Material Delivery Schedule: provide Engineer with schedule of all materials within 2 weeks after award of Contract. Progress claims will not be reviewed until updated schedules are provided.
- 1.8.2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 00 – Cleaning and Waste Management.

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**1.9 System Start-up**

- 1.9.1 Instruct Engineer and operating personnel in operation, care and maintenance of systems, system equipment and components.
- 1.9.2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- 1.9.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

**1.10 Operating Instructions**

- 1.10.1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
- 1.10.2 Operating instructions to include following:
  - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
  - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
  - .3 Safety precautions.
  - .4 Procedures to be followed in event of equipment failure.
  - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
- 1.10.3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
- 1.10.4 Post instructions where directed.
- 1.10.5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
- 1.10.6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

**1.11 Permits and Fees**

- 1.11.1 Submit to Electrical Review Department, Local Fire Authorities and Supply Authority the necessary number of drawings and specifications for examination and approval prior to commencement of work. Obtain all required permits and pay all fees.
- 1.11.2 Arrange for review of all Work by the authorities having jurisdiction. On completion of the Work, furnish final unconditional certificates of approval by the inspecting authorities.

**1.12 Equipment Restraint**

- 1.12.1 It is the entire responsibility of the equipment manufacturers to design their equipment so that the strength and anchorage of

internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.

### **1.13 Seismic Analysis and Provisions**

- 1.13.1 Install electrical systems with adequate structural support to withstand seismic forces in accordance with Section 4.1.8 of the National Building Code, and Province, Territory or Municipality of the project.
- 1.13.2 Retain a structural engineer licensed in the Province or Territory of the project to perform a review of the proposed electrical installation and prepare installation documents indicating all required seismic supports, bracings and fastenings. These documents shall be sealed and signed by the structural engineer and submitted as part of the shop drawing package prior to rough-in work commencing on site.
- 1.13.3 Equipment to be indicated in the structural design documents shall include but not be limited to: suspended transformers, bus ducts, cable trays, suspended conduit runs, free standing distribution equipment such as switchboards and motor control centres, and suspended lighting fixtures.
- 1.13.4 Verify the Facility is classified as "Normal" with an "Importance Factor of 1.0" as referenced in 4.1.8.5 (1) of the National Building Code and Province, Territory or Municipality of the project.
- 1.13.5 Refer to seismic risk reduction of operational and functional components (OFCs) of building S832-06 and meet all requirements.
- 1.13.6 Provide confirmation in writing, signed and sealed by the structural engineer, at completion of project that the electrical installation is in general compliance with the structural installation drawings submitted with the shop drawing package.
- 1.13.7 All light fixtures shall be provided with independent chain supports that are fastened to the structure of the Building.
- 1.13.8 The trade contractor shall be solely responsible for the full scope of this work. Include all costs of structural design, materials and site review in Bid Price.

### **1.14 Drawings and Measurements**

- 1.14.1 Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of work and are not detailed installation drawings. Do not scale the drawings. Obtain accurate dimensions from the Architectural and Structural drawings.
- 1.14.2 Consult the Architectural drawings and details for exact locations of fixtures and equipment. Obtain this information from the Engineer where definite locations are not indicated.

- 1.14.3 Take field measurements where equipment and material dimensions are dependent upon building dimensions.
- 1.14.4 Where imperial units have been indicated in brackets [ ] following the requirements in SI units, the conversion is approximate and provided for convenience. The SI units shall govern.

#### **1.15 Project Coordination**

- 1.15.1 Check drawings of all trades to verify space and headroom limitations for work to be installed. Coordinate work with all trades and make changes to facilitate a satisfactory installation. Make no deviations from the design intent involving extra cost to the Owner without the Engineer's written approval.
- 1.15.2 The drawings indicate the general location and route to be followed by the electrical services. Where details are not shown on the drawings or only shown diagrammatically, the services shall be installed in such a way as to conserve headroom and interfere as little as possible with the free use of space through which they pass. Service lines shall run parallel to building lines. All services in the ceiling shall be kept as tight as possible to beams or other limiting members at high level. All electrical services shall be coordinated in elevation to ensure that they are concealed in the ceiling or structural space provided unless detailed otherwise on drawings.
- 1.15.3 Work out jointly all interference problems on the site and coordinate all work before fabricating or installing any material or equipment. Where necessary, produce interference/coordination drawings showing exact locations of electrical systems or equipment within service areas, shafts and the ceiling space. Distribute copies of the final interference/coordination drawings to the Architect and Engineer and all affected parties.
- 1.15.4 Ensure that all materials and equipment fit into the allotted spaces and that all equipment can be properly serviced and replaced, if and when required. Advise the Engineer of space problems before installing any material or equipment. Demonstrate to the Engineer on completion of the work that all equipment installed can be properly, safely serviced and replaced, if and when required.

#### **1.16 Provision for Future Equipment and Construction**

- 1.16.1 Leave clear spaces designated for future equipment or building expansion where indicated. Plan for the installation under this contract and ensure clear, accessible, unhindered access to the space is allowed for.
- 1.16.2 Where contract documents do not clearly indicate the future expansion requirements but known services are required, provide written "request for information" to the Engineer before making assumptions as to intent.

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**1.17 Sprinkler Proof Requirements**

- 1.17.1 All equipment and wiring systems shall be sprinkler proof standard where sprinkler fire protection systems are installed.
- 1.17.2 In rooms where electrical equipment is installed surface-mounted, electrical equipment contained in these rooms is to be protected by non-combustible drip hoods, shields and gasketed doors as applicable to inhibit water ingress into electrical equipment. Exposed conduits connected to equipment to utilize water-tight connectors. Top entry to be avoided where possible.
- 1.17.3 In particular, all unit substations, transformers, switchgear, motor control and panelboard shop drawings shall be certified "sprinkler proof" design.

**1.18 Phase Construction**

- 1.18.1 See Architectural specifications and drawings for construction phasing. Make all allowances to phase the work in accordance with the project phasing.
- 1.18.2 All existing services and the existing building(s) must be maintained in operation. Provide and install temporary services as required.
- 1.18.3 All trades in this Division shall make allowance for the implications of having to totally complete all work in the new addition before proceeding with work in the existing building.

**1.19 Sequence of Work**

- 1.19.1 Before interrupting major services, notify the Owner well in advance and arrange an acceptable schedule for the interruptions.
- 1.19.2 Before interrupting any services, complete all preparatory work as far as reasonably possible and have all necessary materials on site and pre-fabricated (where practical) and work continuously to keep the length of interruption to a minimum.
- 1.19.3 Include for the cost of all work that may be required out of regular hours to minimize the period of service interruption when modifying the existing systems.
- 1.19.4 All trades in this Division shall make allowance for the implications of having to totally complete all work in the new addition before proceeding with work in the existing building.

**1.20 Tender Inquiries**

- 1.20.1 All Trade Contractor queries during the tender period shall be made in writing to the Engineer. Trade Contractor queries will be collected and suitable addenda will be issued for clarification. No verbal information will be considered valid or issued by the Engineer's office during tender. All tender queries may be emailed, faxed,

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mailed or couriered to the Engineer's office. No telephone queries will be answered.

**1.21 Examination**

- 1.21.1 Visit the site before preparing the tender and examine all existing conditions. No extra cost will be considered for any misunderstanding of the work to be done resulting from failure to visit the site.
- 1.21.2 Examine the documents for details of work included. Obtain a written clarification in the event of conflict within the specification, between the specification and the drawing, or in the drawing. Obtain written clarification from the Engineer if work affecting the installation is not clear. Where this is not done in advance, allow in the tender sum for providing the more costly alternative.

**1.22 Responsibilities**

- 1.22.1 Ensure that equipment does not transmit noise and/or vibration to other parts of the building, as a result of poor installation practices.
- 1.22.2 Where the Contract Documents do not contain sufficient information for the proper selection of equipment for bidding, notify the Engineer during the tendering period. If clarification is not obtainable, allow for the most expensive arrangement. Failure to do this shall not relieve the Trade Contractor of responsibility to provide the intended equipment.
- 1.22.3 Protect equipment and material from the weather, moisture, dust and physical damage.
- 1.22.4 Cover equipment openings and open ends of conduits, piping and pull boxes as work progresses. Failure to do so will result in the Trade being required to adequately clean or replace materials and equipment at no extra cost to the Owner.
- 1.22.5 Protect all existing services encountered. Obtain instructions from the Engineer when existing services require relocation or modification.
- 1.22.6 Refinish damaged or marred factory finish to factory finish.
- 1.22.7 The specifications and drawings form an integral part of the Contract Documents. Neither to drawings nor the specifications shall be used alone. Work omitted from the drawings but mentioned or reasonably implied in the specifications, and vice versa, shall be considered as properly and sufficiently specified and shall be provided. Misinterpretation of any requirement of either plans or specifications shall not relieve the Trade Contractor of the responsibility of properly completing his trade to the approval of the Engineer.

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**1.23 Standard of Acceptance**

- 1.23.1 Standard of Acceptance means that the item named and specified by the manufacturer and/or catalogue number forms part of the specification and sets standard regarding performance, quality of material and workmanship and when used in conjunction with a reference standard, shall be deemed to supplement the standard.
- 1.23.2 Where two or more manufacturers are listed, the manufacturer's name shown first or underlined or shown with a model name and/or number was used in preparing the base design. Tenders may be based on any one of those named, provided that they meet every aspect of the base design and every aspect of the drawings and specifications.
- 1.23.3 Where other than the first named or the underlined manufacturer or scheduled/specified manufacturer is selected or approved, include for the cost of any resulting work (both under this Division and other Divisions) and any necessary redesign of installation or structure. Submit redesign drawings for review with Shop Drawings. Maintain installation, access and servicing clearances. Equipment/materials shall not exceed the available space limitations. Redesign drawings shall be to scale and of a standard equal to the Project Drawings.
- 1.23.4 A visible manufacturer's nameplate shall indicate manufacturer's name, model number, serial number, capacity data, electrical characteristics and approval stamps.

**1.24 Facility Commissioning**

- 1.24.1 The Trade Contractors are obliged to comply with the supporting commissioning documentation prepared by the BMS Contractor. The Trade Contractor is to provide all required manpower, testing, equipment, documentation and staff training in order to meet the Building Integration requirements.

**1.25 Progress Claim and Change Order Breakdowns**

- 1.25.1 Ten (10) days after the award of contract, submit price breakdowns.
- 1.25.2 In particular cases, more detail may be necessary to properly assess a change order or progress claims. This additional information could include all suppliers and all trade contractors when requested by the Engineer. Provide details for each section of the electrical work listed for each separate electrical change order.
- 1.25.3 Mark-up information is required for change orders but is optional on the original tender price.
- 1.25.4 Progress claims will not be certified nor payment made beyond 90% of the overall Electrical contract until commissioning and verification of the systems are complete. This procedure is to allow for any

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necessary deficiency holdbacks on items which do not become apparent until the systems are commissioned.

**1.26 Warranty**

- 1.26.1 Use of installed equipment during construction shall not shorten or alter the warranty period, as specified in Division 1.
- 1.26.2 Take note of any extended warranties specified.
- 1.26.3 Furnish a written warranty stating that all work executed under this Division will be free from defects of material and workmanship for a period of one (1) year from the date of substantial performance.
- 1.26.4 Promptly investigate any electrical or control malfunction and repair or replace all such defective work and all other damages thereby which becomes defective during the time of the warranty.

**1.27 Substantial Performance Requirements**

- 1.27.1 Refer to each section in specifications for detailed requirements.
- 1.27.2 Before the Engineer is requested to make an review for substantial performance of the work:
  - .1 Commission all systems and prove out all components, interlocks and safety devices.
  - .2 Submit a letter certifying that all work is complete for the intended use, operational, clean and all required submissions have been completed.
  - .3 A complete list of incomplete or deficient items shall be provided. If, in the opinion of the Engineer, this list indicates the project is excessively incomplete, a substantial completion review will not be performed.
- 1.27.3 The work will not be considered to be ready for use or substantially complete until the following requirements have been met:
  - .1 All reported deficiencies have been corrected.
  - .2 Operating and Maintenance Manuals completed.
  - .3 "As Built" Record Drawing ready for review.
  - .4 Systems Commissioning has been completed and has been verified by the Engineer.
  - .5 All demonstrations to the Owner have been completed.
  - .6 All documentation required for LEED® certification has been submitted.
- 1.27.4 Engineer's Letters of Assurance will not be issued until the following requirements have been met:
  - .1 All items listed in .1 above have been completed or addressed.
  - .2 Certificate of Penetrations through Separations



- .3 Provincial or City Electrical Review – Certificate of Review.
- .4 Seismic Engineer's Letter of Assurance and Final Review Report.
- .5 Certificate of Substantial Performance.
- .6 Signed off copy of Engineer's Final Review Report.
- .7 Fire Alarm Verification.

**1.28 Deficiency Holdback and Deficiency Reviews**

- 1.28.1 Work under this Division which is still outstanding when substantial performance is certified will be considered deficient and a sum equal to at least twice the estimated cost of completing that work will be held back.
- 1.28.2 It is expected that outstanding work will be completed in an expeditious manner and the entire holdback sum will be retained until the requirements for Total Performance of work have been met and verified.

**2 . PRODUCTS**

**2.1 Sustainable Requirements**

- 2.1.1 Materials and products in accordance with Section 01 47 15 - Sustainable Requirements: Construction.
- 2.1.2 Do verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Trade Contractor's Verification.

**2.2 Materials and Equipment**

- 2.2.1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- 2.2.2 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from inspection authorities before delivery to site and submit such approval as described in PART 1 - SUBMITTALS.
- 2.2.3 Factory-assemble control panels and component assemblies.

**2.3 Warning Signs**

- 2.3.1 Warning Signs: in accordance with requirements of authority having jurisdiction.
- 2.3.2 Porcelain enamel signs, minimum size 175 x 250 mm.
- 2.3.3 For high voltage installations, provide permanent, legible warning notice carrying the wording: "DANGER – HIGH VOLTAGE" as required and indicated in Section 36 of CSA C22.1, CEC – Part 1.

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## 2.4 Wiring Terminations

- 2.4.1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

## 2.5 Equipment Identification

- 2.5.1 Identify electrical equipment with nameplates and labels as follows:

- .1 Nameplates:
  - .1 Supply and install white lamacoid nameplates with black lettering fastened with two (2) round head stainless steel screws on the following equipment and as noted on drawing.
  - .2 power and lighting panels lp-(panel number) 13mm (1/2") letters
  - .3 disconnect switch feed to (equipment name) 6mm (1/4") letters
  - .4 combination starters fan name and number 6mm (1/4") letters
  - .5 Starters and manual starters
- .2 lamicoid 3 mm thick plastic engraving sheet, matte white finish face, black core, lettering accurately aligned and engraved into core and mechanically attached with self tapping screws.

- 2.5.2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.

- 2.5.3 Wording on nameplates and labels to be approved by Engineer prior to manufacture.

- 2.5.4 Allow for minimum of twenty-five (25) letters per nameplate and label.

- 2.5.5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

- 2.5.6 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO. \_\_\_\_" as directed by Engineer.

- 2.5.7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

- 2.5.8 Terminal cabinets and pull boxes: indicate system and voltage.

- 2.5.9 Transformers: indicate capacity, primary and secondary voltages.

## 2.6 Wiring Identification

- 2.6.1 Identify wiring with permanent indelible identifying markings, numbered and coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

- 2.6.2 Maintain phase sequence and colour coding throughout.
- 2.6.3 Colour coding: to CSA C22.1 (current edition).
- 2.6.4 Use colour coded wires in communication cables, matched throughout system.

## **2.7 Conduit and Cable Identification**

- 2.7.1 Colour code conduits, boxes and metallic sheathed cables.
- 2.7.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- 2.7.3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	<b>Prime</b>	<b>Auxiliary</b>
120/208 V	Blue	
347/600 V	Orange	
Up to 25 kV	Yellow	
Emergency distribution	Red	Blue/Orange
Communication Systems	Green	
Fire Alarm	Red	
Emergency Voice	Red	Green
Security Systems	Red	Brown

## **2.8 Finishes**

- 2.8.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
  - .1 Paint outdoor electrical equipment "equipment green" finish.
  - .2 Paint indoor switchgear and distribution enclosures as per the prime colours defined in Part 2.7, Conduit and Cable Identification

## **2.9 Fire-Stopping**

- 2.9.1 Include Labor, materials and equipment necessary to complete the installation required for Firestopping of Through Penetrations in Fire Rated Assemblies.
- 2.9.2 Related Sections
  - .1 Consult all other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.
  - .2 This shall be considered as an augmentation to Section 07 84 10 Firestopping an smoke seals.
  - .3 This addresses those unique elements that affect the Firestopping of Information Technology cabling systems

which may not be addressed in 07 84 00 or any of its sub-sections.

#### 2.9.3 References

- .1 CAN4-S115-M, "Standard Method of Fire Tests of Firestop Systems".
- .2 CAN/ULC-S115, "Standard Method of Fire Tests of Firestop Systems".
- .3 Underwriters Laboratories Canada Inc. (ULC) – Fire Resistance Directory
- .4 Underwriters Laboratories, Inc. (cUL) – Fire Resistance Directory of Products Certified for use in Canada.

#### 2.9.4 Performance Requirements

- .1 Fire rated cable pathway devices shall be used for ALL low-voltage, video, data and voice cabling, optical fibre raceways and certain high-voltage cabling where frequent cable moves, adds and changes may occur. Pathways required for high voltage cabling will be detailed on the prints. Such devices shall:
  - .1 Meet the hourly fire-rating of fire rated wall and or floor penetrated.
  - .2 Be tested for the surrounding construction and cable types involved.
  - .3 Have ULC, cUL or cULus Systems permitting cable loads from; "Zero to 100% Visual Fill." This requirement eliminates need for fill-ratio calculations to be made by cable technicians to ensure cable load is within maximum allowed by ULC, cUL or cULus System.
  - .4 Not have a constrictive inner liner that constricts around or compresses cables tightly together encouraging potential alien cross-talk or network interference.
  - .5 Be "Zero-Maintenance", zero-maintenance is defined as; No action required by cabling technician to open and/or close pathway for cable moves, adds or changes, such as, but not limited to:
    - .1 Opening or closing of doors.
    - .2 Spinning rings to open or close fabric liner.
    - .3 Removal and or replacement of any material such as, but not limited to, firestop caulk, putty, pillows, bags, foam muffins, foam, foam plugs, foam blocks, or foam closures of any sort.
    - .4 Furnish letter from manufacturer certifying compliance with this definition of "Zero-Maintenance".

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- .6 Pathways shall be engineered such that two or more devices may be ganged together. When installed in gypsum wallboard walls, pathways shall be ganged and supported by a grid designed to transfer the weight load of the pathways to the studs by anchoring with fasteners. Unless tested otherwise by an accredited third-party test lab such as ULC, multiple pathways SHALL NOT be clustered unless separated by a minimum of 6" on all sides.
  - .7 Pathways shall be engineered to be re-enterable permitting retrofit and removal from around existing cables without cutting and re-splicing them.
  - .8 Cable Pathway Devices passing vertically through floors shall have equal FT Rating. (See cUL System # F-A-3037, Item #4 "EZ-PATH Grid T-Rating Kit" Part # TRK444)
  - .9 Affix adhesive wall label immediately adjacent to devices to communicate to future cable technicians, authorities having jurisdiction and others the manufacturer of the device and the corresponding cUL, ULC or cULus System number installed.
  - .2 As an alternate to using a fire-rated cable pathway device for single or a pair of low voltage cables (up to 0.53" / 14 mm) penetrating one or two-hour, gypsum board/stud wall assemblies, either as a through-penetration or as a membrane-penetration, a fire-rated cable grommet may be substituted. The firestop shall consist of a molded, two-piece, plenum-rated grommet having a foam fire and smoke sealing membrane that conforms to the outside diameter of the individual cable(s). The grommet product shall be capable of locking into place to secure the cable penetration within the wall assembly. The grommet shall be cUL, ULC or cULus Classified and tested to the requirements of CAN/ULC S115. Ready® Firestop Grommet RFG1 or RFG2.
  - .3 Where non-mechanical pathways cannot be utilized, such as sealing (caulking) around single or grouped conduits, provide products that upon curing do no re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during or after construction. Provide letter from manufacturer certifying compliance with this section.
  - .4 Cable pathway shall replace conduit sleeves in walls and floors, and;
    - .1 When installed individually in floors, devices shall pass through core-drilled opening utilizing tested floor plates.
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- .2 When multiple units are ganged in floors, devices shall be anchored by means of a tested grid.
- .3 When installed individually in walls, devices shall pass through core drilled opening utilizing tested wall plates.
- .4 When multiple units are ganged in walls, devices shall be anchored by means of a tested grid.
- .5 Cable tray shall terminate at each fire barrier and resume on the other side such that cables pass independently through devices. Cable tray shall be properly supported on each side of fire barrier.

#### 2.9.5 Submittals

- .1 Submit under provisions of Section 01 33 00 Submittal procedures.
- .2 Product Data: Provide manufacturer's standard catalog data for specified products demonstrating compliance with referenced standards and listing numbers of systems in which each product is to be used.
- .3 Schedule of ULC, cUL or cULus System Drawings: Submit schedule of all expected opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance ratings. If engineering recommendations are necessary, list these in the schedule too.
- .4 ULC, cUL or cULus System Drawings: Furnish copies of all ULC, cUL or cULus Systems identified in schedule above. Include any engineering recommendations.
- .5 Certificates: Product Certificate of Compliance from the firestop system manufacturer certifying material compliance with applicable code and specified performance characteristics.
- .6 Installation Instructions: Submit manufacturer's printed installation instructions.

#### 2.9.6 Quality Assurance

- .1 Products/Systems: Provide firestopping systems that comply with the following requirements:
  - .1 Firestopping tests are performed by a qualified, testing and inspection agency. A qualified testing and inspection agency is ULC, cUL or cULus, or another agency performing testing and follow-up inspection services for firestop system acceptable to authorities having jurisdiction.
  - .2 Firestopping products bear the classification marking of qualified testing and inspection agency.

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- .2 Installer Qualifications: Experience in performing work of this section who is qualified by the firestopping manufacturer as having been provided the necessary training to install firestop products in accordance with specified requirements.
  - .3 Field Inspections: Inspection of completed work SHALL be performed by Engineer and authority having jurisdiction (AHJ), and/or the building underwriter's designee. If required by AHJ or underwriter, inspections may be performed by an independent, third-party construction inspection and testing service provided that:
    - .1 Inspections are performed to the requirements of the following standards, as applicable.
      - .1 Construction Joints: ASTM E2393 - 10a Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers
      - .2 Service Penetrations: ASTM E2174 - 10a Standard Practice for On-Site Inspection of Installed Fire Stops
    - .2 Individual(s) performing inspection SHALL provide evidence of valid Errors and Omissions insurance coverage for this service.
    - .3 Individual(s) performing inspection SHALL NOT have any financial connection to installer, especially including firestop manufacturer, distributor or supplier.
- 2.9.7 Project Conditions
- .1 Do not install firestopping products when ambient or substrate temperatures are outside limitations recommended by manufacturer.
  - .2 Do not install firestopping products when substrates are wet due to rain, frost, condensation, or other causes.
  - .3 Maintain minimum temperature before, during, and for a minimum 3 days after installation of materials.
  - .4 Do not use materials that contain flammable solvents.
  - .5 Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
  - .6 Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
  - .7 Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings
- 2.9.8 Acceptable Manufacturers

- .1 Single Source: Obtain firestop systems for each type of penetration and construction condition indicated only from a single manufacturer.
- .2 Acceptable Manufacturer: Refer to specification section 07 84 00 Firestopping and any or all sub sections of Section 07 84 00 and Architectural drawing A-661 for details.
- .3 There is no known equal. Submitter shall prove that proposed substitution complies with section 1.4 PERFORMANCE REQUIREMENTS and accept full liability for removal and replacement of specified product, if substituted product fails to meet or exceed specified performance requirements.
- .4

#### 2.9.9 Materials

- .1 General: Use only firestopping products that have been tested for specific fire resistance rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire rating involved for each separate instance.
- .2 Firestop Sealants: Single component latex formulations that upon cure do not re-emulsify during exposure to moisture.
- .3 Firestop Putty: Intumescent, non-hardening, water resistant putties containing no solvents, inorganic fibers or silicone compounds.
- .4 Firestop Pillows: Re-enterable, non-curing, mineral fiber core encapsulated on six sides with intumescent coating contained in a flame retardant poly bag.
- .5 Fire-Rated Cable Grommet: Firestop Grommet is a molded, two-piece grommet with an integral fire and smoke sealing foam membrane for sealing individual cables or pairs of cables penetrating through framed wall assemblies. Grommet snaps together around cable and locks tightly into the wall.
- .6 Fire Rated Cable Pathways: Device modules comprised of steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill.

#### 2.9.10 Examination

- .1 Before beginning installation, verify that substrate conditions previously installed under other sections are acceptable for installation of firestopping in accordance with manufacturer's installation instructions and technical information.
- .2 Surfaces shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellants, and any other substances that may inhibit optimum adhesion.



- .3 Provide masking and temporary covering to protect adjacent surfaces.
- .4 Do not proceed until unsatisfactory conditions have been corrected.

#### 2.9.11 Installation

- .1 General: Install through-penetration firestop systems in accordance with Performance Criteria and in accordance with the conditions of testing and classification as specified in the published design.
- .2 Manufacturer's Instructions: Comply with manufacturer's instructions for installation of firestopping products.

#### 2.9.12 Field Quality Control

- .1 Inspections: Owner shall engage qualified independent inspection agency to inspect through-penetration firestop systems.
- .2 Keep areas of work accessible until inspection by authorities having jurisdiction.
- .3 Where deficiencies are found, repair firestopping products so they comply with requirements.

#### 2.9.13 Documentation

- .1 Place system label on each side of wall penetrations.
- .2 Place a reproduction (photo copy) of the UL System description in a document protector and mount to the wall next to the wall penetration
  - .1 Highlight the section of the system description that lists the allowed cable types.

### 2.10 **Bases Supports**

- 2.10.1 Where conduit and equipment is located on walls or slabs which will not permit the support of equipment, provide suitable supports to the building structure. Supports shall be constructed of steel members or of steel pipe and fittings designed to safely support the equipment.
- 2.10.2 All equipment bases shall be set on pads of kinetic pre-compressed fibreglass or vibration isolators sized to suit the equipment which they ought to support.

### 2.11 **Inserts, Sleeves and Curbs**

- 2.11.1 Provide all inserts, sleeves and curbs required for the work of this contract.
- 2.11.2 Use only factory-made threaded or toggle type inserts as required for support and anchors, properly sized for the load to be carried.

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Place inserts only in portions of the main structure and not in any finishing material.

2.11.3 Use factory-made expansion shields where inserts cannot be placed, but only where approved by the Engineer and only for loads of 50 kg or less.

2.11.4 Do not use powder-activated tools unless with written permission of the Engineer.

2.11.5 Supply and locate all inserts, holes, anchor bolts and sleeves in time when walls, floors and roof are erected.

2.11.6 Size sleeves to provide 25 mm clearance all around.

2.11.7 Use the following sleeving materials:

- .1 Through all interior walls, use Schedule 40 steel pipes, machine cut, flush with finished structure. Check room finish schedules.
- .2 Through all exterior walls above grade, use Schedule 40 steel pipes, machine cut, flush with finished structure inside and to suite flashing on outside.
- .3 Through all exterior walls below grade and all other waterproof walls, use wrought iron pipes. Check flashing details for further information.
- .4 Through all waterproof floors, through washrooms, janitor's closets, boiler rooms, mechanical rooms, kitchen and through roofs, use wrought iron sleeves, machine cut. Extend sleeves 100 mm above finished floor upward and cut flush with underside of floor.
- .5 Approved type plastic sleeves, conduit sleeves or 18-gauge galvanized steel sleeves may be used as an alternative for Schedule 40 steel sleeves in interior areas.
- .6 Provide 100 mm high, 100 mm wide water-tight concrete curbs with 20 mm chamfered edges around all sleeves passing through waterproof floors except where furred in.
- .7 Sleeves are not required in walls and dry area floors where conduit is installed ahead of wall construction.
- .8 Pack all sleeves between the conduit or cable passing through the sleeve and the sleeve and all spare sleeves with loose fibreglass insulation. Seal the annular space on both sides as follows:
  - .1 For all horizontal sleeves in exposed areas, use a seal of equal or better fire rating than the wall to be sealed.
  - .2 For all horizontal concealed sleeves through firewalls and through walls separating areas of different air pressure, use a permanently resilient silicone base or equal sealing compound.

- .3 For all vertical sleeves through roofs, washrooms, janitor closets, equipment rooms, use permanently resilient silicone base or equal compound, non-flammable and waterproof. Ensure that the seal is compatible with floor and ceiling finishes. Check the room finishes schedules for further information.
- .4 The Trade Contractor to provide sleeving diagrams/drawings to the structural Engineer for review and approval prior to any work commencing.

## **2.12 Cutting and Patching**

- 2.12.1 The Trade Contractor shall employ the particular trades to do all required cutting and patching and the repairing of surfaces for his work.
- 2.12.2 Supporting members of any floor, wall or the building structure shall be cut only in such a location and manner as directed by the Engineer or the Structural Engineer.
- 2.12.3 Provide fire barriers around all components in holes which penetrate fire separations. The fire barrier medium provided shall make the fire separation equal to or better than the one which was cut away. All materials shall be CSA approved and UL listed.
- 2.12.4 All floor saw cutting and drilling required for electrical services is to be performed within hours approved by Owner. Prior written notice of 48 hours must be given to the Owner.

## **2.13 Access Panels and Doors**

- 2.13.1 Install concealed electrical equipment requiring adjustment or maintenance in locations easily accessible through access panels or doors. Install systems and components to result in a minimum number of access panels. Indicate access panels on "Record" drawings.
- 2.13.2 Provide other Trades with panels, doors or the frame therefore, complete with all pertinent information for installation. Supply to Trade in whose work they occur to install them. Ensure that access doors are installed in a manner to match the building material grids where applicable.
- 2.13.3 Prepare detail drawings showing location and type of access doors in coordination with other trades before proceeding with installation and hand these to the Engineer for review.
- 2.13.4 Size access doors to provide adequate access and commensurate with the type of structure and architectural finish. Should it be necessary for persons to enter, provide minimum 610 mm x 460 mm size doors.
- 2.13.5 Ensure proper fire rating of access doors in fire separations.

- 2.13.6 Access doors shall be Le Hage, SMS, Pedlar or Acudor with 14 US gauge steel door panel, rust-resistant concealed hinges and positive locking with self-opening screwdriver-operated lock. Frame shall be suitable for wall installation and shall have integral keys for plaster walls. Doors in tile wall shall be stainless steel and ceiling shall be suitable for plaster covering with only the frame joint showing. All other doors shall be prime painted steel. Minimum size of doors shall be 12" x 18" (300 mm x 450 mm). Wherever possible, 24" x 24" (600 mm x 600 mm) doors shall be used.
- 2.13.7 Lay-in type tiles, properly marked, may serve as access panels. Marking of ceiling tiles must be coordinated with Owner.
- 2.13.8 Panels in glazed tile walls shall be 12-gauge, 304 alloy stainless steel, No. 4 finish, with recessed frame secured with stainless steel counter-sunk flush head screws.
- 2.13.9 Panels in plaster surfaces shall have dish-shaped door and welded metal lath, ready to take plaster. Provide a plastic grommet for door key access.
- 2.13.10 Other access doors shall be welded 12-gauge steel, flush type with concealed hinges, lock and anchor straps, complete with factory prime coat. Obtain approval of non-standard door construction details.

## **2.14 Backboards**

- 2.14.1 Provide plywood backboard for all electrical rooms, communication rooms and security rooms as indicated. Where no size is indicated, provide a backboard a minimum of 100 mm wider and 100 mm higher than the equipment. Where more than one piece of equipment is installed on the backboard, construct the backboard of a size to suit the maximum vertical and horizontal dimensions of the equipment.
- 2.14.2 For communication and security rooms where not indicated, provide backboard for all surfaces in communication and security rooms. Backboard shall extend from finished floor to 8' AFF, continuously around the communication and security rooms, or as indicated.
- 2.14.3 Construct plywood backboards from 199 mm thick fir plywood (FSC to UF Free) good one side.
- 2.14.4 Use fire-retardant backboards, pressure impregnated with fire-retardant chemicals, and stamp. Conform to CSA 080.
- 2.14.5 Fastenings:
  - .1 Fasten each backboard to a wall or to a support structure using cadmium-plated hardware. Provide a flat washer under the head of each fastener. Recess the head of the mounting bolt where equipment, including future equipment, is to be installed.

- .2 Use expansion shields, toggle bolts or other types of wall fastenings to suit the wall type. Align the mounting bolts with the wall studs for stud type walls.
- .3 Install fastenings to a maximum 500 mm apart in both the vertical and horizontal directions.
- .4 When installing equipment heavier than 50 kg, fasten the equipment through the backboard directly to the wall or support structure.

### **2.15 Elevators, Lifts and Escalators**

- 2.15.1 A single fusible disconnect switch (or breaker) with means for locking it in the open position shall be provided for the following in each machine room or control room:
  - .1 At least one branch circuit for the car light.
  - .2 Branch circuit for the drive motor.
- 2.15.2 The disconnecting means shall be located where it is visible on entry to the machine room and readily accessibly to authorized persons.
- 2.15.3 Only conductors used in connection with operation of the elevator, lift or escalator shall be permitted to be installed in hoistways, machine room, etc.
- 2.15.4 Provide GFCI receptacle (CSA-5-20RA) in each machine room, hoistway and hoistway pit.
- 2.15.5 Provide Lighting and emergency lighting in each machine room, hoistway and hoistway pit.
- 2.15.6 Provide Fire Alarm smoke/heat detectors in each machine room, top of hoistway, elevator lobbies and fire alarm notification of alarms to each elevator from CACF.
- 2.15.7 Provide generator running notification to each elevator.
- 2.15.8 Provide 35 mm conduit 4 CAT6 UTP cables to each mechanic room for telephong, CATV, CCTV and access control from main command and or demarcation room.
- 2.15.9 Coordinate with elevator contractor for installation of all required sleeving between machine room and hoistway prior to rough-ins. Provide a minimum of 3 – 75 mm conduits.

## **3 . EXECUTION**

### **3.1 Installation**

- 3.1.1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- 3.1.2 Do overhead and underground systems in accordance with CSA C22.3 No.1 except where specified otherwise.

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**3.2 Nameplates and Labels**

- 3.2.1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

**3.3 Location of Devices**

- 3.3.1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- 3.3.2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- 3.3.3 Change location of devices at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- 3.3.4 Locate light switches on latch side of doors.
- 3.3.5 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

**3.4 Mounting Heights**

- 3.4.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- 3.4.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- 3.4.3 Install electrical equipment at following heights unless indicated otherwise.
- .1 Local switches: 1070mm (42") above floor (on centre) or as noted on drawing.
  - .2 Wall outlets:
  - .3 General: 300mm (12") above floor (on centre) to match existing conditions or as noted on drawing.
  - .4 450mm (18") above floor (on centre) for new builds where there are no existing outlets in space or as noted on drawing.
  - .5 Above countertop: 150mm (6") above tabletop (on centre) or as noted on drawing Above top of continuous baseboard heater: 250 mm.
    - .1 Above top of counters or counter splash backs: 250 mm.
    - .2 In mechanical rooms: 1070mm (42") above floor (on centre).
  - .6 Panelboards: 1800 mm to top or as required by Code or as indicated.
  - .7 Communications outlets: 300 mm above floor (on centre) to match existing conditions or as noted on drawing

- .8 Communications outlets: 450 mm(18") above floor (on centre) for new builds where there are no existing outlets in space or as noted on drawing.
- .9 Wall mounted telephone and interphone outlets: 1070mm (42") above floor (on centre) or as noted on drawing.
- .10 Fire alarm manual stations: not less than 1200 mm to top of device.
- .11 Audible signal devices: not less than 2300mm and shall maintain 150mm clearance from the ceiling. Fire Visible Signal Device: not less than 2000mm (96") or 300mm (12") below finished ceiling or as noted. Whichever is lower..
- .12 Fire fighter handset: not less than 1350 mm and not more than 1500 mm to centre of device.
- .13 Fire alarm end of line resistors: less than 1800 mm to centre of device.
- .14 Annunciator: not more than 1800 mm to top of display.
- .15 Wall-mounted emergency lighting heads: 2.35 m.

### **3.5 Coordination of Protective Devices**

- 3.5.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

### **3.6 Field Quality Control**

#### **3.6.1 Load Balance:**

- .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
- .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- .3 Provide upon completion of work, load balance report as directed in PART 1 - SUBMITTALS: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.

#### **3.6.2 Conduct following tests:**

- .1 Power generation and distribution system including phasing, voltage, grounding and load balancing.
- .2 Circuits originating from branch distribution panels.
- .3 Lighting and its control.
- .4 Emergency lighting levels.

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- .5 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
  - .6 Systems: fire alarm system.
  - .7 Insulation resistance testing:
    - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
    - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
    - .3 Check resistance to ground before energizing.
  - 3.6.3 Carry out tests in presence of Engineer.
  - 3.6.4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
  - 3.6.5 Manufacturer's Field Services:
    - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
    - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for review of product installation in accordance with manufacturer's instructions.
    - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
  - 3.6.6 Reports:
    - .1 Provide written reports in a timely manner upon completion of testing and load balance. Indicate date and hour tested.
  - 3.7 Cleaning**
    - 3.7.1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
    - 3.7.2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

**END OF SECTION**



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1. **GENERAL**

1.1 **Section Includes**

1.1.1 Materials and installations for Commissioning.

1.2 **Related Sections**

1.2.1 This section of the specification forms part of the contract documents is to be read, interpreted and coordinated with all other parts.

1.3 **References**

1.3.1 Canadian Standards Association (CSA International)

- .1 CSA C22.1 (current edition), Canadian Electrical Code, Part 1.
- .2 Guidelines for Commissioning Systems, ASHRAE (Current Edition).

1.4 **Sustainable Requirements**

1.4.1 Materials and products in accordance with - Sustainable Requirements: Construction.

1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.

1.4.3 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:

- .1 Construction Waste Management / Product Waste Recyclability.
- .2 Recycled Content.
- .3 Local and Regional Materials.

- .4 Certified Wood.
- .5 Construction Indoor Air Quality (IAQ) management.
- .6 VOC/Low-Emitting Materials Compliance.

1.4.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## **1.5 Operating and Maintenance Manuals**

- 1.5.1 Provide operating and maintenance manuals in accordance with the requirements of this section and Section 26 05 00 - Common Work Results - Electrical.
- 1.5.2 Submit the number of manuals as indicated.
- 1.5.3 Provide the services of electricians, manufacturer's representatives and technicians required to provide information which is necessary for the manuals. Note that a substantial completion certificate will not be issued until such a time as the manuals have been submitted in their final accepted form.
- 1.5.4 Operating and maintenance data shall be submitted to the Engineer for review. A list of comments will be generated and returned to the Trade Contractor as necessary. This process will continue until the manuals are acceptable to the Engineer.
- 1.5.5 The manuals shall be set up by the specification section. Provide all information appropriate for each section.
  - .1 Review Certificates.
  - .2 Letter of Guarantee.
  - .3 List of Suppliers and Contacts.
  - .4 Single Line Diagrams.
  - .5 Distribution Panels.
  - .6 Bus Duct.
  - .7 Lighting and Power Panels.
  - .8 System Coordination and Arc Flash.
  - .9 Lighting Systems including fixtures, ballasts, lamps.
  - .10 Switching and Dimming Systems.
  - .11 Wiring Devices.
  - .12 Fire Alarm Systems.
  - .13 Specialties.

## **1.6 Data for Operating and Maintenance Manuals**

- 1.6.1 Only data associated with actually installed systems should be included in Operating and Maintenance Manuals.
- 1.6.2 Include in operations and maintenance data:

- .1 Details of design elements, construction features, component function and maintenance requirements, to permit effective start up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.
- .2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature is not acceptable.
- .3 Wiring and schematic diagrams and performance curves.
- .4 Names and addresses of local suppliers for items included in maintenance manuals.
- .5 Copy of reviewed shop drawings.
- .6 Copies of all certificates including:
  - .1 Electrical Safety Authority (ESA) final certificate,
  - .2 Life safety systems verification certificate and test,
  - .3 Commissioning reports.

## **1.7      General Tests**

- 1.7.1 Conduct and pay for tests of the following systems:
  - .1 Power distribution systems.
  - .2 All circuits, including power, data, control and communications circuits.
  - .3 Lighting and associated controls.
  - .4 Provide two Infrared Thermo Scans of the entire new and existing normal and emergency power electrical distribution systems. The schedule for the first scan to be completed is at building turn over and the second scan shall be conduct at the ten month point. Submit three copies of test results.
  - .5 Motors, heaters and associated control equipment.
  - .6 All systems.
- 1.7.2 Give sufficient prior notice to the Engineer of the proposed time of the tests so that he can be represented at the tests if he so decides. Submit all test reports in triplicate to the Engineer for his review and records.
- 1.7.3 Submit test results with all operation and maintenance data.
- 1.7.4 Test all systems in accordance with details in appropriate sections.
- 1.7.5 Testing methods and test results shall be in accordance with CSA, the Electrical Code and regulations of the supply authority, other authorities having jurisdiction and in accordance with other sections of these Specifications.

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- 1.7.6 Remove and replace with new materials all conductors that are found to be shorted or grounded.
- 1.7.7 Do di-electric tests, hi pot tests in the factory and, insulation resistance tests and ground continuity tests as required by the nature of the various systems and equipment on site.
- 1.7.8 With the systems completely connected and lamped, the following tests shall be made:
- .1 Control and Switching: Test all circuits for the correct operation of devices, switches and controls.
  - .2 Polarity Tests: Test all circuits for the correct operation of devices, switches and controls.
  - .3 Voltage Tests: Make a voltage test at the last outlet of each circuit. The maximum drop in potential permitted will be 3% on 120 V, 208 V and 600 V branch circuits, 2% on 208 V and 600 V feeder circuits and 2% on feeder circuits serving Motor Control Centres. Correct any deficiency in this regard.
  - .4 Phase Balance: Measure the load on each phase at each switchboard, splitter, distribution panel, lighting panel and power panel and report the results in writing to the Engineer. Re arrange phase connections as necessary to balance the load on each phase as instructed by the Engineer, with the re arrangement being restricted to the exchanging of connections at the distribution points mentioned in this paragraph. After making any such changes, update the record drawings and as-built drawings to show the modified connections.
  - .5 Supply Voltage: Measure the line voltage of each phase at the load terminals of the main breakers and report the results in writing to the Engineer. This test shall be carried out with the majority of electrical equipment in use.
  - .6 Motor Loading: Measure the line current of each phase of each motor with the motor operating under load and report the results in writing to the Engineer. Upon indication of any imbalance or overload, thoroughly examine the electrical connections and rectify any defective parts or wiring. If electrical connections are correct, overloads due to defects in the driven machines shall be reported in writing to the Engineer.
  - .7 General Operations: Energize and put into operation each and every electrical circuit and item. Make repairs, alterations, replacements, tests and adjustments necessary for a complete and satisfactory operating electrical system.
- 1.7.9 Test all systems and obtain written confirmation from the manufacturer of each system that all components have been installed correctly and that the system is functioning properly.

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Present separate certification for all systems: fire alarm, power distribution, IPC units, etc., to the Engineer.

1.7.10 Provide labour, instruments, apparatus and pay all expenses required for the tests. The Engineer reserves the right to demand proof of the accuracy of all instruments used.

1.7.11 When the tests are performed, the Engineer may require that equipment, outlets, devices, etc., be opened and/or removed from their housings and/or outlet boxes in order that the interior of the equipment and wiring terminations and connections may be examined. Provide all labour and tools for this purpose.

1.7.12 The testing of motors shall be coordinated with the trades providing the equipment driven by the motors so that they are carried out at the time the driven equipment is put on test. In addition to the tests called for in motor loading above, provide labour and instruments to take and record all motor load readings required to supplement the tests on the driven equipment through various load sequences, as required by the trades involved.

1.7.13 600 Volt Vacuum Circuit Breaker:

- .1 Conduct Visual and Mechanical Review:
  - .1 Inspect the frame, covers and conductors for proper mounting and alignment.
  - .2 Check cell fit and element alignment and proper operation of racking interlocks.
  - .3 Verify proper nameplate data to drawings and specifications.
  - .4 Inspect the insulating supports, bushings, operating links and barriers for potential shipping or installation damage.
  - .5 Check mechanical operation by manual closing and tripping. Verify proper latching and smooth operation.
  - .6 Breaker shall be closed and opened several times to assure free movement of all parts and correct mechanical sequence.
  - .7 Verify operation of cell interlocks, undervoltage trip (if exists), operations counter, the close-open indicator, anti-pumping relay and the spring charge indicator. Control wiring connections shall be checked.
  - .8 Primary disconnect fingers shall be inspected for proper alignment and lubricated with an oxidation inhibiting grease.
- .2 Complete the following Electrical Testing:

- .1 Measure contact resistance for each phase with a micro-ohmmeter and compare these values to adjacent poles and similar breakers.
- .2 Measure insulation resistance at the appropriate test value, each pole to ground, between phases and across open contacts of each phase with a DC test potential.
- .3 Verify proper operation including spring charge motor, closing operation, shunt trip and ground fault operation.
- .4 Verify operation by control switch and protective relays.
- .5 Test the trip unit by secondary current injection, if applicable.

1.7.14 HV (15,000 V) Primary Switchgear Assemblies:

- .1 Conduct Visual and Mechanical Review:
  - .1 Inspect the switch and enclosure for physical and mechanical condition.
  - .2 Inspect the switch, bus, and cable terminations for proper connections.
  - .3 Inspect the switch contacts. Check for smooth movement, proper alignment and flicker blade operation per manufacturer's procedures.
  - .4 Verify that any mechanical and key interlock schemes function as intended.
  - .5 Verify equipment ground connection.
  - .6 Compare equipment nameplate data with drawings and specifications.
  - .7 Verify proper phase barrier materials and installation.
  - .8 Inspect all indicating devices for proper operation.
  - .9 Clean and lubricate the operating mechanism and blade contact surfaces as required.
  - .10 Clean the switch, bus and support insulators by vacuuming and wiping. Some components may be cleaned with a manufacture approved electrical solvent.
- .2 Complete the following Electrical Testing:
  - .1 Measure contact resistance for each phase.
  - .2 Measure the fuse resistance.
  - .3 Measure insulation resistance at the appropriate test value, each pole to ground, between phases and across open contacts of each phase.
- .3 Complete the following Electrical Testing:

- .1 Measure insulation resistance at the appropriate test value.
- .2 Confirm starter operation On - Off - Hand.
- .3 Confirm current draw under normal operations condition.
- .4 Confirm current operation of all interlocks.

**1.7.15 600 Volt Switchgear and Switchboard Assemblies:**

- .1 Conduct Visual and Mechanical Review:
  - .1 Inspect panels, doors and latches for fit, dents, corrosion and missing hardware.
  - .2 Inspect insulators and barriers for contamination and broken parts.
  - .3 Check for proper operation of key interlock devices.
  - .4 Check breaker racking mechanisms, if applicable, for smooth movement, full travel and position indicator operation. Clean and lubricate per manufacturer=s guidelines.
  - .5 Check for proper shutter operation and position indicator operation.
  - .6 Inspect load cable termination for signs of overheating or deterioration.
  - .7 Inspect physical condition of PT's and CT's. Check for smooth draw-out movement and proper contact operation.
  - .8 Check that indicating lights are functional.
  - .9 Verify proper operation of digital metering systems.
  - .10 Clean cells, insulators and bus by vacuuming and wiping de-energized sections only.
  - .11 Check accessible bus connections with torque wrench or low-resistance ohmmeter.
- .2 Complete the following Electrical Testing:
  - .1 Test the bus insulation integrity by insulation resistance tests.
  - .2 Test for proper control power voltage.
  - .3 Test switchgear ground and bonding connections.
  - .4 Test protective relays.
  - .5 Verify proper tripping operation of breakers using protective devices.
  - .6 Test Ammeters and Voltmeters by applying appropriate signals.

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- .7 Check CT's and PT's for proper ratio.
- 1.7.16 HV – 600 V Volt Power Transformers:
- .1 Conduct Visual and Mechanical Review:
    - .1 With case covers removed, vacuum, cloth wipe and/or brush major insulating surfaces.
    - .2 Clean contacts and terminations by brushing, cloth wipe and applying electrical joint compound.
    - .3 Compare equipment nameplate data to drawings and specifications.
    - .4 Check primary, secondary and ground connections.
    - .5 Check tap connections and tap changer.
    - .6 Check tightness of all bolted connections.
    - .7 Verify that shipping brackets or fixtures have been removed or free.
    - .8 Check for loose iron and damaged coils.
    - .9 Inspect insulation.
    - .10 Inspect for loose mounting and support.
    - .11 Inspect for adequate electrical clearance.
    - .12 Inspect accessories when used.
    - .13 Verify proper core grounding.
    - .14 Verify proper equipment grounding.
    - .15 Verify that the tap changer is set at the specified ratio.
  - .2 Complete the following Electrical Testing:
    - .1 Perform an insulation resistance test using a megohmmeter at the appropriate test level on the transformer windings high to low and ground, low to high and ground, and high to low to ground.
    - .2 Perform a Turns Ratio Test on all three phases and at all tap settings.
    - .3 Check proper operation of fans and alarms.
    - .4 Perform an insulation resistance test on the core ground at the appropriate test level using a megohmmeter.
- 1.7.17 600 Volt Distribution Transformers:
- .1 Conduct Visual and Mechanical Review:
    - .1 With case covers removed, vacuum, cloth wipe and/or brush major insulating surfaces.
    - .2 Clean contacts and terminations by brushing, cloth wipe and applying electrical joint compound.



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- .3 Compare equipment nameplate data to drawings and specifications.
  - .4 Check primary, secondary and ground connections.
  - .5 Check tap connections and tap changer.
  - .6 Check tightness of all bolted connections.
  - .7 Verify that shipping brackets or fixtures have been removed or free.
  - .8 Check for loose iron and damaged coils.
  - .9 Inspect insulation.
  - .10 Inspect for loose mounting and support.
  - .11 Check for frame damage.
  - .12 Inspect for adequate electrical clearance.
  - .13 Inspect accessories when used.
  - .14 Verify proper core grounding.
  - .15 Verify proper equipment grounding.
  - .2 Complete the following Electrical Testing:
    - .1 Perform an insulation resistance test using a megohmmeter at the appropriate test level on the transformer windings high to low and ground, low to high and ground, and high to low to ground.
    - .2 Perform a Turns Ratio Test on all three phases and at all tap settings.
    - .3 Perform an insulation resistance test on the core ground at the appropriate test level using a megohmmeter.
- 1.7.18 Surge Protection Device (SPD)
- .1 Formally known as a Transient Voltage Surge Suppression (TVSS)
  - .2 Conduct Visual and Mechanical Review:
    - .1 As per Section.
  - .3 Complete the following Electrical Testing:
    - .1 As per Section.
- 1.7.19 Grounding Systems
- .1 Conduct Visual and Mechanical Review:
    - .1 As per Section.
  - .2 Complete the following Electrical Testing:
    - .1 As per Section.
- 1.7.20 Metering
- .1 Conduct Visual and Mechanical Review:
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- .1 As per Section.
    - .2 Complete the following Electrical Testing:
      - .1 As per Section.
  - 1.7.21 Generator
    - .1 Conduct Visual and Mechanical Review:
      - .1 As per Section.
    - .2 Complete the following Electrical Testing:
      - .1 As per Section.
  - 1.7.22 Static Uninterruptible Power Supply
    - .1 Conduct Visual and Mechanical Review:
      - .1 As per Section.
    - .2 Complete the following Electrical Testing:
      - .1 As per Section.
  - 1.7.23 Emergency Lighting
    - .1 Conduct Visual and Mechanical Review:
      - .1 As per Section
    - .2 Complete the following Electrical Testing:
      - .1 As per Section.
  - 1.7.24 Lighting Controls – Occupancy Based
    - .1 Conduct Visual and Mechanical Review:
      - .1 As per Section.
    - .2 Complete the following Electrical Testing:
      - .1 As per Section.
  - 1.7.25 Lighting Controls – Photoelectric Based
    - .1 Conduct Visual and Mechanical Review:
      - .1 As per Section.
    - .2 Complete the following Electrical Testing:
      - .1 As per Section.
  - 1.7.26 Lighting Controls – Centralized Systems
    - .1 Conduct Visual and Mechanical Review:
      - .1 As per Section.
    - .2 Complete the following Electrical Testing:
      - .1 As per Section.
  - 1.7.27 Fire Alarm Systems
    - .1 Conduct Visual and Mechanical Review:
      - .1 As per Section.
    - .2 Complete the following Electrical Testing:
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.1 As per Section.

1.7.28 Communication Systems

.1 Conduct Visual and Mechanical Review:

.1 As per Section.

.2 Complete the following Electrical Testing:

.1 As per Section.

**1.8 Building Turn Over**

1.8.1 Provide labour, material, tools, etc., required to building turn over the electrical systems in the presence of the Engineer and the Owner.

1.8.2 Operate all systems and demonstrate how they conform with specifications. Under supervision, make adjustments and fine tune systems.

**1.9 Care, Operation, Start-Up and Training of Owner's Personnel**

1.9.1 Instruct operating personnel in operation, care and maintenance of equipment.

1.9.2 Arrange and pay for services of manufacturer's factory service representative to supervise start-up of installation, check, adjust, balance and calibrate components.

1.9.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

**1.10 Single Line Electrical Diagrams**

1.10.1 Provide single line diagrams in glazed frame of the Electrical distribution system. Locate in main Electrical Room and all other electrical rooms. The single line diagram shall be an up to date drawing of the new system distribution.

**1.11 Integration with BMS**

1.11.1 Supply and install BACnet IP certified interface.

1.11.2 Provide all wiring and devices required for the installation, programming, commissioning and documents of commissioning to prove correct circuitry and performance.

**1.12 Training of Owner Personnel**

1.12.1 General:

.1 Detailed information regarding contents, duration and instructors for any particular building system is included in Specification Section 01 91 00 – General Commissioning Requirements.

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1.12.2 Trade Contractor:

- .1 The trade contractor shall have the following training responsibilities:
  - .1 Provide the **Engineer** with a training plan two weeks before the planned training according to the outline described in Section 01 91 0 – General Commissioning Requirements.
  - .2 Provide designated Owner Representative with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of commissioned electrical equipment or system.
  - .3 Training shall start with classroom sessions, if necessary, followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including start-up, shutdown, fire/smoke alarm, power failure, etc.
  - .4 During any demonstration, should the system fail to perform in accordance with the requirements of the O&M Manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
  - .5 The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing trade contractor or manufacturer's representative. Practical building operating expertise, as well as in-depth knowledge of all modes of operation of the specific piece of equipment, is required.
  - .6 The training sessions shall follow the outline in the Table of Contents of the O&M Manual and illustrate wherever possible the use of the O&M Manual for reference.
  - .7 Training shall include:
    - .1 Use the printed installation, operation and maintenance instruction material included in the O&M Manuals.
    - .2 Include a review of the written O&M manual instructions, emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shutdown,

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- seasonal changeover and any emergency procedures.
  - .3 Discuss relevant health and safety issues and concerns.
  - .4 Discuss warranties and guarantees.
  - .5 Cover common troubleshooting problems and solutions.
  - .6 Explain information included in the O&M manuals and the location of all plans and manuals in the facility.
  - .7 Discuss any peculiarities of equipment installation or operation.
  - .8 Classroom sessions shall include the use of overhead projections, slides, and video and audio taped materials as might be appropriate.
  - .8 Hands-on training shall include start-up; operation in all modes possible, including manual; shutdown; and any emergency procedures and maintenance of all pieces of equipment.
  - .9 The trade contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.
  - .10 Training shall occur after functional testing is complete, unless approved otherwise by the Project Manager.
  - .2 Duration of Training:
    - .1 The trade contractor shall provide training on each piece of equipment.

**END OF SECTION**

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**1.    GENERAL**

**1.1    Section Includes**

1.1.1    Materials and installation for Short Circuit and Arc Flash Analysis

**1.2    Related Sections**

1.2.1    This section of the specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

**1.3    References**

1.3.1    Institute of Electrical and Electronics Engineers, Inc. (IEEE):

- .1        IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
- .2        IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
- .3        IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis
- .4        IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings
- .5        IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
- .6        IEEE 1584 -Guide for Performing Arc-Flash Hazard Calculations

1.3.2    American National Standards Institute (ANSI):

- .1        ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
- .2        ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
- .3        ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
- .4        ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.

1.3.3    The National Fire Protection Association (NFPA)

- .1        NFPA 70 -National Electrical Code, latest edition
- .2        NFPA 70E – Standard for Electrical Safety in the Workplace

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**1.4 Sustainable Requirements**

- 1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.
- 1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.
- 1.4.3 Waste Management and Disposal
- .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
  - .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
  - .3 Place materials defined as hazardous or toxic waste in designated containers.
- 1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:
- .1 Construction Waste Management / Product Waste Recyclability.
  - .2 Recycled Content.
  - .3 Local and Regional Materials.
  - .4 Certified Wood.
  - .5 Construction Indoor Air Quality (IAQ) management.
  - .6 VOC/Low-Emitting Materials Compliance.
- 1.4.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

**1.5 Submittals**

- 1.5.1 The studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the study may cause delays in equipment shipments, approval from the Engineer may be obtained for a preliminary submittal of data to ensure that the selection of device ratings and characteristics will be satisfactory to properly select the distribution equipment. The formal study will be provided to verify preliminary findings.

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**1.6 Submittals for Construction**

1.6.1 The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. A minimum of five (5) bound copies of the complete final report shall be submitted. For large system studies, submittals requiring more than five (5) copies of the report will be provided without the section containing the computer printout of the short-circuit input and output data. Electronic PDF copies of the report shall be provided upon request.

1.6.2 The report shall include the following sections:

- .1 Executive Summary including Introduction, Scope of Work and Results/Recommendations.
- .2 Short-Circuit Methodology Analysis Results and Recommendations
- .3 Short-Circuit Device Evaluation Table
- .4 Protective Device Coordination Methodology Analysis Results and recommendations
- .5 Protective Device Settings Table
- .6 Time-Current Coordination Graphs and Recommendations
- .7 Arc Flash Hazard Methodology Analysis Results and Recommendations including the details of the incident energy and flash protection boundary calculations, along with Arc Flash boundary distances, working distances, Incident Energy levels and Personal Protection Equipment levels.
- .8 Arc Flash Labeling section showing types of labels to be provided. Section will contain descriptive information as well as typical label images.
- .9 One-line system diagram that shall be computer generated and will clearly identify individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location, device numbers used in the time-current coordination analysis, and other information pertinent to the computer analysis.

**1.7 Qualifications**

1.7.1 The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the responsible charge and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.



- 1.7.2 The Registered Professional Electrical Engineer shall be an employee of the equipment manufacturer or an approved engineering firm.
- 1.7.3 The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.
- 1.7.4 The approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analyses it has performed in the past year.
- 1.7.5 The engineering firm shall have a minimum of twenty-five (25) years experience in performing power system studies.

**1.8 Description of System**

- 1.8.1 The trade contractor shall furnish short-circuit and protective device coordination studies.
- 1.8.2 The trade contractor shall furnish an Arc Flash Hazard Analysis Study per the requirements set forth in the current version of NFPA 70E -Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE Standard 1584 – 2002, the IEEE Guide for Performing Arc-Flash Calculations.
- 1.8.3 The scope of the studies shall include new distribution equipment supplied by trade contractor under this contract and engineering services by the Vendor.

**2 . PRODUCT**

**2.1 Studies**

- 2.1.1 The trade contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E -Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D. This study shall also include short-circuit and protective device coordination studies. All studies to be prepared by approved vendor.

**2.2 Data**

- 2.2.1 Trade Contractor shall furnish all data as required for the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Trade Contractor with a listing of required data immediately after award of the contract. The Trade Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

- 2.2.2 Source combination may include present and future motors and generators.
- 2.2.3 Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner, or Trade Contractor.
- 2.2.4 If applicable, include fault contribution of existing motors in the study. The Trade Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

## **2.3 Short Circuit Analysis**

- 2.3.1 Transformer design impedances shall be used when test impedances are not available.
- 2.3.2 Provide the following:
  - .1 Calculation methods and assumptions
  - .2 Selected base per unit quantities
  - .3 One-line diagram of the system being evaluated that clearly identifies individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location and other information pertinent to the computer analysis
  - .4 The study shall include input circuit data including electric utility system characteristics, source impedance data, conductor lengths, number of conductors per phase, conductor impedance values, insulation types, transformer impedances and X/R ratios, motor contributions, and other circuit information as related to the short-circuit calculations.
  - .5 Tabulations of calculated quantities including short-circuit currents, X/R ratios, equipment short-circuit interrupting or withstand current ratings and notes regarding adequacy or inadequacy of the equipment rating.
  - .6 Results, conclusions, and recommendations. A comprehensive discussion section evaluating the adequacy or inadequacy of the equipment must be provided and include recommendations as appropriate for improvements to the system.
- 2.3.3 For solidly-grounded systems, provide a bolted line-to-ground fault current study for applicable buses as determined by the engineer performing the study.

## **2.4 Protective Device Evaluation:**

- 2.4.1 Evaluate equipment and protective devices and compare to short circuit ratings

- 2.4.2 Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses
- 2.4.3 Vendor shall notify Owner in writing, of any circuit protective devices improperly rated for the calculated available fault current.

**2.5 Protective Device Time Current Coordination Analysis**

- 2.5.1 Protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.
- 2.5.2 Include on each TCC graph, a complete title with descriptive device names.
- 2.5.3 Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
- 2.5.4 Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
- 2.5.5 Plot the following characteristics on the TCC graphs, where applicable:
  - .1 Electric utility's overcurrent protective device
  - .2 Medium voltage equipment overcurrent relays
  - .3 Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands
  - .4 Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands
  - .5 Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves
  - .6 Medium voltage conductor damage curves
  - .7 Ground fault protective devices, as applicable
  - .8 Pertinent motor starting characteristics and motor damage points, where applicable
  - .9 Pertinent generator short-circuit decrement curve and generator damage point
  - .10 The largest feeder circuit breaker in each motor control center and applicable panelboard.
- 2.5.6 Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.
- 2.5.7 Provide the following:
  - .1 A One-line diagram shall be provided which clearly identifies individual equipment buses, bus numbers, device identification numbers and the maximum available short-circuit current at each bus when known.

- .2 A sufficient number of log-log plots shall be provided to indicate the degree of system protection and coordination by displaying the time-current characteristics of series connected overcurrent devices and other pertinent system parameters.
- .3 Computer printouts shall accompany the log-log plots and will contain descriptions for each of the devices shown, settings of the adjustable devices, and device identification numbers to aid in locating the devices on the log-log plots and the system one-line diagram.
- .4 The study shall include a separate, tabular printout containing the recommended settings of all adjustable overcurrent protective devices, the equipment designation where the device is located, and the device number corresponding to the device on the system one-line diagram
- .5 A discussion section which evaluates the degree of system protection and service continuity with overcurrent devices, along with recommendations as required for addressing system protection or device coordination deficiencies.
- .6 Square D shall notify Owner in writing of any significant deficiencies in protection and/or coordination. Provide recommendations for improvements.

## **2.6 Arc Flash Hazard Analysis**

- 2.6.1 The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D. The arc flash hazard analysis shall be performed in conjunction with the short-circuit analysis (Section 2.03) and the protective device time-current coordination analysis (Section 2.04)
- 2.6.2 The flash protection boundary and the incident energy shall be calculated at significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.
- 2.6.3 Circuits 240V or less where available bolted short circuit current is less than 10 kA may be omitted from the computer model and will be assumed to have a hazard risk category 0 per NFPA 70E Table 130.7(C)(9)(a), including footnote 3.
- 2.6.4 Circuits 240V or less fed by transformers 112.5 kVA or less may be omitted from the computer model and will be assumed to have a hazard risk category 0 per IEEE 1584.
- 2.6.5 Working distances shall be based on IEEE 1584. The calculated arc flash protection boundary shall be determined using those working distances.

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- 2.6.6 When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations
- 2.6.7 The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location in a single table. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum. Conversely, the maximum calculation will assume a maximum contribution from the utility. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable as well as any stand-by generator applications.
- 2.6.8 The Arc-Flash Hazard Analysis shall be performed utilizing mutually agreed upon facility operational conditions, and the final report shall describe, when applicable, how these conditions differ from worst-case bolted fault conditions.
- 2.6.9 The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors should be decremented as follows:
- .1 Fault contribution from induction motors should not be considered beyond 5 cycles.
- 2.6.10 For each piece of ANSI rated equipment with an enclosed main device, two calculations shall be made. A calculation shall be made for the main cubicle, sides, or rear; and shall be based on a device located upstream of the equipment to clear the arcing fault. A second calculation shall be made for the front cubicles and shall be based on the equipment's main device to clear the arcing fault. For all other non-ANSI rated equipment, only one calculation shall be required and it shall be based on a device located upstream of the equipment to clear the arcing fault.
- 2.6.11 When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
- 2.6.12 Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest

device to compute the incident energy for the corresponding location.

2.6.13 Arc Flash calculations shall be based on actual overcurrent protective device clearing time. A maximum clearing time of 2 seconds will be used based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

2.6.14 Provide the following:

- .1 Results of the Arc-Flash Hazard Analysis shall be submitted in tabular form, and shall include device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, working distances, personal-protective equipment classes and AFIE (Arc Flash Incident Energy) levels.
- .2 The Arc-Flash Hazard Analysis shall report incident energy values based on recommended device settings for equipment within the scope of the study.
- .3 The Arc-Flash Hazard Analysis may include recommendations to reduce AFIE levels and enhance worker safety.
- .4 Provide a copy of the arc flash report to the owner.

### **3 . EXECUTION**

#### **3.1 Field Adjustment**

- 3.1.1 Trade Contractor shall adjust relay and protective device settings according to the recommended settings table provided by the coordination study.
- 3.1.2 Trade Contractor shall make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- 3.1.3 Vendor shall notify Owner in writing of any required major equipment modifications.

#### **3.2 Arc Flash Labels**

- 3.2.1 Trade Contractor shall provide a 4.0 in. x 4.0 in. Brady thermal transfer type label of high adhesion polyester for each work location analyzed.
- 3.2.2 The labels shall be designed according to the following standards:
  - .1 UL969 – Standard for Marking and Labeling Systems
  - .2 ANSI Z535.4 – Product Safety Signs and Labels

- .3 NFPA 70 (National Electric Code) – Article 110.16
- 3.2.3 The label shall include the following information:
  - .1 System Voltage
  - .2 Flash protection boundary
  - .3 Personal Protective Equipment category
  - .4 Arc Flash Incident energy value (cal/cm<sup>2</sup>)
  - .5 Limited, restricted, and prohibited Approach Boundaries
  - .6 Study report number and issue date
- 3.2.4 Labels shall be printed by a thermal transfer type printer, with no field markings.
- 3.2.5 Arc flash labels shall be provided for equipment as identified in the study and the respective equipment access areas per the following:
  - .1 Floor Standing Equipment - Labels shall be provided on the front of each individual section. Equipment requiring rear and/or side access shall have labels provided on each individual section access area. Equipment line-ups containing sections with multiple incident energy and flash protection boundaries shall be labeled as identified in the Arc Flash Analysis table.
  - .2 Wall Mounted Equipment – Labels shall be provided on the front cover or a nearby adjacent surface, depending upon equipment configuration.
  - .3 General Use Safety labels shall be installed on equipment in coordination with the Arc Flash labels. The General Use Safety labels shall warn of general electrical hazards associated with shock, arc flash, and explosions, and instruct workers to turn off power prior to work.
- 3.2.6 Labels shall be field installed by Trade Contractor. The technician providing the installation shall have completed an 8-Hour instructor led Electrical Safety Training Course with includes NFPA 70E material including the selection of personal protective equipment.

### **3.3 Arc Flash Training**

- 3.3.1 The vendor supplying the Arc Flash Hazard Analysis shall train the owner's qualified electrical personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET) or equivalent. The trainer shall be an authorized OSHA Outreach instructor. The cost of training shall be included in electrical tender bid.
- 3.3.2 The vendor supplying the Arc Flash Hazard Analysis shall offer instructor led and online NFPA 70E training classes.

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**END OF SECTION**



## **1. GENERAL**

### **1.1 Section Includes**

1.1.1 Materials and installation for wire and box connectors.

### **1.2 Related Sections**

1.2.1 This section of the specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

1.2.2 Section 01 74 00 – Cleaning and Waste Management.

### **1.3 References**

1.3.1 Canadian Standards Association (CSA International):

- .1 CAN/CSA-C22.1 (current edition), Canadian Electrical Code, Part 1.
- .2 CAN/CSA-C22.2No.18 (current edition), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
- .3 CSA C22.2No.65 (current edition), Wire Connectors.

1.3.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC):

- .1 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1,200 Ampere Maximum Rating).

1.3.3 National Electrical Manufacturers Association (NEMA).

### **1.4 Sustainable Requirements**

1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.

1.4.2 Do verification requirements in accordance with Section Sustainable Requirements: Contractor's Verification.

1.4.3 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be

fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:

- .1 Construction Waste Management / Product Waste Recyclability.
- .2 Recycled Content.
- .3 Local and Regional Materials.
- .4 Certified Wood.
- .5 Construction Indoor Air Quality (IAQ) management.
- .6 VOC/Low-Emitting Materials Compliance.

1.4.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## **1.5 Submittals**

1.5.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

1.5.2 Product Data:

- .1 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 47 15 - Sustainable Requirements: Construction and include: product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish

## **1.6 Delivery, Storage and Handling**

1.6.1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.

1.6.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.6.3 Handle materials with suitable lifting equipment.

1.6.4 Store materials in heated, dry, weather-protected enclosure

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## 2 . **PRODUCTS**

### 2.1 **Material**

- 2.1.1 Pressure type wire connectors shall be in accordance with CSA C22.2 No.65, with current carrying parts of cooper sized to fit cooper conductors as required.
- 2.1.2 Fixture type splicing connectors to shall be in accordance with CSA C22.2 No.65, with current carrying parts of cooper sized to fit copper conductors 10 AWG or less.
- 2.1.3 Bushing stud connectors shall be EEMAC 1Y-2 to consist of:
  - .1 Connector body and stud clamp for stranded copper conductors.
  - .2 Clamp for stranded copper conductors to bar.
  - .3 Clamp for conductors
  - .4 Stud clamp bolts.
  - .5 Bolts for copper conductors
  - .6 Bolts for aluminum conductors
  - .7 Sized for conductors as indicated.
- 2.1.4 Clamps or connectors for aluminum sheathed cable mineral insulated cable flexible conduit, non-metallic sheathed cable as required shall be in accordance with CAN/CSA-C22.2 No.18.

## 3 . **EXECUTION**

### 3.1 **Installation**

- 3.1.1 Remove insulation carefully from ends of conductors and:
  - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
  - .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.
  - .3 Install fixture type connectors and tighten. Replace insulating cap.
  - .4 Install bushing stud connectors in accordance with EEMAC 1Y-2

### 3.2 **Maintenance – Clearances**

- 3.2.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

**3.3 Cleaning**

- 3.3.1 Proceed in accordance with Section 01 74 00 Cleaning and waste management.
- 3.3.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**1. GENERAL**

**1.1 Section Includes**

- 1.1.1 Materials and installation for Wires and Cables (0 – 1,000 V)

**1.2 Related Sections**

- 1.2.1 This section of the specification forms part of the contract documents and is to be read, interpreted, and coordinated with all other parts.

**1.3 References**

- 1.3.1 Canadian Standards Association (CSA International)  
.1 CSA C22.1 (current edition), Canadian Electric Code, Part 1.

**1.4 Sustainable Requirements**

- 1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.
- 1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.
- 1.4.3 Waste Management and Disposal
- .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.
- 1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:
- .1 Construction Waste Management / Product Waste Recyclability.
- .2 Recycled Content.
- .3 Local and Regional Materials.
- .4 Certified Wood.
- .5 Construction Indoor Air Quality (IAQ) management.

.6 VOC/Low-Emitting Materials Compliance.

1.4.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## **1.5 Submittals**

1.5.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

1.5.2 Product Data:

- .1 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 47 15 - Sustainable Requirements: Construction and include: product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish
- .3 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.

## **1.6 Delivery, Storage and Handling**

- 1.6.1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- 1.6.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- 1.6.3 Handle materials with suitable lifting equipment.
- 1.6.4 Store materials in heated, dry, weather-protected enclosure

## **1.7 Acceptable Manufactures**

- 1.7.1 Canda Wire
- 1.7.2 General Wire
- 1.7.3 Pirelli
- 1.7.4 United Wire and Cable
- 1.7.5 Or approved equal

## **2 . PRODUCTS**

### **2.1 Building Wires**

- 2.1.1 Conductors shall be stranded for 10 AWG and larger. Minimum size shall be 12 AWG.

- 2.1.2 All conductors shall be cooper unless otherwise indicated in contract documents.
- 2.1.3 Cooper and aluminum conductors shall be sized as indicated, with 1000 V insulation of cross-linked thermosetting polyethylene material rated 75 C.
- 2.1.4 Cooper and aluminum conductors shall be sized as indicated with thermoplastic insulation type TWH rated at 600 V.
- 2.1.5 Neutral supported cable shall be phase (as indicated) insulated conductors of cooper and one neutral conductor of cooper steel reinforced, size as indicated. Type shall be NS75

## **2.2 Teck 90 Cable**

- 2.2.1 Cable shall be in accordance with Section 26 05 00 - Common Work Results for Electrical.
- 2.2.2 Conductors:
  - .1 Grounding conductor shall be cooper as indicated.
  - .2 Circuit conductors shall be cooper as indicated; size as indicated.
- 2.2.3 Insulation:
  - .1 Ethylene propylene rubber EP.
  - .2 Cross-linked polyethylene XLPE.
  - .3 Rating shall be 1000V.
- 2.2.4 Inner jacket shall be polyvinyl chloride material.
- 2.2.5 Armour shall be interlocking.
- 2.2.6 Fastenings:
  - .1 One-hole steel to secure surface cables 50 mm and smaller. Two-hole steel straps for cables larger than 50 mm.
  - .2 Channel type supports for two or more cables at 50 mm centers.
  - .3 Threaded rods shall be 6 mm diameter to support suspended channels.
- 2.2.7 Connectors:
  - .1 Watertight approved for Teck cable.

## **2.3 Mineral-Insulated Cables**

- 2.3.1 Conductors shall be solid bare soft-annealed copper, size as indicated.
- 2.3.2 Insulation shall be compressed powdered magnesium oxide or silicon dioxide to form compact homogeneous mass throughout entire length of cable.

- 2.3.3 Outer covering shall be annealed seamless cooper sheath, Type M1 rated 600 V, 250°C.
- 2.3.4 Overall jacket shall be.
- 2.3.5 Two-hour fire rating.
- 2.3.6 Connectors shall be approved for MI cable.
- 2.3.7 Termination kits shall be field installed approved for MI cable

## **2.4 Armoured Cables**

- 2.4.1 Conductors shall be insulated, cooper, size as indicated.
- 2.4.2 Type shall be AC90.
- 2.4.3 Armour shall be interlocking type fabricated from aluminum strip.
- 2.4.4 Type shall ACWU90 jacket over thermoplastic armour and compliant to applicable Building Code classification for this project wet locations.
- 2.4.5 Connectors shall be anti-short connectors.

## **2.5 Aluminum Sheathed Cable**

- 2.5.1 Conductors shall be cooper size as indicated.
- 2.5.2 Insulation shall be cross linked polyethylene Type RA90 rated 1000V
- 2.5.3 Sheath shall be aluminum applied to form continuous seamless sheath.
- 2.5.4 Outer jacket shall be thermoplastic applied over sheath and to be compliant to applicable Building Code classification for this project.
- 2.5.5 Fastenings for aluminum sheathed cable:
  - .1 One-hole steel straps to secure surface cables 25 mm and smaller. Two-hole steel straps for cables larger than 25 mm. Use aluminum strap only with single conductor cable.
  - .2 Channel type supports for two or more cables at 50 mm centers.
  - .3 Threaded rods shall be 6 mm diameter to support suspended channels.

## **2.6 Control Cables**

- 2.6.1 Type shall be LVT with two soft annealed copper conductors, sized as indicated:
  - .1 Insulation shall be thermoplastic.
  - .2 Sheath shall be thermoplastic jacket.
- 2.6.2 Type shall be low energy 300 V control cable with stranded annealed copper conductors sized as indicated LVT with two soft annealed copper conductors, sized as indicated:



- .1 Insulation shall be TWH.
  - .2 Shielding shall be metallized tapes over each conductor.
  - .3 Overall covering shall be polyethylene jackets, copper strip.
- 2.6.3 Type shall be 600 V stranded annealed copper conductors, sizes as indicated:
- .1 Insulation shall be RW75, TWH, R90 cross-linked polyethylene type.
  - .2 Shielding shall be metalized tapes.
  - .3 Overall covering shall be thermoplastic jacket.

## **2.7 Non-Metallic Sheathed Cable**

- 2.7.1 Non-metallic sheathed cooper cable type shall be NMD90XLPE, size as indicated.

## **3 . EXECUTION**

### **3.1 General Cable Installation**

- 3.1.1 Install cable in trenches in accordance with Section 26 05 43.01 Installation of Cables in Trenches and ducts.
- 3.1.2 Lay cable in cable trays in accordance with Section 26 05 36 - Cable Trays for Electrical Systems.
- 3.1.3 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0 - 1,000 V).
- 3.1.4 Cable Colour Coding shall be in accordance with Section 26 05 00 Common Work Results for Electrical.
- 3.1.5 Conductor length for parallel feeders to be identical.
- 3.1.6 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- 3.1.7 Wiring in walls shall be typical drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- 3.1.8 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be two-wire circuits only, i.e. common neutrals not permitted.
- 3.1.9 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

### **3.2 Installation of Building Wires**

- 3.2.1 Install wiring as follows:

- .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 In underground ducts in accordance with Section 33.
- .3 In underfloor distribution system in accordance with Section 21.
- .4 In cellular floor raceways in accordance with Section 21.
- .5 In surface and lighting fixture raceways in accordance with Section 26.
- .6 In wireways and auxiliary gutters in accordance with Section 21.
- .7 Overhead service conductors in accordance with Section 21.

**3.3 Installation of Teck 90 Cable (0 - 1,000 V)**

- 3.3.1 Group cables wherever possible on channels.
- 3.3.2 Install cable exposed, securely supported by straps or hangers.

**3.4 Installation of Mineral-Insulated Cables**

- 3.4.1 Install cable exposed, securely supported by straps or hangers.
- 3.4.2
- 3.4.3 Support two-hour fire rated cables at 1 m intervals.
- 3.4.4 Make cable terminations by using factory-made kits.
- 3.4.5 Cable terminations: use thermoplastic sleeving over bare conductors.
- 3.4.6 Where cables are buried in cast concrete or masonry, sleeve for entry of cables.
- 3.4.7 Do not splice cables unless indicated.

**3.5 Installation of Armoured Cables**

- 3.5.1 Group cables wherever possible on channels.

**3.6 Installation of Aluminum Sheathed Cable**

- 3.6.1 Group cables wherever possible on channels.

**3.7 Installation of Control Cables**

- 3.7.1 Install control In conduit.
- 3.7.2 Ground control cable shield.

**3.8 Installation of Non-Metallic Sheathed Cable**

- 3.8.1 Install cables.
- 3.8.2 Install straps and box connectors to cables as required.

**3.9 Cleaning**

- 3.9.1 Proceed in accordance with Section 01 74 00 – Cleaning and Waste Management.
- 3.9.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**3.10 Field Quality Control**

- 3.10.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- 3.10.2 Perform 5 tests using method appropriate to site conditions and to approval of Engineer and local authority having jurisdiction over installation.
- 3.10.3 Perform tests before energizing electrical system.

**END OF SECTION**

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**1. GENERAL**

**1.1 Section Includes**

1.1.1 Materials and installation for Wires and Cables (0 – 600 V)

**1.2 Related Sections**

1.2.1 This section of the specification forms part of the contract documents and is to be read, interpreted, and coordinated with all other parts.

**1.3 References**

1.3.1 Canadian Standards Association (CSA International)

- .1 CSA C22.1 (current edition), Canadian Electric Code, Part 1.

**1.4 Sustainable Requirements**

1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.

1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.

1.4.3 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:

- .1 Construction Waste Management / Product Waste Recyclability.
- .2 Recycled Content.
- .3 Local and Regional Materials.
- .4 Certified Wood.
- .5 Construction Indoor Air Quality (IAQ) management.

.6 VOC/Low-Emitting Materials Compliance.

1.4.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## **1.5 Submittals**

1.5.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

1.5.2 Product Data:

- .1 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 47 15 - Sustainable Requirements: Construction and include: product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish
- .3 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.

## **1.6 Delivery, Storage and Handling**

- 1.6.1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- 1.6.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- 1.6.3 Handle materials with suitable lifting equipment.
- 1.6.4 Store materials in heated, dry, weather-protected enclosure

## **1.7 Acceptable Manufacturers**

- 1.7.1 Canada Wire
- 1.7.2 General Wire
- 1.7.3 Pirelli
- 1.7.4 United Wire and Cable
- 1.7.5 Or approved equal.

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## 2 . PRODUCTS

### 2.1 Building Wires

- 2.1.1 All conductors shall be copper unless requested in the contract documents. When indicated only larger than No. 2 AWG can be NUAL.
- 2.1.2 Conductors shall be stranded for 10 AWG and larger. Minimum size shall be 12 AWG.
- 2.1.3 Cooper and aluminum conductors shall be sized as indicated, with 1000 V insulation of cross-linked thermosetting polyethylene material rated 75 C.
- 2.1.4 Cooper and aluminum conductors shall be sized as indicated with thermoplastic insulation type TWH rated at 600 V.

### 2.2 Neutral supported cable shall be phase (as indicated) insulated conductors of cooper and one neutral conductor of cooper steel reinforced, size as indicated. Type shall be NS75 Teck 90 Cable

- 2.2.1 Conductors:
  - .1 Grounding conductor shall be cooper as indicated.
  - .2 Circuit conductors shall be cooper as indicated size as indicated.
- 2.2.2 Insulation:
  - .1 Ethylene propylene rubber EP.
  - .2 Cross-linked polyethylene XLPE.
  - .3 Rating shall be 600 V.
- 2.2.3 Inner jacket shall be polyvinyl chloride material.
- 2.2.4 Armour shall be interlocking.
- 2.2.5 Outer jacket: Sunlight Resistant AG14 Polyvinyl chloride jacket, - 40°C, FT-4 rated suitable for direct burial and suitable for Class 1, Zone 1 and 2, and classes 2, and 3, Division 1 and 2 hazardous locations.
- 2.2.6 Fastenings:
  - .1 One-hole steel to secure surface cables 50 mm and smaller. Two-hole steel straps for cables larger than 50 mm.
  - .2 Channel type supports for two or more cables at 50 mm centers.
  - .3 Threaded rods shall be 6 mm diameter to support suspended channels.
- 2.2.7 Connectors:
  - .1 Watertight approved for Teck cable.

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**2.3 Mineral-Insulated Cables**

- 2.3.1 Conductors shall be solid bare soft-annealed copper, size as indicated.
- 2.3.2 Insulation shall be compressed powdered magnesium oxide or silicon dioxide to form compact homogeneous mass throughout entire length of cable.
- 2.3.3 Outer covering shall be annealed seamless copper sheath, Type M1 rated 600 V, 250°C.
- 2.3.4 Overall jacket shall be
- 2.3.5 Two-hour fire rating.
- 2.3.6 Connectors shall be approved for MI cable.
- 2.3.7 Termination kits shall be **field** installed approved for MI cable

**2.4 Armoured Cables**

- 2.4.1 Conductors shall be insulated, copper, size as indicated.
- 2.4.2 Type shall be AC90.
- 2.4.3 Armour shall be interlocking type fabricated from **aluminum** strip.
- 2.4.4 Type shall ACWU90 jacket over thermoplastic armour and compliant to applicable Building Code classification for this project wet locations.
- 2.4.5 Connectors shall be anti-short connectors.

**2.5 Aluminum Sheathed Cable**

- 2.5.1 Conductors shall be copper size as indicated.
- 2.5.2 Insulation shall be cross linked polyethylene Type RA90 rated 1000V
- 2.5.3 Sheath shall be aluminum applied to form continuous seamless sheath.
- 2.5.4 Outer jacket shall be thermoplastic applied over sheath and to be compliant to applicable Building Code classification for this project.
- 2.5.5 Fastenings for aluminum sheathed cable:
  - .1 One-hole steel straps to secure surface cables 25 mm and smaller. Two-hole steel straps for cables larger than 25 mm. Use aluminum strap only with single conductor cable.
  - .2 Channel type supports for two or more cables at 50 mm centers.
  - .3 Threaded rods shall be 6 mm diameter to support suspended channels.

## **2.6 Control Cables**

- 2.6.1 Type shall be LVT with two soft annealed copper conductors, sized as indicated:
- .1 Insulation shall be thermoplastic.
  - .2 Sheath shall be thermoplastic jacket.
- 2.6.2 Type shall be low energy 300 V control cable with stranded annealed copper conductors sized as indicated LVT with two soft annealed copper conductors, sized as indicated:
- .1 Insulation shall be TWH.
  - .2 Shielding shall be metallized tapes over each conductor.
  - .3 Overall covering shall be polyethylene jacket.
- 2.6.3 Type shall be 600 V stranded annealed copper conductors; sizes as indicated:
- .1 Insulation shall be RW75, TWH, R90 cross polyethene.
  - .2 Shielding shall be metalized tapes.
  - .3 Overall covering shall be thermoplastic jacket.

## **2.7 Non-Metallic Sheathed Cable**

- 2.7.1 Non-metallic sheathed cooper cable type shall be NMD90XLPE, size as indicated.

## **3 . EXECUTION**

### **3.1 General Cable Installation**

- 3.1.1 Install cable in trenches in accordance with Section 33 71 73.02 - Underground Electrical Service.
- 3.1.2 Lay cable in cable trays in accordance with Section 26 05 36 - Cable Trays for Electrical Systems.
- 3.1.3 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0 - 1,000 V).
- 3.1.4 Cable Colour Coding shall be in accordance with Section 26 05 00 Common Work Results for Electrical.
- 3.1.5 Conductor length for parallel feeders to be identical.
- 3.1.6 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- 3.1.7 Wiring in walls shall be typical drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- 3.1.8 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be two-wire circuits only, i.e. common neutrals not permitted.



- 3.1.9 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

**3.2 Installation of Building Wires**

3.2.1 Install wiring as follows:

- .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 In underground ducts in accordance with Section 33.
- .3 In underfloor distribution system in accordance with Section 21.
- .4 In cellular floor raceways in accordance with Section 21.
- .5 In surface and lighting fixture raceways in accordance with Section 26.
- .6 In wireways and auxiliary gutters in accordance with Section 21.
- .7 Overhead service conductors in accordance with Section 21.

**3.3 Installation of Teck 90 Cable (0 - 600 V)**

- 3.3.1 Group cables wherever possible on channels.
- 3.3.2 Install cable exposed securely supported by straps or hangers.

**3.4 Installation of Mineral-Insulated Cables**

- 3.4.1 Install cable exposed, securely supported by straps or hangers.
- 3.4.2 Support two hour fire rated cables at 1 m intervals.
- 3.4.3 Make cable terminations by using factory-made kits.
- 3.4.4 Cable terminations: use thermoplastic sleeving over bare conductors.
- 3.4.5 Where cables are buried in cast concrete or masonry, sleeve for entry of cables.
- 3.4.6 Do not splice cables unless indicated.

**3.5 Installation of Armoured Cables**

- 3.5.1 Group cables wherever possible on channels.

**3.6 Installation of Aluminum Sheathed Cable**

- 3.6.1 Group cables wherever possible on channels.

**3.7 Installation of Control Cables**

- 3.7.1 Install control cables in conduit.
- 3.7.2 Ground control cable shield.

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**3.8 Installation of Non-Metallic Sheathed Cable**

- 3.8.1 Install cables.
- 3.8.2 Install straps and box connectors to cables as required.

**3.9 Cleaning**

- 3.9.1 Proceed in accordance with 01 74 00 Cleaning and waste management.
- 3.9.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**3.10 Field Quality Control**

- 3.10.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- 3.10.2 Perform 5 tests using method appropriate to site conditions and to approval of Engineer and local authority having jurisdiction over installation.
- 3.10.3 Perform tests before energizing electrical system.

**END OF SECTION**

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1. **GENERAL**

1.1 **Section Includes**

1.1.1 Materials and installation for connectors and terminations.

1.2 **Related Sections**

1.2.1 This section of the specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

1.2.2 Section 01 33 00 - Submittal Procedures.

1.2.3 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.2.4 Section 26 05 33 - Raceway and Boxes for Electrical Systems.

1.3 **References**

1.3.1 Canadian Standards Association (CSA International):

- .1 CSA C22.1 (current edition), Canadian Electrical Code, Part 1.
- .2 CSA C22.2 No.41 (current edition), Grounding and Bonding Equipment.

1.4 **Sustainable Requirements**

1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.

1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.

1.4.3 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:

- .1 Construction Waste Management / Product Waste Recyclability.
- .2 Recycled Content.
- .3 Local and Regional Materials.
- .4 Certified Wood.
- .5 Construction Indoor Air Quality (IAQ) management.
- .6 VOC/Low-Emitting Materials Compliance.

1.4.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## **1.5 Submittals**

1.5.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

1.5.2 Product Data:

- .1 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 47 15 - Sustainable Requirements: Construction and include: product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish
- .3 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

## **1.6 Delivery, Storage and Handling**

1.6.1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.

1.6.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.6.3 Handle materials with suitable lifting equipment.

1.6.4 Store materials in heated, dry, weather-protected enclosure

## **1.7 Acceptable Manufactures**

1.7.1 Hubbell,

1.7.2 Thomas and Betts

1.7.3 Or approved equal

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**1.8 Certificates**

- 1.8.1 Obtain inspection certificate of compliance covering high voltage stress coning from inspection authority and include it with maintenance manuals.

**2 . PRODUCTS**

**2.1 Connectors and Terminations**

- 2.1.1 Cooper long barrel compression connectors to CSA C22.2No. 2 as required sized for conductors.
- 2.1.2 Contact aid for aluminum cables where applicable.
- 2.1.3 Two, three or four -way joint boxes dry location type in accordance with Section 26 05 33 - Raceway and Boxes for Electrical Systems.
- 2.1.4 Two, three or four-way junction boxes with respective pothead for Two, three or four -conductor cables for enclosing stress - cone within X-linked polyethylene cable with copper sheath, and overall jacket in accordance with Section 26 05 33 - Raceway and Boxes for Electrical Systems.

**3 . EXECUTION**

**3.1 Installation**

- 3.1.1 Install stress cones, terminations, and splices in accordance with manufacturer's instructions.
- 3.1.2 Bond and ground as required to CSA C22.2No.41.

**3.2 Maintenance – Clearances**

- 3.2.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

**3.3 Cleaning**

- 3.3.1 Proceed in accordance with Section 01 74 00 Cleaning and waste management.
- 3.3.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

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**1. GENERAL**

**1.1 Section Includes**

1.1.1 Material and installation for primary grounding.

**1.2 Related Sections**

1.2.1 This section of the Specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

**1.3 References**

1.3.1 Canadian Standards Association (CSA International)

- .1 CSA C22.1 (current edition), Canadian Electrical Code, Part 1
- .2 CSA C22.2 (current edition), Grounding and Bonding Equipment.

1.3.2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)

- .1 ANSI/IEEE 837 (current edition), Qualifying Permanent Connections Used in Substation Grounding.
- .2 Transformer grounding shall comply with CSA C22.2 No. 41 (current edition).

**1.4 Sustainable Requirements**

1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.

1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.

1.4.3 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve

sustainable goals, including any applicable exemplary performance levels, for the following:

- .1 Construction Waste Management / Product Waste Recyclability.
- .2 Recycled Content.
- .3 Local and Regional Materials.
- .4 Certified Wood.
- .5 Construction Indoor Air Quality (IAQ) management.
- .6 VOC/Low-Emitting Materials Compliance.

1.4.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## **1.5 Submittals**

1.5.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

1.5.2 Product Data:

- .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

1.5.3 Quality assurance submittals:

- .1 Manufacturer's Instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence, and cleaning procedures.

## **1.6 Delivery, Storage and Handling**

1.6.1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.

1.6.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.6.3 Handle materials with suitable lifting equipment.

1.6.4 Store materials in heated, dry, weather-protected enclosure

## **1.7 Testing Requirements**

1.7.1 Perform ground continuity and resistance test using method appropriate to site conditions. Measure ground grid resistance.

1.7.2 Any third party testing agency costs for the testing and reporting shall be included in the Electrical Division base tender and shall be carried out by a pre-approved testing agency.

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## 2 . **PRODUCTS**

### 2.1 **Materials**

- 2.1.1 Rod electrodes: copper clad steel, 19 mm diameter by 3 m long.
- 2.1.2 Plate electrode: galvanized surface area and thickness as defined by the CSA C22.1-CEC Part 1.
- 2.1.3 Conductors: bare, stranded, soft annealed copper wire, size No. 4/0 AWG and 2/0 AWG for ground bus, electrode interconnections, metal structures, gradient control mats, transformers, switchgear, motors, ground connections.
- 2.1.4 Conductors: bare, stranded soft annealed copper wire, size No. 4 AWG for grounding cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers.
- 2.1.5 Conductors: pvc insulated coloured green, stranded soft annealed copper wire No. 10 AWG for grounding meter and relay cases.
- 2.1.6 Conductors: No. 4/0 AWG extra flexible copper conductor for connection of switch mechanism operating rod to gradient control mat, fence gates, vault doors.
- 2.1.7 Bolted removable test links.
- 2.1.8 Accessories: non-corroding, necessary for complete grounding system, type, size material as indicated, including:
  - .1 Grounding and bonding bushings.
  - .2 Protective type clamps.
  - .3 Bolted type conductor connectors.
  - .4 Thermit welded type conductor connectors.
  - .5 Bonding jumpers, straps.
  - .6 Pressure wire connectors.
- 2.1.9 Wire connectors and terminations: as indicated.
- 2.1.10 Grounding resistance bank: indoor, 3-phase, star-connected, 1 ohm, 25,000 A, 0.5 rating, 5,000 V, metallic type.
- 2.1.11 Cable sheath isolating sleeves.

## 3 . **EXECUTION**

### 3.1 **Installation**

- 3.1.1 Install continuous grounding system including, electrodes, conductors, connectors and accessories as indicated and to requirements of local authority having jurisdiction.
- 3.1.2 Ground fences to grounding system independent of station ground.
- 3.1.3 Install connectors and cadweld in accordance with manufacturer's instructions.



- 3.1.4 Protect exposed grounding conductors during and after construction.
- 3.1.5 Make buried connections, and connections to electrodes, structural steel work, using permanent mechanical connectors to ANSI/IEEE 837.
- 3.1.6 Use mechanical connectors for grounding connections to equipment provided with lugs.
- 3.1.7 Use No. 4/0 AWG bare copper cable for main ground bus of substation and No. 2/0 AWG mhd bare copper cable for taps on risers from main ground bus to equipment.
- 3.1.8 Use tinned copper conductors for aluminum structures.
- 3.1.9 Do not use bare copper conductors near un-jacketed lead sheath cables.
- 3.1.10 Install grounding resistor bank.
- 3.1.11 Install zig-zag grounding transformer.

### **3.2 Electrode Installation**

- 3.2.1 Provide and install an artificial ground consisting typically of four 3000mm x 20mm copper-weld ground rods, interconnected by bare-stranded copper #4/0 conductor and terminating to the Main Electrical Room ground bus. Conductors shall be cad-welded to the ground rods and shall be buried 600mm below grade. Check and measure the installation to ensure an adequate resistance to ground before floor slab cover is poured.
- 3.2.2 Provide additional grounding as necessary to meet the ground resistance specified.
- 3.2.3 In certain difficult circumstances, in-situ concrete-encased grounding conductors ("UFER") grounding may be used to enhance the grounding grid system.
- 3.2.4 Provide ground test well over one of the rods on the ground grid to allow access to the grid for testing.
- 3.2.5 Install gradient control mats. Connect mats to station ground electrode and switch mechanism operating rods.
- 3.2.6 Make special provision for installing electrodes that will give acceptable resistance to ground value, where rock or sand terrain prevails.

### **3.3 Building Service Grounding**

- 3.3.1 Water – From the main electrical room ground bus, connect 1#3/0 insulated ground conductor in 27mm conduit to water main with approved ground clamp ahead of water meter. Install 1#3/0 ground conductor jumper strapped around water meter and associated unions and valves to ground building side of water system.

- 3.3.2 Metallic Waste Water Piping – Each metallic waste water piping system to the building is to be grounded by bonding it to the interior metallic water supply system by copper bonding jumper of not less than No. 6 AWG as per the Canadian Electrical Code.
- 3.3.3 Gas Pip Grounding – All interior metal gas piping which may become energized is to be made electrically continuous and is to be bonded in accordance with the requirements of the Canadian Electrical Code.

### **3.4 Equipment Grounding**

- 3.4.1 Install grounding connections as indicated to typical station equipment including: metallic water main, line sky wire, neutral, gradient control mats. Non current carrying parts of: transformers, generators, motors, circuit breakers, reclosers, current transformers, frames of gang-operated switches and fuse cutout bases. Cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers. Meter and relay cases. Any exposed building metal, within or forming part of station enclosure. Sub-station fences, pothead bodies. Outdoor lighting.
- 3.4.2 Ground hinged doors to main frame of electrical equipment enclosure with flexible jumper.

### **3.5 Neutral Grounding**

- 3.5.1 Connect transformer neutral and distribution neutral together using 1000 V insulated conductor to one side of ground test link, the other side of the test link being connected directly to main station ground. Ensure distribution neutral and neutrals of potential transformers and service banks are bonded directly to transformer neutral and not to main station ground.
- 3.5.2 Interconnect electrodes and neutrals at each grounding installation.
- 3.5.3 Connect neutral of station service transformer to main neutral bus with tap of same size as secondary neutral.
- 3.5.4 Ground transformer tank with continuous conductor from tank ground lug through connector on ground bus to primary neutral. Connect neutral bushing at transformer to primary neutral in same manner.

### **3.6 Grounding in Manholes**

- 3.6.1 Install conveniently located grounding stud, electrode, size 3/0 stranded copper conductor in each manhole.
- 3.6.2 Install ground rod with lug for grounding connection in each manhole so that top projects through bottom of manhole.

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**3.7 Field Quality Control**

- 3.7.1 Engage an independent testing agent to inspect grounding and perform ground resistance test before backfill.
- 3.7.2 Perform earth loop test and resistance tests using method appropriate to site conditions and to approval of Engineer and local authority having jurisdiction.
- 3.7.3 Perform test before energizing electrical system.
- 3.7.4 Provide step-and-touch potential calculations using measured station ground resistance measurements. Submit test result and review certificate before energizing electrical system.

**3.8 Maintenance – Clearances**

- 3.8.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

**3.9 Cleaning**

- 3.9.1 Proceed in accordance with Section 01 74 00 Cleaning and waste management.
- 3.9.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

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**1. GENERAL**

**1.1 Section Includes**

- 1.1.1 Materials and installation for secondary grounding.

**1.2 Related Sections**

- 1.2.1 This section of the Specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

**1.3 References**

- 1.3.1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE).  
1.3.2 ANSI/IEEE 837 (current edition), Qualifying Permanent Connections Used in Substation Grounding.  
1.3.3 Canadian Standards Association, (CSA International).  
1.3.4 CAN/CSA Z32 (current edition), Electrical Safety and Essential Electrical Systems in Health Care Facilities.

**1.4 Sustainable Requirements**

- 1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.  
1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.  
1.4.3 Waste Management and Disposal  
.1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.  
.2 Avoid using landfill waste disposal procedures when recycling facilities are available.  
.3 Place materials defined as hazardous or toxic waste in designated containers.  
1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:  
.1 Construction Waste Management / Product Waste Recyclability.

- .2 Recycled Content.
- .3 Local and Regional Materials.
- .4 Certified Wood.
- .5 Construction Indoor Air Quality (IAQ) management.
- .6 VOC/Low-Emitting Materials Compliance.

1.4.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## **1.5 Delivery, Storage and Handling**

- 1.5.1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- 1.5.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- 1.5.3 Handle materials with suitable lifting equipment.
- 1.5.4 Store materials in heated, dry, weather-protected enclosure

## **1.6 Testing Requirements**

- 1.6.1 Perform ground continuity and resistance test using method appropriate to site conditions. Measure ground grid resistance.
- 1.6.2 Any third party testing agency costs for the testing and reporting shall be included in the Electrical Division base tender and shall be carried out by a pre-approved testing agency.

## **2. PRODUCTS**

### **2.1 Material**

- 2.1.1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.
- 2.1.2 Copper conductor: minimum 6 m long for each concrete encased electrode, bare, stranded, soft annealed, size as indicated.
- 2.1.3 Rod electrodes: galvanized steel 19 mm diameter by 3 m long.
- 2.1.4 Plate electrodes: galvanized steel, surface area 0.2 m<sup>2</sup>, 1.6 mm thick.
- 2.1.5 Grounding conductors: bare stranded copper as indicated.
- 2.1.6 Insulated grounding conductors: green, type RWU90 XLPE.
- 2.1.7 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- 2.1.8 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

- .1 Grounding and bonding bushings.
  - .2 Protective type clamps.
  - .3 Bolted type conductor connectors.
  - .4 Thermit welded type conductor connectors.
  - .5 Bonding jumpers, straps.
  - .6 Pressure wire connectors.
- 2.1.9 Grounding resistance bank: indoor, 3 phase, star connected, metallic type, system voltage as per drawings.

### 3 . **EXECUTION**

#### 3.1 **Installation – General**

- 3.1.1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.
- 3.1.2 Install connectors in accordance with manufacturer's instructions.
- 3.1.3 Protect exposed grounding conductors from mechanical injury.
- 3.1.4 Make buried connections, and connections to conductive water main, electrodes, using permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837.
- 3.1.5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- 3.1.6 Soldered joints not permitted.
- 3.1.7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- 3.1.8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- 3.1.9 Install separate ground conductor to outdoor lighting standards.
- 3.1.10 Install grounding resistance bank.
- 3.1.11 Connect building structural steel and metal siding to ground by welding copper to steel.
- 3.1.12 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- 3.1.13 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.
- 3.1.14 Ground secondary service pedestals.

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**3.2 Manholes**

- 3.2.1 Install conveniently located grounding stud, electrode, size 3/0 stranded copper conductor in each manhole.
- 3.2.2 Install ground rod in each manhole so that top projects through bottom of manhole. Provide with lug to which grounding connection can be made.

**3.3 Electrodes**

- 3.3.1 Make ground connections to continuously conductive underground water pipe on street side of water meter.
- 3.3.2 Install water meter shunt.
- 3.3.3 Install concrete encased electrodes in building foundation footings, with terminal connected to grounding network.
- 3.3.4 Install rod electrodes and make grounding connections.
- 3.3.5 Bond separate, multiple electrodes together.
- 3.3.6 Use size 3/0 AWG copper conductors for connections to electrodes.
- 3.3.7 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

**3.4 System and Circuit Grounding**

- 3.4.1 Install system and circuit grounding connections to neutral of secondary 600 V system.
- 3.4.2 Install home run a #6 AWG insulated bonding conductor in conduit from the building main ground bus to the:
  - .1 Main Fire Alarm Panel
  - .2 Main Security Panel
  - .3 Sound and Communication Systems Head End
  - .4 RF Television System
  - .5 Uninterruptible Power Supply (UPS) System(s)

**3.5 Equipment Grounding**

- 3.5.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting.
- 3.5.2 Provide a grounding conductor from the secondary of every distribution transformer to the grounding system. Ground conductor to be sized and installed in accordance with the Canadian Electrical Code.

- 3.5.3 Provide grounding conductor(s) from all major switchgear to solidly ground the secondary system. This includes equipment located in the main electrical room as well as each sub-electrical room. Grounding conductors are to be sized to Canadian Electrical Code and switchgear manufacturer's requirements.

### **3.6 Grounding Bus**

- 3.6.1 Provide a ground bus in the main electrical room. The ground bus shall consist of a suitable length of 50mm x 6mm copper bus mounted on a 25mm insulating standoff. This bus shall be drilled and tapped to receive all the grounding conductors indicated and an engraved nameplate or tag shall be installed above or below individual conductors indicating their function.
- 3.6.2 Provide a similar ground bus in each sub-electrical room and major mechanical room. Interconnect to the main ground bus with a 3/0 AWG insulated copper grounding conductor that is typically installed with the power feeders.
- 3.6.3 Provide a similar ground bus in each data and voice equipment room and closet as indicated in "Data & Voice Grounding" clause.
- 3.6.4 Ground items of electrical equipment in the electrical room to the ground bus with individual bare stranded copper connections, size 3/0 AWG or as indicated.
- 3.6.5 Copper or bronze lugs are required for termination of all copper conductors at ground busses.

### **3.7 Communication Systems**

- 3.7.1 Install home run insulated ground conductor in conduit from the building main ground bus as follows:
- .1 #1/0 AWG to a ground bus in the main telecommunication equipment room.
  - .2 #2 AWG to a ground bus in the telecommunication equipment room.
  - .3 #2 AWG to a ground bus in the main telephone equipment room.
  - .4 #2 AWG to a ground bus in each telephone backboard in equipment rooms/closets.
- 3.7.2 Unless otherwise solidly bonded, bond all data and telephone incoming and outgoing steel conduits with insulated 1#12 AWG from the nearest "Communication" ground bus.

### **3.8 Permafrost**

- 3.8.1 Bond non-current carrying metal parts together with size AWG copper equipotential conductor. Run conductor from separate lug or



service neutral bar to, but not necessarily limited to, following indoor systems and equipment:

- .1 Hot water heating system.
  - .2 Main water pipe.
  - .3 Main building drain.
  - .4 Oil line.
  - .5 Telephone, radio/tv, emergency and fire alarm lead-in or service conduits, near panels.
  - .6 Make connections to pipes on building side of main valves and tanks. Connect jumpers across boilers to supply and return hot water heating pipes.
- 3.8.2 Drive three -19 mm diam x 3 m copper clad ground rods at least 1.8 m apart in original undisturbed ground. If rods will not penetrate permafrost, drive at angle not more than 60o from vertical, and in same direction. Rods must be driven, not trenched.
- 3.8.3 Install ground wire from service neutral bar to rods and where buried use bare copper not smaller than size 1AWG7- strand or size 4AWG solid, and at least 460 mm below ground. Bond ground conductor, or short tap from it, to outside metal sheathing of building close to power service conduit. Use lug or cast clamp, with bronze or plated bolt, nut and washers (not sheet metal screw or wood screw). Remove paint from sheathing for good contact. Conduit is required only on outside wall of building. Indoors, run bare and fasten as specified for equipotential bonding wire.
- 3.8.4 Install electrode interconnections where metal parts, circuits or grounding conductors and/or electrodes are in proximity to lightning rod conductors.

### **3.9 Mechanical Equipment Grounding**

- 3.9.1 Provide a #2 ground conductor from the mechanical room ground bus to each MCC.
- 3.9.2 Provide a #6 ground conductor from the mechanical room ground bus to each VFD.
- 3.9.3 Ground wires are to be installed in all conduits serving motor feeder circuits and are to extend to ground screws on junction and outlet boxes for bonding.

### **3.10 Emergency Generator Grounding**

- 3.10.1 Ground unit frame, control panel and switchgear in accordance with the Canadian Electrical Code (CEC).
- 3.10.2 Provide a grounding conductor in switchgear to solidly ground emergency system neutral. Grounding conductor to be sized to CEC and switchgear manufacturer's recommendations.

3.10.3 The generator neutral ground is to be connected at the generator input side of the generator breaker.

3.10.4 If a four-pole automatic transfer switch is utilized, provide a grounding conductor from the generator switchgear to solidly ground emergency system neutral. The grounding conductor is to be sized to Canadian Electrical Code and switchgear manufacturer's requirements.

**3.11 Cable Tray Grounding**

3.11.1 Install 1#2 to each cable tray from the nearest Telecom ground bus.

3.11.2 Install 1#2 bare copper ground, unless shown otherwise, for full length of tray bonded to tray at 15m intervals and to ground bus at each termination point as specified.

**3.12 Access Floor Grounding**

3.12.1 Install 1#4 ground connection to every fourth floor pedestal of the access flooring structural support system and make connection to a server room ground bus installed on the wall below the raised floor. From the ground bus, install one 3/0 ground to ground bus in the main electrical room.

**3.13 Post-Mounted Luminaire Grounding**

3.13.1 Provide #10 AWG bonding conductor with green RW90 X-link insulation to luminaire standards. Connect to luminaire corrosion-resistant ground stud or ground clamp.

**3.14 Field Quality Control**

3.14.1 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Engineer and local authority having jurisdiction over installation.

3.14.2 Perform tests before energizing electrical system.

3.14.3 Disconnect ground fault indicator during tests.

**3.15 Maintenance – Clearances**

3.15.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

**3.16 Cleaning**

3.16.1 Proceed in accordance with Section 01 74 00 Cleaning and waste management.

3.16.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

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**1. GENERAL**

**1.1 Section Includes**

- 1.1.1 Material and installation for hangers and supports.

**1.2 Related Sections**

- 1.2.1 This section of the Specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

**1.3 References**

- 1.3.1 Canadian Standards Association (CSA International)  
1.3.2 CSA C22.1 (current edition), Canadian Electrical Code, Part 1.

**1.4 Sustainable Requirements**

- 1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.
- 1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.
- 1.4.3 Waste Management and Disposal
- .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
  - .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
  - .3 Place materials defined as hazardous or toxic waste in designated containers.
- 1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:
- .1 Construction Waste Management / Product Waste Recyclability.
  - .2 Recycled Content.
  - .3 Local and Regional Materials.
  - .4 Certified Wood.
  - .5 Construction Indoor Air Quality (IAQ) management.
  - .6 VOC/Low-Emitting Materials Compliance.

- 1.4.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

**1.5 Submittals**

- 1.5.1 Submittals: in accordance with section 01 33 00 – Submittal Procedures.

- 1.5.2 Product Data:

- .1 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.

**1.6 Delivery, Storage and Handling**

- 1.6.1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- 1.6.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- 1.6.3 Handle materials with suitable lifting equipment.
- 1.6.4 Store materials in heated, dry, weather-protected enclosure

**2 . PRODUCTS**

**2.1 Support Channels**

- 2.1.1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted, suspended or set in poured concrete walls and ceilings.

**3 . EXECUTION**

**3.1 Installation**

- 3.1.1 Secure equipment to masonry, tile and plaster surfaces with lead anchors.
- 3.1.2 Secure equipment to poured concrete with expandable inserts.
- 3.1.3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- 3.1.4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- 3.1.5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

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- 3.1.6 Fasten exposed conduit or cables to building construction or support system using straps.
    - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
    - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
    - .3 Beam clamps to secure conduit to exposed steel work.
  - 3.1.7 Suspended support systems.
    - .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
    - .2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
  - 3.1.8 For surface mounting of two or more conduits use channels at 1.5 m on centre spacing.
  - 3.1.9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
  - 3.1.10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
  - 3.1.11 Do not use wire lashing or perforated strap to support or secure raceways or cables.
  - 3.1.12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Engineer.
  - 3.1.13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

### **3.2 Maintenance – Clearances**

- 3.2.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

### **3.3 Cleaning**

- 3.3.1 Proceed in accordance with Section 01 74 00 Cleaning and waste management.
- 3.3.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

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**1. GENERAL**

**1.1 Section Includes**

- 1.1.1 Materials and installation for splitters, junctions, pull boxes and cabinets.

**1.2 Related Sections**

- 1.2.1 This section of the Specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

**1.3 References**

- 1.3.1 Canadian Standards Association (CSA International)
- .1 CSA C22.1 (current edition), Canadian Electrical Code, Part 1, 20th Edition.
  - .2 CSA C22.2 No. 76, Splitters.
  - .3 CSA C22.2 No. 40, (Cutout), Junction and pull boxes.

**1.4 Sustainable Requirements**

- 1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.
- 1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.
- 1.4.3 Waste Management and Disposal
- .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
  - .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
  - .3 Place materials defined as hazardous or toxic waste in designated containers.
- 1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:
- .1 Construction Waste Management / Product Waste Recyclability.
  - .2 Recycled Content.

- .3 Local and Regional Materials.
- .4 Certified Wood.
- .5 Construction Indoor Air Quality (IAQ) management.
- .6 VOC/Low-Emitting Materials Compliance.

1.4.5 **NOTE:** Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## 1.5 **Submittals**

1.5.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

1.5.2 Product Data:

- .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 47 15 - Sustainable Requirements: Construction and include: product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish

## 1.6 **Delivery, Storage and Handling**

- 1.6.1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- 1.6.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- 1.6.3 Handle materials with suitable lifting equipment.
- 1.6.4 Store materials in heated, dry, weather-protected enclosure

## 2. **PRODUCTS**

### 2.1 **Splitters**

- 2.1.1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- 2.1.2 Terminations: main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
- 2.1.3 Spare Terminals: minimum three spare terminals or lugs on each connection or lug block sized less than 400 A.



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**2.2 Junction and Pull Boxes**

- 2.2.1 Construction-welded steel enclosure.
- 2.2.2 Covers Flush Mounted: 25 mm minimum extension all around.
- 2.2.3 Covers Surface Mounted: screw-on flat covers.

**2.3 Cabinets**

- 2.3.1 Construction: welded sheet steel hinged door, handle, latch and catch
- 2.3.2 Type E Empty: flush overlapping sides, mounting as indicated.
- 2.3.3 Type T Terminal: flush overlapping sides mounting as indicated containing 19 mm plywood backboard.

**3 . EXECUTION**

**3.1 Splitter Installation**

- 3.1.1 Mount plumb, true and square to building lines.
- 3.1.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

**3.2 Junction, Pull Boxes and Cabinets Installation**

- 3.2.1 Install pull boxes in inconspicuous but accessible locations.
- 3.2.2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.
- 3.2.3 Install terminal block as indicated in Type T cabinets.
- 3.2.4 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

**3.3 Identification**

- 3.3.1 Identification Labels: size 2 indicating system name, voltage and phase, or as indicated.

**3.4 Maintenance – Clearances**

- 3.4.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

**3.5 Cleaning**

- 3.5.1 Proceed in accordance with Section 01 74 00 Cleaning and waste management.
- 3.5.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

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**1.    GENERAL**

**1.1    Section Includes**

1.1.1    Materials and installation for outlet boxes, conduit boxes and fittings.

**1.2    Related Sections**

1.2.1    This section of the Specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

**1.3    References**

1.3.1    Canadian Standards Association (CSA International)

- .1        CSA C22.1 (current edition), Canadian Electrical Code, Part 1, 20th Edition.
- .2        CSA C22.2 No. 18, Outlet boxes, conduit boxes and fittings.

**1.4    Sustainable Requirements**

1.4.1    Materials and products in accordance with Sustainable Requirements: Construction.

1.4.2    Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.

1.4.3    Waste Management and Disposal

- .1        Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
- .2        Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3        Place materials defined as hazardous or toxic waste in designated containers.

1.4.4    In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:

- .1        Construction Waste Management / Product Waste Recyclability.
- .2        Recycled Content.
- .3        Local and Regional Materials.
- .4        Certified Wood.

.5 Construction Indoor Air Quality (IAQ) management.

.6 VOC/Low-Emitting Materials Compliance.

1.4.5 **NOTE:** Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## **1.5 Submittals**

1.5.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

1.5.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.

## **1.6 Delivery, Storage and Handling**

1.6.1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.

1.6.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.6.3 Handle materials with suitable lifting equipment.

1.6.4 Store materials in heated, dry, weather-protected enclosure

## **2. PRODUCTS**

### **2.1 Outlet and Conduit Boxes - General**

2.1.1 Size boxes in accordance with CSA C22.1.

2.1.2 102 mm square or larger outlet boxes as required.

2.1.3 Gang boxes where wiring devices are grouped.

2.1.4 Blank cover plates for boxes without wiring devices.

2.1.5 Combination boxes with barriers where outlets for more than one system are grouped.

### **2.2 Galvanized Steel Outlet Boxes**

2.2.1 One-piece electro-galvanized construction.

2.2.2 Single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.

- 2.2.3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48mm.
- 2.2.4 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- 2.2.5 Extension and plaster rings for flush mounting devices in finished walls.

## **2.3 Masonry Boxes**

- 2.3.1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

## **2.4 Concrete Boxes**

- 2.4.1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

## **2.5 Floor Boxes**

- 2.5.1 Concrete tight electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brushed aluminum faceplate. Device mounting plate to accommodate short or long ear duplex receptacles. Minimum depth: 73 mm for receptacles and communication outlets. Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 16, 21, 27 and 35 mm conduit. Minimum size: 73 mm deep.
- 2.5.2 Raised Floor Type: Electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brushed aluminum faceplate. 4 Gang with device mounting plate to accommodate short or long ear duplex receptacles. Minimum depth: 73 mm for receptacles and communication outlets. Adjustable, watertight floor boxes with openings drilled and tapped for 16, 21, 27 and 35 mm conduit. Minimum size: 73 mm deep.

## **2.6 Conduit Boxes**

- 2.6.1 Cast FS aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

## **2.7 Outlet Boxes for Non-Metallic Sheathed Cable**

- 2.7.1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63 mm with two double clamps to take non-metallic sheathed cables.

## **2.8 Fittings - General**

- 2.8.1 Bushing and connectors with nylon insulated throats.
- 2.8.2 Knock-out fillers to prevent entry of debris.
- 2.8.3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.

2.8.4 Double locknuts and insulated bushings on sheet metal boxes.

**2.9 Service Fittings**

2.9.1 'High tension' receptacle fitting made of 2 piece die-cast aluminum with brushed aluminum housing finish for two duplex receptacles. Bottom plate with two knockouts for centered or offset installation. 12 x 102 mm extension piece as indicated.

2.9.2 Pedestal type 'low tension' fitting made of 2 piece die cast aluminum with brushed aluminum housing finish to accommodate two amphenol jack connectors.

**3 . EXECUTION**

**3.1 Installation**

3.1.1 Support boxes independently of connecting conduits.

3.1.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

3.1.3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

3.1.4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.

3.1.5 Vacuum clean interior of outlet boxes before installation of wiring devices.

3.1.6 Identify systems for outlet boxes as required.

**3.2 Maintenance – Clearances**

3.2.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

**3.3 Cleaning**

3.3.1 Proceed in accordance with Section 01 74 00 Cleaning and waste management.

3.3.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

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**1. GENERAL**

**1.1 Section Includes**

- 1.1.1 Materials and installation for cable splice and junction boxes.

**1.2 Related Sections**

- 1.2.1 Section 01 33 00 - Submittal Procedures.  
1.2.2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**1.3 References**

- 1.3.1 Canadian Standards Association (CSA International):  
.1 CSA C22.2No.40-M1989(R1999), Cut-out, Junction and Pull Boxes.

**1.4 Sustainable Requirements**

- 1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.  
1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.  
1.4.3 Waste Management and Disposal  
.1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.  
.2 Avoid using landfill waste disposal procedures when recycling facilities are available.  
.3 Place materials defined as hazardous or toxic waste in designated containers.  
1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:  
.1 Construction Waste Management / Product Waste Recyclability.  
.2 Recycled Content.  
.3 Local and Regional Materials.  
.4 Certified Wood.  
.5 Construction Indoor Air Quality (IAQ) management.

.6 VOC/Low-Emitting Materials Compliance.

1.4.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## **1.5 Submittals**

1.5.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

1.5.2 Product Data:

- .1 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 47 15 - Sustainable Requirements: Construction and include: product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish

## **1.6 Delivery, Storage and Handling**

- 1.6.1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- 1.6.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- 1.6.3 Handle materials with suitable lifting equipment.
- 1.6.4 Store materials in heated, dry, weather-protected enclosure

## **2. PRODUCTS**

### **2.1 Junction Boxes Distribution Level**

2.1.1 Welded steel rectangular boxes 6 mm thick painted with chromate primer and gray enamel with removable plate on front side, designed for through run of main cable and porcelain enclosed disconnecting branches of three single conductor cables, using pothead plug and socket disconnectors enclosed in porcelain tubes and caps, standard designed for no voltage disconnecting, and for wall mounting in tunnels, branch cables rated 100 A, 5 kV, filled with medium hard asphalt base compound.

### **2.2 Junction Boxes Power Level**

2.2.1 Cast iron octagonal box painted with chromate primer and gray enamel with joints ground smooth and fitted with gasket, contacts



mounted on porcelain supports to which conductors are fastened by soldered-on lugs, medium hard asphalt compound filled, suitable for three-phase, 15 kV cable, 350 MCM maximum cable size, with wiping sleeve and stuffing box entrance.

- 2.2.2 Welded steel rectangular boxes, oil resistant gasketed steel plate lids fastened with silicon-bronze bolts, shot blasted and painted with chromate primer and gray enamel, cable-heads medium hard asphalt compound filled cap-nut sealed potheads with [stuffing box entrances, air filled, disconnecting links insulated switch stick operated at no voltage rated 500 A at 15,000 V, four-way for wall mounting in tunnels.

### 3 . **EXECUTION**

#### 3.1 **Installation**

- 3.1.1 Install splice boxes at cable joint, on floor of trench. Tighten armour clamps and fill with compound.
- 3.1.2 Install junctions boxes on trench floor around cable splice to CSA C22.2No.40. Connect cable terminals to box contacts. Fasten lid securely and check for air leaks before trench is backfilled.
- 3.1.3 Install subway level steel boxes on wall of tunnels. Connect cables to bus, install links, fasten lid and test for air leaks and fill with compound.
- 3.1.4 Install distribution level steel boxes on walls of tunnels. Splice main cable in box and connect branch feeder. Fasten cover and fill with compound.
- 3.1.5 Install power level boxes as follows:
- .1 Cast iron type shall be on trench floor, connect cable terminals to box contacts, fasten lid and fill with compound before trench is backfilled.
  - .2 Steel type shall be mount on wall of tunnel; connect cables to box terminals; install disconnect links, fasten lid securely fill with oil and check for air leaks.

#### 3.2 **Maintenance – Clearances**

- 3.2.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

#### 3.3 **Cleaning**

- 3.3.1 Proceed in accordance with Section 01 74 00 Claening and waste management.

- 
- 3.3.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**1. GENERAL**

**1.1 Section Includes**

- 1.1.1 Materials and installation for Surface and Lighting Fixture Raceways.

**1.2 Related Sections**

- 1.2.1 This section of the specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

**1.3 References**

- 1.3.1 Canadian Standards Association (CSA International):
- .1 CSA C22.1 (current edition), Canadian Electrical Code, Part 1.
  - .2 CAN/CSA-C22.2 No. 62-93(R2003), Surface Raceway Systems.

**1.4 Sustainable Requirements**

- 1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.
- 1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.
- 1.4.3 Waste Management and Disposal
- .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
  - .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
  - .3 Place materials defined as hazardous or toxic waste in designated containers.
- 1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:
- .1 Construction Waste Management / Product Waste Recyclability.
  - .2 Recycled Content.
  - .3 Local and Regional Materials.

- .4 Certified Wood.
- .5 Construction Indoor Air Quality (IAQ) management.
- .6 VOC/Low-Emitting Materials Compliance.

1.4.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## **1.5 Submittals**

- 1.5.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- 1.5.2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- 1.5.3 Quality assurance submittals shall be provided in accordance with Section 01 40 00 Quality requirement.
  - .1 Provide manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.
- 1.5.4 Indicate types of raceways with terminology similar to that used in this Section.

## **2. PRODUCTS**

### **2.1 Surface Raceway System (Wiring Pulled In)**

- 2.1.1 One-piece steel, free of sharp edges to CAN/CSA-C22.2 No. 62.
- 2.1.2 Corners, pull boxes, elbows, tees, two piece assembly to facilitate site wiring.
- 2.1.3 Finish shall be White/ivory enamel.
- 2.1.4 Switch, receptacle, extension boxes, adapters and fittings required for complete installation.

### **2.2 Surface Raceway System (Wiring Laid In)**

- 2.2.1 Two-piece steel assembly CAN/CSA-C22.2 No. 62.
  - .1 Finish shall be White/ivory enamel.
- 2.2.2 Switch, receptacle, extension boxes, adapters and fittings required for complete installation.

- 
- 2.3 Surface Floor Raceway System**
- 2.3.1 Two-piece steel assembly manufactured for floor lay-in type raceway to CAN/CSA-C22.2 No. 62.
- 2.3.2 Finish shall be White/ivory enamel.
- 2.4 Channel Raceway**
- 2.4.1 Channel type raceway shall be in accordance with CAN/CSA-C22.2 No. 62, steel, solid.
- 2.5 Plastic Raceway**
- 2.5.1 Plastic raceway shall be in accordance with CAN/CSA-C22.2 No. 62, rigid extruded polyvinyl chloride with slots on either side of raceway for exit of wiring.
- 2.5.2 Channel shall be with solid snap-on cover throughout entire length.
- 2.6 Lighting Fixture Raceway**
- 2.6.1 Fluorescent fixture support system using channel type raceway with snap-on cover.
- 2.6.2 Channel shall be minimum 1.6 mm thick.
- 2.6.3 Clamp hangers with threaded rod, chain hangars.
- 2.7 Fittings**
- 2.7.1 Elbows, tees, supports, connectors couplings and fittings: to CAN/CSA-C22.2 No. 62.
- 3 . EXECUTION**
- 3.1 Installation**
- 3.1.1 Install raceway systems as indicated and in accordance with manufacturer's instructions.
- 3.1.2 Install supports, elbows, tees, connectors, fittings, bushings, adaptors as required.
- 3.1.3 Keep number of elbows, offsets and connections to minimum.
- 3.1.4 Use wiring with mechanical protection in channel raceways.
- 3.1.5 Install barriers in raceways for different services where required by code.
- 3.1.6 Install wiring after installation of raceway system is complete.

**END OF SECTION**

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## 1. **GENERAL**

### 1.1 **Section Includes**

- 1.1.1 Material and installation for conduits, conduit fastenings and conduit fittings.

### 1.2 **Related Sections**

- 1.2.1 This section of the Specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

### 1.3 **References**

- 1.3.1 Canadian Standards Association (CSA International)
  - .1 CAN/CSA C22.2 No. 18 (current edition), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
  - .2 CSA C22.2 No. 45 (current edition), Rigid Metal Conduit.
  - .3 CSA C22.2 No. 56 (current edition), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .4 CSA C22.2 No. 83 (current edition), Electrical Metallic Tubing.
  - .5 CSA C22.2 No. 211.2 (current edition), Rigid PVC (Unplasticized) Conduit.
  - .6 CAN/CSA C22.2 No. 227.3 (current edition), Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

### 1.4 **Sustainable Requirements**

- 1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.
- 1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.
- 1.4.3 Waste Management and Disposal
  - .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
  - .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
  - .3 Place materials defined as hazardous or toxic waste in designated containers.

1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:

- .1 Construction Waste Management / Product Waste Recyclability.
- .2 Recycled Content.
- .3 Local and Regional Materials.
- .4 Certified Wood.
- .5 Construction Indoor Air Quality (IAQ) management.
- .6 VOC/Low-Emitting Materials Compliance.

1.4.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## **1.5 Submittals**

1.5.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

1.5.2 Product Data:

- .1 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section Requirements: Construction and include: product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish.

## **1.6 Delivery, Storage and Handling**

1.6.1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.

1.6.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.6.3 Handle materials with suitable lifting equipment.

1.6.4 Store materials in heated, dry, weather-protected enclosure

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## 2. PRODUCTS

### 2.1 Cables and Reels

- 2.1.1 Provide cables on reels or coils.
  - .1 Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.
- 2.1.2 Each coil or reel of cable to contain only one continuous cable without splices.

### 2.2 Conduits

- 2.2.1 Rigid metal conduit: to CSA C22.2 No. 45, hot dipped galvanized steel threaded.
- 2.2.2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.
- 2.2.3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- 2.2.4 Rigid PVC conduit: to CSA C22.2 No. 211.2.
- 2.2.5 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.

### 2.3 Conduit Fastenings

- 2.3.1 One-hole steel straps to secure surface conduits 50 mm and smaller.
  - .1 Two hole steel straps for conduits larger than 50 mm.
- 2.3.2 Beam clamps to secure conduits to exposed steel work.
- 2.3.3 Channel type supports for two or more conduits at 1.5 m on centre.
- 2.3.4 Threaded rods, 6 mm diameter, to support suspended channels.

### 2.4 Conduit Fittings

- 2.4.1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.
- 2.4.2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.
- 2.4.3 Watertight connectors and couplings for EMT.
  - .1 Set-screws are not acceptable.

### 2.5 Expansion Fittings for Rigid Conduit

- 2.5.1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.



- 2.5.2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.
- 2.5.3 Weatherproof expansion fittings for linear expansion at entry to panel.

## **2.6 Fish Cord**

- 2.6.1 Polypropylene.

## **3 . EXECUTION**

### **3.1 Installation**

- 3.1.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- 3.1.2 Conceal conduits except in mechanical and electrical service rooms.
- 3.1.3 Use rigid hot dipped galvanized steel threaded conduit except where specified otherwise.
- 3.1.4 Use epoxy coated conduit in corrosive areas.
- 3.1.5 Use electrical metallic tubing (EMT) except in cast concrete.
- 3.1.6 Use rigid PVC conduit underground.
- 3.1.7 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- 3.1.8 Use explosion proof flexible connection for connection to explosion proof motors.
- 3.1.9 Install conduit sealing fittings in hazardous areas.
  - .1 Fill with compound.
- 3.1.10 Minimum conduit size for lighting and power circuits: 19 mm.
- 3.1.11 Install EMT conduit from branch circuit panel to outlet boxes located in sub floor.
- 3.1.12 Bend conduit cold:
  - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- 3.1.13 Mechanically bend steel conduit over 19 mm diameter.
- 3.1.14 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- 3.1.15 Install fish cord in empty conduits.
- 3.1.16 Run two 25 mm spare conduits up to ceiling space and two 25 mm spare conduits down to ceiling space from each flush panel.

- .1 Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in flush concrete type box.

3.1.17 Remove and replace blocked conduit sections.

- .1 Do not use liquids to clean out conduits.

3.1.18 Dry conduits out before installing wire.

### **3.2 Manufacturer's Instructions**

3.2.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

### **3.3 Surface Conduits**

3.3.1 Surface conduits shall only be installed in mechanical and electrical rooms.

3.3.2 Run parallel or perpendicular to building lines.

3.3.3 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

3.3.4 Run conduits in flanged portion of structural steel.

3.3.5 Group conduits wherever possible on suspended channels.

3.3.6 Do not pass conduits through structural members except as indicated.

3.3.7 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

### **3.4 Concealed Conduits**

3.4.1 Run parallel or perpendicular to building lines.

3.4.2 Do not install horizontal runs in masonry walls.

3.4.3 Do not install conduits in terrazzo or concrete toppings.

### **3.5 Conduits in Cast-in-Place Concrete**

3.5.1 Locate to suit reinforcing steel.

- .1 Install in centre one third of slab.

3.5.2 Protect conduits from damage where they stub out of concrete.

3.5.3 Install sleeves where conduits pass through slab or wall.

3.5.4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed.

- .1 Use cold mastic between sleeve and conduit.

3.5.5 Conduits in slabs: minimum slab thickness 4 times conduit diameter.

3.5.6 Encase conduits completely in concrete with minimum 25 mm concrete cover.

3.5.7 Organize conduits in slab to minimize cross-overs.

**3.6 Conduits in Cast-in-Place Slabs on Grade**

3.6.1 Run conduits 25 mm and larger below slab and encase in 75 mm concrete envelope.

.1 Provide 50 mm of sand over concrete envelope below floor slab.

**3.7 Conduits Underground**

3.7.1 Slope conduits to provide drainage.

3.7.2 Waterproof joints (pvc excepted) with heavy coat of bituminous paint.

**3.8 Maintenance – Clearances**

3.8.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

**3.9 Cleaning**

3.9.1 Proceed in accordance with Section 01 74 00 Cleaning and waste management.

3.9.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

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**1. GENERAL**

**1.1 Section Includes**

1.1.1 Material and installation for cable trays.

**1.2 Related Sections**

1.2.1 This section of the Specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

**1.3 References**

1.3.1 Canadian Standards Association (CSA International)

- .1 CAN/CSA C22.1 No.126.1 (current edition), Metal Cable Tray Systems.
- .2 CAN/CSA C22.1 No.126.2(current edition), Non Metallic Cable Tray Systems.

1.3.2 National Electrical Manufacturers Association (NEMA)

- .1 NEMA FG 1 (current edition), Fibreglass and Cable Tray Systems.
- .2 NEMA VE 1 (current edition), Metal Cable Tray Systems.
- .3 NEMA VE 2 (current edition), Cable Tray Installation Guidelines.

**1.4 Sustainable Requirements**

1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.

1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.

1.4.3 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve

sustainable goals, including any applicable exemplary performance levels, for the following:

- .1 Construction Waste Management / Product Waste Recyclability.
- .2 Recycled Content.
- .3 Local and Regional Materials.
- .4 Certified Wood.
- .5 Construction Indoor Air Quality (IAQ) management.
- .6 VOC/Low-Emitting Materials Compliance.

1.4.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## 1.5 **Submittals**

1.5.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

1.5.2 Product Data:

- .1 Submit manufacturer's product data sheets for cable tray indicating dimensions, materials, and finishes, including classifications and certifications.
- .2 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Sustainable Requirements: Construction and include: product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish.

1.5.3 Shop Drawings:

- .1 Submit shop drawings showing materials, finish, dimensions, accessories, layout, and installation details.

1.5.4 Identify types of cabletroughs used.

1.5.5 Show actual cabletrough installation details and suspension system.

1.5.6 Closeout Submittals:

- .1 Provide maintenance data for materials for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Data necessary for maintenance of materials.

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**1.6 Delivery, Storage and Handling**

- 1.6.1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- 1.6.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- 1.6.3 Handle materials with suitable lifting equipment.
- 1.6.4 Store materials in heated, dry, weather-protected enclosure

**1.7 Acceptable Manufactures**

- 1.7.1 Lagrand
- 1.7.2 Graybar
- 1.7.3 Or approved equal.

**2. PRODUCTS**

**2.1 Cable Tray (Communication Room)**

- 2.1.1 A flex or basket type cable tray shall be provided around the perimeter of the room and shall be attached to the Communications cable tray infrastructure as per standard drawing ITSTD-05.
- 2.1.2 The tray shall be mounted at level indicated AFF.
- 2.1.3 When used, wall-mounted tray brackets shall be bolted through the plywood to the wall.
- 2.1.4 Concrete mounting will be as per standard drawing ITSTD-30.

**2.2 Cable Tray (Interior Pathways)**

- 2.2.1 All ventilated trays are to be steel or aluminum, complete with angles, offsets, corners, saddles, tees, etc., as indicated and required to suit the installation.
  - .1 Trays shall be as indicated mm wide with depth as indicated mm.
  - .2 Radii on fittings shall be according to cable tray size in mm minimum.
- 2.2.2 All steel non-painted trays shall be hot dip galvanized after fabrication to CSA G164-1965 ASTM designation A386.
- 2.2.3 All trays shall have 45° corners at all vertical and horizontal corners, tees and width change locations.
- 2.2.4 Cable trays are to have a minimum cable loading depth of 114mm. Cable tray width is to be a minimum of 305mm wide for communications, or as indicated on drawings.
- 2.2.5 Suspended tray supports are to be trapeze-style hangers of minimum 400mm square "Unistrut" supported from 9.5mm threaded

rod hangers from preset or afterset concrete inserts or direct steel support.

- 2.2.6 Barriers, where specified, are to be continuous metal dividers for the entire length of the tray.
- 2.2.7 Ventilated type shall be Class C1 to CSA C22.2 No. 126-M1980.
- 2.2.8 Fire Barrier Pillows are to be self-contained intumescent firestop product for use in through-penetration firestops. The product is to achieve up to three (3) hours fire rating in accordance with ASTM E 814 tests.

### **2.3 Supports**

- 2.3.1 Provide splices, supports for a continuously grounded system as required.

## **3 . EXECUTION**

### **3.1 Installation**

- 3.1.1 Provide cable tray in approximate location and general routing as shown on drawings.
- 3.1.2 Cable trays are usually installed in the false ceiling space of hallways and located to keep conduit lengths to a minimum.
- 3.1.3 Provide dropouts when cables exiting all horizontal cable trays.
- 3.1.4 Cable tray may require installation of risers, bend, etc. to adjust tray up or down as well as sideways for the tray routing to fit within limits of space available, and to clear other services, ducts, pipes etc. along the route. Routing maybe adjusted somewhat as necessary to enable installation of services under other trades. The above field adjustments are to be done at no extra cost to the Owner.
- 3.1.5 Where tray runs change elevation, trays shall overlay each other when manufactured waterfall assemblies can not be used. To prevent cables stress install drop-outs on the top tray when overlap method is to be used. Further, tray sections shall be coupled together to provide some rigidity. This coupling maybe made by using a short length of tray and adjustable elbows or may be coupled by means of common support rods at the tray overlap.
- 3.1.6 The Trade Contractor's price is to include an allowance for tray fittings required for change in elevation, direction, waterfall assemblies and cable drop out.
- 3.1.7 Trays shall be separated at a minimum 450mm from the adjacent wall unless otherwise instructed by the Information Technology Representative.
- 3.1.8 Install ventilated type tray in corridors and as vertical risers. Where cable trays pass through solid walls and floors, trays shall be solid

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type with cover and shall extend a minimum of 450 mm on each side of the wall or floor.

- 3.1.9 Sharp metal edges in cable trays which could cut the cable shall be smoothed and the cable dressed away from these edges. Manufacturer surface imperfections shall be touched up with a cold galvanizing coating before installing cable.
- 3.1.10 Support suspended cable tray from trapeze style hangers with hangers spaced as recommended by the manufacturer based on a maximum load capacity for the tray. Support trays at all corners, offsets and tee fittings
- 3.1.11 Where shown and appropriate, support cable tray from wall using a cantilever support arrangement. Cable trays may be supported using wall mounted support on masonry walls or from the building steel only.
- 3.1.12 Cable tray location and mounting heights to be coordinated on site with other trades to provide minimum headroom and serviceability. Verify drawing details to allow for all services run in ceiling spaces. Provide vertical and horizontal offsets as required to suit job site conditions.
- 3.1.13 Cable tray sections shall be joined by approved connector plates and rust-resistant (plated) hardware. Torque all hardware as per manufacturer's recommendations.
- 3.1.14 Cables shall be secured in place in tray with tie wraps where in horizontal runs and with cable clamps in vertical runs. Low tension cabling shall be secured to tray by use of Velcro style straps. Support cables routed vertically through a service riser with a basket type wire grip equal to Hubbell Kellems grip for power cables and data cables including fiber optic cables.
- 3.1.15 Unless otherwise indicated, bond all cable tray with a minimum #2 AWG bare copper bonding conductor installed continuously within the full length of all cable trays. Securely connect the bond wire to the tray at each end and at a minimum of 15m intervals. Connect bonding conductor to the building ground system at one or both ends.
- 3.1.16 Provide pulleys and rollers to install cables.
- 3.1.17 Where cable tray passes through fire separations install fire stop material to maintain proper fire rating.
- 3.1.18 Power distribution conduits shall not be located within 200mm of the cable tray.
- 3.1.19 There shall be no joints or splices within the cable tray.
- 3.1.20 The cable tray system is for extra-low voltage cabling only. There shall be no cables within the tray that has a voltage exceeding 30V.



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**3.2 Maintenance – Clearances**

3.2.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

**3.3 Cleaning**

3.3.1 Proceed in accordance with Section 01 74 00 Cleaning and waste management.

3.3.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

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**1. GENERAL**

**1.1 Section Includes**

- 1.1.1 Materials and installation for Installation of Cables in Trenches and Ducts.

**1.2 Related Sections**

- 1.2.1 This section of the specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.
- 1.2.2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- 1.2.3 Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- 1.2.4 Section 26 05 00 - Common Work Results - Electrical.

**1.3 References**

- 1.3.1 Canadian Standards Association, (CSA International).
  - .1 CSA C22.1 (current edition), Canadian Electrical Code, Part 1
- 1.3.2 Insulated Cable Engineers Association, Inc. (ICEA).

**1.4 Sustainable Requirements**

- 1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.
- 1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.
- 1.4.3 Waste Management and Disposal
  - .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
  - .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
  - .3 Place materials defined as hazardous or toxic waste in designated containers.
- 1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:

- .1 Construction Waste Management / Product Waste Recyclability.
  - .2 Recycled Content.
  - .3 Local and Regional Materials.
  - .4 Certified Wood.
  - .5 Construction Indoor Air Quality (IAQ) management.
  - .6 VOC/Low-Emitting Materials Compliance.
- 1.4.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## **1.5 Submittals**

- 1.5.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- 1.5.2 Product Data:
- .1 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Sustainable Requirements: Construction and include: product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish.
- 1.5.3 Sample:
- .1 Submit samples in accordance with Section 01 33 00 - Submittal.
- 1.5.4 Quality Assurance:
- .1 Engineer reserves the right to witness standard factory testing of the above.
  - .2 Submit site tests results of installed electrical systems and instrumentation
- 1.5.5 Closeout Submittals:
- .1 Provide maintenance data for materials for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
  - .2 Data necessary for maintenance of materials.
  - .3 Manufacturers recommended list of spare parts.

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**1.6 Delivery, Storage and Handling**

- 1.6.1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- 1.6.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- 1.6.3 Handle materials with suitable lifting equipment.
- 1.6.4 Store materials in heated, dry, weather-protected enclosure

**2 . PRODUCTS**

**2.1 Cable Protection**

- 2.1.1 38 mm x 140 mm planks pressure treated with clear, or copper naphthenate or 5% pentachlorophenol solution, water repellent preservative.

**2.2 Markers**

- 2.2.1 Concrete type cable markers shall be 600 mm x 600 mm x 100 mm with words, cable, joint or conduit impressed in top surface, with arrows to indicate change in direction of cable and duct runs.
- 2.2.2 Cedar post type markers shall be 89 mm x 89 mm, 1.5 m long, pressure treated with clear, or copper naphthenate or 5% pentachlorophenol solution, water repellent preservative, with nameplate fastened near post top, on side facing cable or conduit to indicate depth and direction of duct and cable runs.
  - .1 Nameplate: aluminum anodized 89 mm x 89 mm, 1.5 mm thick mounted on cedar post with Mylar label 0.125 mm thick with words cable, joint or conduit with arrows to indicate change in direction.

**3 . EXECUTION**

**3.1 Direct Burial of Cables**

- 3.1.1 After sand bed specified in Section 31 23 33.01 - Excavating, Trenching and Backfilling, is in place, lay cables maintaining 75 mm clearance from each side of trench to nearest cable. Do not pull cable into trench.
- 3.1.2 Provide offsets for thermal action and minor earth movements. Offset cables 150 mm for each 60 m run, maintaining minimum cable separation and bending radius requirements.
- 3.1.3 Make termination and splice only as indicated leaving 0.6 m of surplus cable in each direction.

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- .1 Make splices and terminations in accordance with manufacturer's instructions using approved splicing kits.
  - 3.1.4 Underground cable splices not acceptable.
  - 3.1.5 Minimum permitted radius at cable bends for rubber, plastic or lead covered cables, eight times diameter of cable; for metallic armoured cables, 12 times diameter of cables or in accordance with manufacturer's instructions.
  - 3.1.6 Cable separation:
    - .1 Maintain 75 mm minimum separation between cables of different circuits.
    - .2 Maintain 300 mm horizontal separation between low and high voltage cables.
    - .3 When low voltage cables cross high voltage cables maintain 300 mm vertical separation with low voltage cables in upper position.
    - .4 At crossover, maintain 75 mm minimum vertical separation between low voltage cables and 150 mm between high voltage cables.
    - .5 Maintain 300 mm minimum lateral and vertical separation for fire alarm and control cables when crossing other cables, with fire alarm and control cables in upper position.
    - .6 Install treated planks on lower cables 0.6 m in each direction at crossings.
  - 3.1.7 After sand protective cover specified in Section 31 23 33.01 - Excavating, Trenching and Backfilling, is in place, install continuous row of overlapping 38 x 140 mm interlocking cable blocks as indicated to cover length of run.

### **3.2 Cable Installation in Ducts**

- 3.2.1 Install cables as indicated in ducts.
  - .1 Do not pull spliced cables inside ducts.
- 3.2.2 Install multiple cables in duct simultaneously.
- 3.2.3 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- 3.2.4 To facilitate matching of colour coded multi-conductor control cables reel off in same direction during installation.
- 3.2.5 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.
- 3.2.6 After installation of cables, seal duct ends with duct sealing compound.

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**3.3 Markers**

- 3.3.1 Mark cable every 150 m along cable or duct runs and changes in direction.
- 3.3.2 Mark underground splices.
- 3.3.3 Where markers are removed to permit installation of additional cables, reinstall existing markers.
- 3.3.4 Install concrete cable markers within 180 m from each side of runway centreline; 45 m from each side of taxi way centreline; 50 m from edge of taxi ramps or aprons.
- 3.3.5 Install cedar post type markers.
- 3.3.6 Lay concrete markers flat and centred over cable with top flush with finish grade.

**3.4 Field Quality Control**

- 3.4.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.
- 3.4.2 Perform tests using qualified personnel. Provide necessary instruments and equipment.
- 3.4.3 Check phase rotation and identify each phase conductor of each feeder.
- 3.4.4 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.
- 3.4.5 Pre-Acceptance Tests:
  - .1 After installing cable but before splicing and terminating, perform insulation resistance test with 1,000 V megger on each phase conductor.
  - .2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.
- 3.4.6 Acceptance Tests
  - .1 Ensure that terminations and accessory equipment are disconnected.
  - .2 Ground shields, ground wires, metallic armour and conductors not under test.
  - .3 High Potential (Hipot) Testing.
    - .1 Conduct hipot testing in accordance with manufacturer's ICEA recommendations.
  - .4 Leakage Current Testing:

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- .1 Raise voltage in steps from zero to maximum values as specified by ICEA manufacturer for type of cable being tested.
  - .2 Hold maximum voltage for specified time period by ICEA manufacturer.
  - .3 Record leakage current at each step.
- 3.4.7 Provide Engineer with list of test results showing location at which each test was made, circuit tested and result of each test.
- 3.4.8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

**3.5 Maintenance – Clearances**

- 3.5.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

**3.6 Cleaning**

- 3.6.1 Proceed in accordance with Section 01 74 00 Cleaning and waste management.
- 3.6.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**1. GENERAL**

**1.1 Section Includes**

- 1.1.1 Materials and installation for Pathways for Communications Systems.

**1.2 Related Sections**

- 1.2.1 This section of the Specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

**1.3 Sustainable Requirements**

- 1.3.1 Materials and products in accordance with Sustainable Requirements: Construction.
- 1.3.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.
- 1.3.3 Waste Management and Disposal
- .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
  - .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
  - .3 Place materials defined as hazardous or toxic waste in designated containers.
- 1.3.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:
- .1 Construction Waste Management / Product Waste Recyclability.
  - .2 Recycled Content.
  - .3 Local and Regional Materials.
  - .4 Certified Wood.
  - .5 Construction Indoor Air Quality (IAQ) management.
  - .6 VOC/Low-Emitting Materials Compliance.
- 1.3.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this



project. Any proposed alternative products must meet the Sustainable requirements of the project.Products

**1.4 Description of System**

1.4.1 Provide a complete system of conduits and boxes to suit wiring of the following systems:

- .1 Communication cabling
- .2 CATV
- .3 Security
- .4 Lighting control
- .5 Access control
- .6 CCTV
- .7 Metering
- .8 Wireless
- .9 DDC
- .10 BMS
- .11 Elevators
- .12 PV array

1.4.2 The conduit system is to be complete with all necessary fittings and components to facilitate the future system installation whether or not each and every item is necessarily mentioned.

1.4.3 The electrical division is to be responsible for supply and installation of all backboards, conduits, pullboxes, junction boxes, device boxes and terminal panels where required to provide a complete raceway system.

1.4.4 Install proprietary or specialists back boxes if provided by the systems installer.

1.4.5 Any indicated conduit and panel sizes are not to be reduced, or the layouts revised, without prior approval of the Engineer.

1.4.6 The design of the conduit system is based on a generic system layout wherever possible.

**2 . PRODUCTS**

**2.1 Material**

2.1.1 Conduits: 27mm EMT type, in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings (16111).

2.1.2 Cabletroughs: in accordance with Section 26 05 36 - Cable Trays for Electrical Systems (16114).

- 2.1.3 Junction boxes, cabinets type E: in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets (16131).
- 2.1.4 Outlet boxes, conduit boxes and fittings: in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets (16131).
- 2.1.5 Fish wire: polypropylene type.

### **3 . EXECUTION**

#### **3.1 Installation**

- 3.1.1 Install empty raceway system, including under-floor distribution system, fish wire, terminal cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves and caps, cable troughs, service poles, miscellaneous and positioning material to constitute complete system.
- 3.1.2 Verify outlet height, layout and orientation in areas where equipment is to be positioned in millwork.
- 3.1.3 All outlet boxes are to be flush-mounted in all areas, excluding mechanical rooms, electrical rooms and above removable ceilings.
- 3.1.4 Adjust the position of outlets in finished masonry walls to suit masonry course lines. Coordinate cutting of masonry walls to achieve neat openings for all boxes. All cutting of masonry work for installation of electrical fittings is to be done using rotary cutting equipment.
- 3.1.5 No sectional or handy boxes are to be installed.
- 3.1.6 Provide vapour barrier wrap or boots behind outlets mounted in exterior walls. Maintain the integrity of the vapour barrier and insulation to prevent condensation through boxes.
- 3.1.7 Coordinate the location and mount heights of outlets above counters, benches, splash-backs, and with respect to heating units and plumbing fixtures. Coordinate with architectural details.
- 3.1.8 Separate outlets located immediately alongside one another are to be mounted at exactly the same height above the finished floor. Similarly, outlets mounted on a wall in the same general location at varying heights are to be on the same vertical centre-lines unless otherwise noted.
- 3.1.9 Where outlet boxes penetrate through a fire separation, ensure that the boxes are externally tightly fitted with an approved non-combustible material to prevent passage of smoke or flame in the event of a fire.

#### **3.2 Coordination**

- 3.2.1 Coordinate detail requirements where system and equipment suppliers are known.

- 3.2.2 Where available, refer to architectural layouts for mounting heights and positioning of outlet boxes.

**3.3 Maintenance – Clearances**

- 3.3.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

**3.4 Cleaning**

- 3.4.1 Proceed in accordance with Section 01 74 00 Cleaning and waste management.
- 3.4.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

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**1. GENERAL**

**1.1 Section Includes**

- 1.1.1 Materials, components, cabinets, instruments and installation for metering and switchboard Instruments.

**1.2 Related Sections**

- 1.2.1 Section 01 33 00 - Submittal Procedures.  
1.2.2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.  
1.2.3 Section 26 05 00 - Common Work Results - Electrical.

**1.3 References**

- 1.3.1 Canadian Standards Association, (CSA International):  
.1 C22.1 (current edition), Canadian Electrical Code, Part 1  
.2 CAN3-C17-M84(R1999), Alternating - Current Electricity Metering.

**1.4 Sustainable Requirements**

- 1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.  
1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.  
1.4.3 Waste Management and Disposal  
.1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.  
.2 Avoid using landfill waste disposal procedures when recycling facilities are available.  
.3 Place materials defined as hazardous or toxic waste in designated containers.  
1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:  
.1 Construction Waste Management / Product Waste Recyclability.

- .2 Recycled Content.
- .3 Local and Regional Materials.
- .4 Certified Wood.
- .5 Construction Indoor Air Quality (IAQ) management.
- .6 VOC/Low-Emitting Materials Compliance.

1.4.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## 1.5 **Submittals**

1.5.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

1.5.2 Product Data:

- .1 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with and include: product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish.
- .3 Indicate meter outline dimensions, panel drilling dimensions and include cut-out template.

1.5.3 Sample:

- .1 Submit samples in accordance with Section 01 33 00 - Submittal.

1.5.4 Quality Assurance:

- .1 Engineer reserves the right to witness standard factory testing of the above.
- .2 Submit site tests results of installed electrical systems and instrumentation

1.5.5 Closeout Submittals:

- .1 Provide maintenance data for materials for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Data necessary for maintenance of materials.
- .3 Manufacturers recommended list of spare parts.

## 1.6 **Delivery, Storage and Handling**

1.6.1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.

- 1.6.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- 1.6.3 Handle materials with suitable lifting equipment.
- 1.6.4 Store materials in heated, dry, weather-protected enclosure

## **1.7 Description of System**

- 1.7.1 Provide all material, equipment and services necessary for a complete and operational metering system.
- 1.7.2 Building Management System (BMS) Integration
  - .1 The system protocol shall be native BACnet/IP certified and fully compatible with the BMS. Gateways will not be accepted. The system software programmable controllers shall reside/communicate with the BACnet/IP on the management or automation level networks of the Building Management System.

## **2 . PRODUCTS**

### **2.1 Meter**

- 2.1.1 Polyphase, kilowatt-hour energy meter shall be in accordance with CAN3-C17.
- 2.1.2 Polyphase, kilowatt, kilovar, demand, thermally lagged, integrating, indicating, recording meter: to CAN3-C17.
- 2.1.3 Combination energy and demand meter shall be in accordance with CAN3-C17.
- 2.1.4 Ratings shall be as indicated.
- 2.1.5 Register shall be range, pulse contacts for transmitting signal.
- 2.1.6 Provision for remote sensing.

### **2.2 Meter Cabinet**

- 2.2.1 Sheet steel CSA enclosure with meter backplate, to accommodate meters, test terminal block and associated equipment, factory installed and wired.

### **2.3 Metering Instrument Transformer Cabinet**

- 2.3.1 Sheet steel CSA enclosure to accommodate potential and current transformers.

### **2.4 Test Terminal Blocks**

- 2.4.1 Test terminal blocks as required.

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**2.5 Indicating Instruments**

2.5.1 Analogue indicating instruments shall be to ANSI C39.1, 1% accuracy, switchboard mounting, semi-flush, operated from shunt, current transformer.

- .1 Ammeter range shall be as indicated.
- .2 Voltmeter range shall be as indicated.
- .3 Wattmeter range shall be as indicated.
- .4 Varmeter range shall be as indicated.
- .5 Frequency meter range shall be as indicated.
- .6 Power factor meter range shall be as indicated.
- .7 Synchroscope range shall be as indicated.

**2.6 Instrument Selector Switches**

2.6.1 Voltmeter and ammeter selector switches: rotary, multi-position, maintained contacts, panel mounting, round notched handle, rated to suit instruments, nameplate marked as indicated to coincide with each rotary position. Ammeter selector switches designed to preclude opening of current circuits.

2.6.2 Four position ammeter selector switches identified "off-A-B-C".

2.6.3 Four position voltmeter selector switches identified "A-B, B-C, C-A, off".

2.6.4 Seven position voltmeter selector switches identified "A-B, B-C, C-A, off, A-N, B-N, C-N".

**2.7 Recording Instruments**

2.7.1 Recording instruments shall have 1% accuracy switchboard mounting, direct acting marking device, continuous marking, round strip chart size electric driver timing mechanism, chart speed in mm/h, scale calibrated

- .1 Ammeter range shall be as indicated.
- .2 Voltmeter range shall be as indicated.
- .3 Wattmeter: range shall be as indicated.
- .4 Varmeter range shall be as indicated.
- .5 Frequency mete: range shall be as indicated.
- .6 Power factor meter range shall be as indicated.

**2.8 Shop Installation**

2.8.1 Install meters and instrument transformers in separate compartment of switchboard.

2.8.2 Install instruments on switchboard

- 2.8.3 Ensure adequate spacing between current transformers installed on each phase.
- 2.8.4 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, transducers, signal sources, electrical supplies.

### **3 . EXECUTION**

#### **3.1 Installation**

- 3.1.1 Install meters in location free from vibration and shock.
- 3.1.2 Make connections in accordance with diagrams.
- 3.1.3 If applicable, ensure power factor corrective equipment connected on load side of meter.
- 3.1.4 Connect meter and instrument transformer cabinets to ground.
- 3.1.5 Locate meters within 9 m of instrument transformers. Use 32 mm conduit for interconnections. Use separate conduit for each set of current transformer connections, exclusive for metering.

#### **3.2 Field Quality Control**

- 3.2.1 Conduct tests in accordance with Section 26 05 00 - Common Work Results - Electrical and in accordance with manufacturer's recommendations.
- 3.2.2 Perform simulated operation tests with metering, instruments disconnected from permanent signal and other electrical sources.
- 3.2.3 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, transducers, signal sources and electrical supplies.
- 3.2.4 Perform tests to obtain correct calibration.
- 3.2.5 Do not dismantle meters and instruments.

#### **3.3 Maintenance – Clearances**

- 3.3.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

#### **3.4 Cleaning**

- 3.4.1 Proceed in accordance with Section 01 74 00 Cleaning and waste management.
- 3.4.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.



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**END OF SECTION**

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## 1. GENERAL

### 1.1 Summary

- 1.1.1 Provide labor, material, equipment, related services, and supervision required, including, but not limited to, manufacturing, fabrication, erection, and installation for electrical power monitoring and control equipment as required for the complete performance of the work, and as shown on the project drawings and as herein specified.

### 1.2 Standards & References

- 1.2.1 American National Standards Institute (ANSI):
- .1 ANSI C12.20, "Electricity Meters - 0.2 and 0.5 Accuracy Classes – Part 5.5.4 Accuracy tests."
  - .2 ANSI / ISA – 61010-1, "Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements."
  - .3 ANSI / ISA – 61010-2-030, "Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 2-030: Particular requirements for testing and measuring circuits."
- 1.2.2 Canadian Standards Association (CSA):
- .1 CAN/CSA C22.2 No. 61010-1, "Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements."
  - .2 CAN/CSA C22.2 No. 61010-2-030, "Safety Requirements for Electrical Equipment for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 2-030: Particular requirements for testing and measuring circuits."
  - .3 CSA Standard C17; Electricity Meters.
  - .4 CSA Standard C13; Instrument Transformers.
- 1.2.3 Measurement Canada
- .1 Measurement Canada LMB-EG-07 Specifications for Approval of Type of Electricity Meters, Instrument Transformers and Auxiliary Devices. Canadian Approval and Calibration Services Laboratory(ACSL).
- 1.2.4 ROP Mechanical Specifications
- .1 ROP Mechanical Specifications, Division 15 – Building Automation System (BAS) integration and metering.

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**1.3 Submittals**

- 1.3.1 **Product Data:** Submit product data showing material proposed. Submit sufficient information to determine compliance with the Drawings and Specifications.
- 1.3.2 **Shop Drawings:** Submit shop drawings for each product and accessory required. Include information not fully detailed in manufacturer's standard product data.
- 1.3.3 **Wiring Diagrams:** Submit wiring diagrams detailing power, signal, and control systems, clearly differentiating between manufacturer-installed wiring and field-installed wiring, and between components provided by the manufacturer and those provided by others.
- 1.3.4 **Operation and Maintenance Data:** Submit operation and maintenance data for electrical power monitoring and control equipment to include in operation and maintenance manuals specified in **Division 01 - General Requirements**.

**1.4 Quality Assurance**

- 1.4.1 Manufacturer shall be a firm engaged in the manufacture of electrical power monitoring and control equipment of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of five years. The product test and calibration process shall be part of a quality program that is certified to ISO 9001.

**2 . ELECTRICAL METERING EQUIPMENT AND DEVICES:**

**2.1 Primary Service Entrance Energy Meter**

- 2.1.1 **Functionality:** Revenue metering and advanced power quality analysis.
- 2.1.2 **Applications:** includes but not limited to Tariff metering, distribution metering, demand side management, power quality analysis, Energy Pulsing and totalization, etc.
- 2.1.3 **Mounting:** The digital power meter instrument base unit must be flush mountable available as a combined front panel and base unit that can be mounted in switchgear cabinet doors.
- 2.1.4 **Basis of Design:** The revenue grade metering package designed in accordance with Ontario/ROP Specifications, tagged with region of Peel standard tags, Measurement Canada Revenue approved, sealed, identical to or exceed the functionality of Schneider Electric Power Logic design ION8650 / Model M8650A0C0H6E1A3A - AA403.
- 2.1.5 **Features:** The revenue grade metering device used to monitor incoming utility medium voltage mains for grid revenue, substation

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automation, network management, energy cost allocation, power quality analysis, asset management, operational efficiency, and compliance reporting, shall have at minimum the following features:

- .1 Form factor—ANSI socket 9S, 29S, 35S and 36S; user-selectable 9S, 29S, and 36S. FT-21 switchboard/draw-out style as required.
- .2 Voltage and current inputs—3 phase inputs; Direct connect to circuits up to 600 VAC, eliminating the need for voltage (potential) transformers; 5 A nominal current inputs; equipped with two spring-loaded socket grounding tabs to ensure reliable electrical contact; mechanical bonding ground that may be optionally connected.
- .3 Supported measured and calculated metering parameters—four-quadrant metering, full range of three-phase voltage, current, power and energy measurements, percentage unbalance, power factor (true and displacement per phase and three-phase) demand (minimum/maximum, present demand interval, running average demand, and predicted demand), total harmonic distortion (THD), individual current, and voltage harmonics readings.
- .4 High accuracy standards—meet in a single device over the Class 2/10/20 current classes in a single device (over all environmental conditions and influence factors outlined in the standard and its referenced standards).
  - .1 Less than half the measurement error of ANSI C12.20 class 0.2 accuracy over the Class 2/10/20 current classes.
  - .2 Less than half the measurement error of IEC62053-22 class 0,2S accuracy from 0.010A- 20A in a single device.
  - .3 Less than 20 times the measurement error of IEC62053-23 class 2 accuracy from 0.010A-20A in a single device.
  - .4 Support up to 8 points of magnitude and phase correction for each voltage and current measurement input.
  - .5 Overvoltage/overcurrent protection—capable of meeting all accuracy specifications after withstanding 500A for 1 second or 2500 VAC RMS for 1 minute (with internal protection disabled).
- .5 High-visibility display with the following characteristics:
  - .1 User programmable to display up to 4 quantities per screen.

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- .2 Capable of displaying graphical metering data such as phasor diagrams, watt-hour disk simulator, spectral components etc.
  - .3 Capable of displaying harmonics content (THD, K-factor, crest-factor) in histogram format.
  - .6 Input/outputs—provide at least 4 digital inputs and 4 digital output for equipment status/position monitoring and equipment control or interfacing (e.g. Pulse output relay operation for kWh/kVARh total/imported/exported). Provide at least 4 analog 4-20 mA inputs.
  - .7 Communications Capability.
    - .1 Ethernet, RS485/232 serial, ANSI 12.18 compliant optical port.
    - .2 Protocol support: DNP3.0(Ethernet/serial); Modbus slave/mastering (Ethernet/serial); SMTP/SNTP(Ethernet); MV90(Ethernet/serial); XML(TCP); IEC61850(TCP).
    - .3 IRIG-B port to allow GPS time synchronization to +/- 1ms accuracy from GPS source.
    - .4 Automatically e-mail alarm notifications, scheduled system status updates and data logs on an event-driven or scheduled basis.
  - .8 On-board logging.
    - .1 Non-volatile time stamps with on-board logging of I/O conditions, minimum/maximum values, energy and demand, maintenance data, alarms, and any measured parameters; trending and short-term forecasting of energy and demand.
    - .2 Ability to record any parameter in the meter and trigger multiple such recordings in continuous succession (triggered manually or through internal event conditions, including periodic timers or set-point activity).
    - .3 Continuous recording of intervals from 100 years down to ½ cycle.
    - .4 Number of records (depth) and overflow conditions (stop-when-full or circular) shall be programmable.
  - .9 On-board web server that can be used for:
    - .1 Access to real-time values and basic power quality data through a web browser.
    - .2 Basic meter configuration.
  - .10 Alarming capabilities:
    - .1 Set-point driven alarming capability.

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- .2 Generate an email notification upon an alarm condition.
  - .3 Millisecond resolution timestamp on alarm entries
  - .4 Support consecutive high-speed alarm conditions for alarms and waveform recording, triggering on a cycle-by-cycle basis with no "dead" time between events (i.e., no need for a re-arming delay time between events).
  - .5 Operate relays or initiate data logging captures on alarm conditions.
  - .6 Control any number of digital output relays in an AND or an OR configuration using pulse mode or latch mode operation for control and alarm purposes.
  - .7 Combine any logical combination of any number of available set-point conditions to control an internal or external function or event.
  - .11 Time-stamped event log (1 ms resolution) with the following characteristics:
    - .1 Support at least 500 events, programmable up to a maximum of 20000 events.
    - .2 For each event, record date and time, cause and effect, and priority.
    - .3 Record all events relating to set-point activity, relay operation, and self-diagnostics.
    - .4 Capable of synchronizing time stamps between devices on the same serial communications network, to within 100 mss.
    - .5 Minimum event recording response time is  $\frac{1}{2}$  cycle (8.3ms 60Hz, 10ms 50Hz) for high- speed events and 1 second for other events.
    - .6 Programmable set-point events.
  - .12 Power quality analysis and compliance monitoring.
    - .1 Without separate software, shall have the following capabilities:
      - .1 Display statistical indicators of power quality on the front display.
      - .2 Compare power quality parameters (present, predicted, average, or calculated values) with an absolute or relative set point. When set-point is exceeded, alert via e-mail or pager, or enable control via a local interface to PQ mitigation equipment or control systems through relays and analog or digital outputs.
      - .3 Support EN50160 reporting for compliance monitoring.

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- .2 Third party Laboratory tested to the power quality standards IEC 61000-4-30 Class 'A' 2nd edition, IEC 61000-4-15, and Flicker.
    - .3 Low pass anti-aliasing signal filters to meet the requirements of IEC 61000-4-7:2002.
  - .13 Fault recording and waveform capture.
    - .1 Simultaneously capture voltage and current channels for sub-cycle disturbance, transients, as well as multi-cycle sags, swells and outages in quick succession, without dead time between recordings.
    - .2 1024 samples per cycle waveform recording, minimum 17/20  $\mu$ s transient capture (60/50 Hz).
    - .3 Configurable to provide COMTRADE waveforms for all captures.
  - .14 Disturbance detection.
    - .1 High-speed sag/swell detection of voltage disturbances on a cycle-by-cycle basis, providing duration of the disturbance, the minimum, maximum, and average value of the voltage for each phase during the disturbance.
    - .2 Detect disturbances less than one cycle in duration.
    - .3 Determine the location of a disturbance more quickly and accurately by determining the direction of the disturbance relative to the meter. Capture analysis results in the event log, along with a timestamp and confidence level indicating level of certainty.
  - .15 Programmability.
    - .1 Capable of deriving values for any combination of measured or calculated parameter using arithmetic, trigonometric, logic, thermocouple linearization, and temperature conversion functions,
    - .2 Capable (through a graphical flexible programming language) of creating programmable modules with metered and input data through arithmetic and logic operations (such as minimum, maximum, set point, digital input, digital output, etc.) that can be arbitrarily linked together to create application functionality.
    - .3 System Integration—capable of integrating with custom reporting, spreadsheet, database and other applications with XML compatible data.
  - .16 Field programmability: The power meter is field programmable as follows:
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- .1 Basic parameters: Voltage input scale, voltage mode (Wye, Delta, single phase), current input scale, auxiliary input and output scales, and communications setup parameters are programmable from the front panel.
  - .2 All basic parameters described above, plus additional setpoint/relay and data log setup parameters may be programmed via the communications port using a portable or remotely located computer terminal.
  - .3 Custom configuration of all operating parameters is possible through a graphical, flexible programming language.
  - .4 The configuration of the device will be done using programmable modules. The modules can be linked together in an arbitrary manner to create arbitrary functionality. Some example module types include min, max, setpoint, digital input, and digital output.
  - .5 Programming through a computer can be secured by user ID and password.
  - .6 Programming through the front panel is secured by password.
  - .7 Programmability shall be sectioned such that when the power meter is sealed it shall still be configurable to an extent that does not affect the accumulation of revenue metering- related data.
  - .17 Safety/grounding
    - .1 The power meter shall have two spring-loaded socket grounding tabs on the base to ensure a reliable electrical contact with the socket.
    - .2 The power meter shall have an optional mechanical bonding ground to allow for a permanent grounding method.

## **2.2 Advanced Energy And Power Quality Digital Meter**

2.2.1 **Functionality:** Advanced Energy and Power Quality Analysis.

2.2.2 **Applications:** Where Energy Demand and PQ Monitoring is required on the following Incomers/Feeders:

- .1 Main Incomer (s) breaker(s) on all switchgears and switchboards,
- .2 Main Sub-Station Transformers: on the secondary side of each substation transformer with primary of 44000 Volts, 27600 Volts, 13800 Volts or 4160 Volts and a secondary of 4160 Volts or 600Volts.



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- .3 Distribution Transformers: on the secondary side of each distribution transformer with a primary of 4160 Volts and a secondary of 600 Volts
- 2.2.3 **Mounting:** The digital energy and power quality meter instrument shall be designed for front-panel mounting supporting integrated or remote displays. The meter with integrated display option is designed to fit DIN standard 192 cutout (186 mm by 186 mm)
- 2.2.4 **Basis of Design:** The Energy and Power Quality metering package designed in accordance with Ontario/ROP Specifications, Measurement Canada approved, sealed, identical to or exceed the functionality of Schneider Electric Power Logic design **ION7650 / Model M7650A0C0B6F1N0E**
- 2.2.5 **Features:** The metering device used to monitor medium voltage mains for network management, energy cost allocation, power quality analysis, asset management, operational efficiency, and compliance reporting, shall have at minimum the following features:
- .1 Voltage and current inputs—3 phase inputs; direct connect to circuits up to 600 VAC, eliminating the need for voltage (potential) transformers; 5 A nominal current inputs.
  - .2 Supported measured and calculated metering parameters—four-quadrant metering, full range of 3 phase voltage, current, power and energy measurements, percentage unbalance, power factor (true and displacement per phase and 3 phase) demand (minimum/maximum, present demand interval, running average demand, and predicted demand), total harmonic distortion (THD), individual current and voltage harmonics readings.
  - .3 High accuracy standards—meets stringent IEC and ANSI measurement accuracy standards such as IEC 62053-22 Class 0.2S, ANSI C12.20 0.2 Class 10 and 20.
  - .4 High-visibility display with the following characteristics:
    - .1 User programmable to display up to 4 quantities per screen.
    - .2 Capable of displaying graphical metering data such as phasor diagrams, watt-hour disk simulator, spectral components etc.
    - .3 Capable of displaying harmonics content (THD, K-factor, crest-factor) in histogram format.
  - .5 Input/outputs—provide at least 4 digital inputs and 4 digital output for equipment status/position monitoring and equipment control or interfacing (e.g. Pulse output relay operation for kWh/kVARh total/imported/exported). Provide at least 4 analog 4-20 mA inputs.
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- .6 Communications Capability—multi-port serial and Ethernet communications with at least 2 Modbus serial ports and 1 Ethernet port offering e-mail on alarm, web server, and an Ethernet-to-serial RS-485 gateway able to serve as a Modbus Master in a communication network, either through reading and logging data from other Modbus devices, or serving as a Modbus serial to Ethernet gateway.
  - .7 On-board logging:
    - .1 Non-volatile time stamps with on-board logging of I/O conditions, minimum/maximum values, energy and demand, maintenance data, alarms, and all measured parameters; trending and short-term forecasting of energy and demand.
    - .2 Ability to record all parameters in the meter and trigger multiple such recordings in continuous succession (triggered manually or through internal event conditions, including periodic timers or set-point activity).
    - .3 Continuous recording of intervals from 100 years down to one-half ( $\frac{1}{2}$ ) cycle.
    - .4 Number of records (depth) and overflow conditions (stop-if-full or circular) shall be programmable
  - .8 On-board web server can be used for:
    - .1 Access to real-time values and basic power quality information using standard web browser.
    - .2 Basic meter configuration.
  - .9 Alarming capabilities:
    - .1 Set-point driven alarming capability in which the meter has the capability of learning set- point limits based on the system behavior.
    - .2 Generate an email notification upon an alarm condition.
    - .3 Millisecond resolution timestamp on alarm entries.
    - .4 Support consecutive high-speed triggers for alarms and waveform recording, triggering on a cycle-by-cycle basis with no “dead” time between events (i.e. no need for a re- arming delay time between events).
    - .5 Operate relays or initiate data logging captures on alarm conditions
    - .6 Control all digital output relays in an AND or an OR configuration, using pulse mode or latch mode operation, for control and alarm purposes.

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- .7 Combine all logical combinations of available set-point conditions to control an internal or external function/event.
  - .10 Time-stamped event log (1 ms resolution) with the following characteristics:
    - .1 Support at least 500 events, programmable up to a maximum of 20000 events.
    - .2 For each event, record date and time, cause and effect, and priority.
    - .3 Record all events relating to set-point activity, relay operation and self-diagnostics.
    - .4 Capable of synchronizing time stamps between devices on the same serial communications network to within 100 ms.
    - .5 Minimum event recording response time is one-half ( $\frac{1}{2}$ ) cycle (8.3ms 60Hz, 10ms 50Hz) for high-speed events and 1 second for other events.
    - .6 Programmable set-point events.
  - .11 Power quality analysis and compliance monitoring:
    - .1 Without separate software, have the following capabilities:
      - .1 Display statistical indicators of power quality on the front display.
      - .2 Compare power quality parameters (present, predicted, average, or calculated values) with an absolute or relative set point, and alert (via e-mail or pager), or enable control (via a local interface to power quality (PQ) mitigation equipment/control systems through relays and analog or digital outputs) if set-point is exceeded.
      - .3 Support EN50160 reporting for compliance monitoring.
    - .2 Third party laboratory tested to the power quality standards—IEC 61000-4-30 Class 'A' 2nd edition, IEC 61000-4-15 – Flicker.
    - .3 Low pass anti-aliasing signal filters to meet the requirements of IEC 61000-4-7:2002.
  - .12 Fault recording and waveform capture:
    - .1 Simultaneously capture voltage and current channels for sub-cycle disturbance, transients, as well as multi-cycle sags, swells and outages in quick succession, without dead time between recordings.

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- .2 1024 samples per cycle waveform recording, minimum 17/20  $\mu$ s transient capture (60/50 Hz).
  - .3 Configurable to provide COMTRADE waveforms for all captures.
  - .13 Disturbance detection:
    - .1 High-speed sag/swell detection of voltage disturbances on a cycle-by-cycle basis, providing duration of the disturbance, the minimum, maximum, and average value of the voltage for each phase during the disturbance.
    - .2 Detect disturbances less than one cycle in duration.
    - .3 Determine the location of a disturbance more quickly and accurately by determining the direction of the disturbance relative to the meter. Capture analysis results in the event log, along with a timestamp and confidence level indicating level of certainty.
    - .4 Programmability:
    - .5 Capable of deriving values for combinations of measured or calculated parameters, using arithmetic, trigonometric, logic, thermocouple linearization, and temperature conversion functions.
    - .6 Capable (through a graphical flexible programming language) of creating programmable modules with metered and input data, through arithmetic and logic operations (such as minimum, maximum, set point, digital input, digital output, etc.) that can be arbitrarily linked together to create application functionality.
  - .14 Field programmability
    - .1 The power monitoring instrument is field programmable as follows:
    - .2 Basic parameters: Voltage input scale, voltage mode (Wye, Delta, single phase), current input scale, auxiliary input and output scales, and communications set-up parameters are programmable from the front panel, without the need of external software.
    - .3 The power monitoring instrument firmware shall be field upgradeable.

## 2.3 **Sub-Metering For Energy And Electrical Monitoring**

2.3.1 **Functionality:** Energy Use and Electrical Monitoring

2.3.2 **Applications:** Where Energy Usage & Demand analysis, Sub-metering/billing, Electrical Monitoring, pinpointing energy savings,

optimizing equipment efficiency and utilization, and performing a basic assessment of the power quality of the electrical network.

2.3.3 **Mounting:** designed for front-panel mounting (Flush-mounted) supporting integrated or remote displays.

2.3.4 **Basis of Design:** The Energy and Electrical monitoring metering package designed in accordance with Ontario/ROP Specifications, Measurement Canada approved, identical to or exceed the functionality of Schneider Electric Power Logic design **PM5000 Series / Model METSEPM5560**

2.3.5 **Features:** The metering device used to provide the measurement capabilities needed to allocate energy usage, perform tenant metering and sub billing, pinpoint energy savings, optimize equipment efficiency and utilization, and perform a basic assessment of the power quality of the electrical network, shall have at minimum the following features:

- .1 Direct connect to circuits up to 600 VAC, eliminating the need for voltage (potential) transformers; Four metered 5 A nominal current inputs for 3 phase measurement plus neutral.
- .2 Hardware:
  - .1 A fourth current input for direct and accurate measurement of neutral current, to help avoid device overload and network outage.
  - .2 Two digital outputs for control and energy pulsing applications.
  - .3 Four digital inputs/two digital inputs with input metering support for WAGES monitoring applications.
  - .4 LED that can be used for energy pulsing applications when necessary.
  - .5 Two analog inputs to interpret an incoming analog current signal from transducers and provide the resulting scaled value such as gas metering pulses, etc.
- .3 Display and user interface
  - .1 Onboard webpages for displaying real-time, logged data and waveform capture information using a web browser.
  - .2 Multiple language support: The back-lit anti-glare display screen can be switched to display meter information in one of the supported languages (on models with a display screen).
  - .3 Graphical display of harmonics and phasor diagrams on models with an integrated or optional remote display.

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- .4 QR codes with embedded data for viewing meter information using Meter Insights.
  - .4 Alarming
    - .1 Extensive alarming options like unary, digital, standard, logic, custom, and disturbance alarms.
    - .2 The ability to send emails with alarm information.
  - .5 Communications
    - .1 Dual Ethernet switched ports allow fast Ethernet interconnection to other PM5500 / PM5600 / PM5700 meters using only one IP switch.
    - .2 Ethernet gateway functionality, allowing a Modbus master using Modbus TCP to communicate through the meter to downstream serial devices using Modbus RTU.
    - .3 Support for a variety of Ethernet protocols, such as Modbus TCP, BACnet/IP, EtherNet/IP and DNP3. All the Ethernet protocols can be used at the same time.
    - .4 Enhanced Modbus security using TCP/IP filtering to set the specific IP addresses that are permitted to access the meter.
  - .6 Measurements and logging
    - .1 4-quadrant, Class 0.2S accurate energy metering.
    - .2 Present, last, predicted and peak (maximum) demand using a selection of demand calculation methods.
    - .3 Highly accurate 1-second measurements.
    - .4 Onboard data logging support for up to 14 selectable parameters.
    - .5 Complete harmonic distortion metering, recording and Realtime reporting, up to the 63rd harmonic for all voltage and current inputs.
    - .6 Recording of each new minimum and new maximum value.
  - .7 Compliance to international standards
- 3 . **IEC 62053-22 CLASS 0.5S / CLASS 0.2S, ANSI C12.20 CLASS 0.2, IEC 61557-12 PMD/S/K70/0.2, IEC 62053-23, IEC 62052-11, IEC 62052-31, MID, EN50470-1/3 – ANNEX B AND ANNEX D, CE AS PER IEC 61010-1 ED.3,**

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**CULUS AS PER UL 61010-1 ED.3, BACNET/IP - BTL LISTED (B-ASC),  
ETHERNET/IP - ODVA CERTIFIED**

**3.1 Instrument Transformers**

3.1.1 Current Transformers (CTs):

- .1 All Current Transformers shall be solid core CT (donut) or primary-wound with a 5A secondary unless noted otherwise.
- .2 CTs shall be Measurement Canada type approved or have a minimum accuracy of 0.3%.
- .3 All CT secondaries shall terminate in CT shorting blocks before being wired to the meter.
- .4 One CT is required for each phase being metered.

3.1.2 Potential Transformers (PTs).

- .1 PTs shall be supplied as required.
- .2 PTs shall be wired line-neutral for Wye systems and line-line for delta systems.
- .3 PTs shall be Measurement Canada type approved or have a minimum accuracy of 0.3%.
- .4 Meters shall not be powered from the PT secondaries.
- .5 Voltage inputs shall be fed from a dedicated 15A breaker in distribution panel where practical.
- .6 Supply and install appropriate 1A fuses.

**3.2 Meter Enclosures**

3.2.1 The PRIMARY SERVICE ENTRANCE ENERGY METER specified under 2.1 section shall be free issued to the Utility by the RoP and Installed by the Utility in their Energy Meter cabinet. Refer to sections for CEM Panels/ Enclosures.

3.2.2 The digital meters and sub-meters, specified in sections 2.2 & 2.3, shall be installed in new switchgear, panelboards, or switchboards.

3.2.3 For retrofit applications, or where meters are not installed in distribution equipment, the meters shall be installed in pre-wired, NEMA 12, CSA approved enclosures.

- .1 Multiple meters may be installed in the same enclosure.
- .2 Meters supplied from two different switchboards or different sources cannot be installed in the same enclosure.
- .3 Meters shall be wired according to manufacturer's recommended method.
- .4 Meter control power shall be from a separate source or control power transformer and not from the phase inputs to the meter.

3.2.4 General wiring guidelines:

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- .1 Control power and voltage sensing power separated for distribution to each meter from main set of incoming terminals.
  - .2 External control power transformers not required for any power systems up to, and including, 480 volts.
  - .3 Standard wiring harnesses for control power and voltage sensing to connect each meter internally. The harness may daisy chain the voltage connections from meter to meter on each row of meters. Finger safe terminals to terminate the meter end of the wiring harness.
  - .4 Common daisy chain wiring for communications wiring, with a single loop for all meters connected to the circuit and each end terminated in a common location. Communication wiring installed such that interference from the power wiring is minimized.
  - .5 Shorting terminal blocks for connecting the current transformer leads from the field to all ordered meters. Factory installed wiring harness shall be provided to connect the CT circuit from the shorting block to the meter. Shorting terminal blocks and wiring harness shall not be required for meters for meters compatible with low voltage current transducers.
  - .6 Capability to field-install meters without cutting or splicing the voltage or communication wiring harnesses to be provided.
  - .7 Terminal blocks for incoming and outgoing communications circuit connections.

**3.3 COROPRATE ENERGY METER CABINETS (To Support Primary Service Entrance Energy Meter Installation As Per RoP/Utility Requirement)**

**3.3.1 Indoor Panels (CEM) For Schneider Electric Meter ION 8650A/B/C:**

- .1 Supply and install a 30"x 30" x 12" NEMA 12 panel next to the main utility panel and install a conduit between the two panels with a maximum length of 5 feet using a minimum 2-inch inner diameter raceway. Tag the CEM panel with feeder information. This panel shall have the following specs:
  - .1 Fabricated in carbon steel construction finished with ANSI 61 gray polyester powder coating inside and out.
  - .2 Have a back plate for instrumentation mounting
  - .3 Have the door removed by pulling continuous hinge pin.
  - .4 Neoprene gasket attached to door with oil resistant seal.
  - .5 External welded-on mounting brackets for easy wall installation



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- .6 Panel shall have a backboard for mounting electrical devices
  - .7 Panel shall have one terminal strip mounted on the backboard of at least twelve positions.
  - .8 Panel shall have DIN rail of 10-inch length to fix components.
  - .9 Panel shall be grounded.
  - .10 Panel shall have Hasp and staple or similar provided for padlocking (minimum padlock size 1¼ inch)
  - .2 Supply and install a 120V (30 A) circuit from the existing back up generator / emergency supply (if on site) into the CEM panel and terminate inside the cabinet into a suitable disconnect switch, 30A, 120/240 VAC, DP general-duty safety switch for isolation in the CEM panel.
  - .3 Supply and connect three wire 120 VAC wirings from the disconnect switch to the duplex receptable in the 'CEM Panel'. A suitable beaker (15 A) shall be provided for protection.
  - .4 Supply and connect three wire 120 VAC wiring from the disconnect switch to the duplex receptable inside the 'Existing Utility Panel'. A suitable beaker (15 A) shall be provided for protection.
  - .5 Supply Cat 6 and/or fibre cable (minimum 6 strand multi mode 50/125) from the CEM panel to the Region of Peel Network switch for connection to the Region of Peel Corporate LAN or the SCADA ICP.
  - .6 Label all wirings, components, and circuits.
  - .7 Refer to below Conceptual Sketch (Power Cabling Only) of Electrical Installation Work Required.
  - .8 Note: If the existing switchgear is equipped with a dedicated disconnect switch, feeding the CEM panel, within the same room/space and clearly visible from the CEM panel, then the requirement for the disconnect switch is not necessary and the enclosure size can be reduced to 24"x24"x12"
- 3.3.2 Outdoor Panels (CEM) For Schneider Electric Meter ION 8650A/B/C:
- .1 Supply and install a 30" x 30" x 12" NEMA 4X panel next to or back-to-back with the existing main utility panel and install a conduit between the two panels with a maximum length of 5 feet using a minimum 2-inch inner diameter raceway. Tag the CEM panel with feeder information. This panel shall have the following specs:
    - .1 Fabricated in stainless steel construction.
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- .2 Have a back plate for instrumentation mounting
  - .3 Have the door removed by pulling stainless steel continuous hinge pin.
  - .4 Neoprene gasket attached to door with oil resistant adhesive.
  - .5 Clamps on three sides of door for watertight seal.
  - .6 Stainless steel external hardware
  - .7 Panel shall have a backboard for mounting electrical devices
  - .8 Panel shall have one terminal strip mounted on the backboard of at least twelve positions.
  - .9 Panel shall have DIN rail of 10-inch length to fix components.
  - .10 Panel shall be grounded.
  - .11 Panel shall have Hasp and staple or similar provided for padlocking (minimum padlock size 1¼ inch)
  - .2 Supply and install a 120V (30 A) circuit from the existing back up generator / emergency supply (if on site) into the CEM panel and terminate inside the cabinet into a suitable disconnect switch, 30A, 120/240 VAC, DP general-duty safety switch for isolation in the CEM panel.
  - .3 Supply and connect three wire 120 VAC wirings from the disconnect switch to the duplex receptable in the 'CEM Panel'. A suitable beaker (15 A) shall be provided for protection.
  - .4 Supply and connect three wire 120 VAC wiring from the disconnect switch to the duplex receptable inside the 'Existing Utility Panel'. A suitable beaker (15 A) shall be provided for protection.
  - .5 Supply Cat 6 and/or fibre cable (minimum 6 strand multi mode 50/125) from the CEM panel to the Region of Peel Network switch for connection to the Region of Peel Corporate LAN or the SCADA ICP.
  - .6 Label all wirings, components, and circuits.
  - .7 Refer to below Conceptual Sketch (Power Cabling Only) of Electrical Installation Work Required.
  - .8 Note: If the existing switchgear is equipped with a dedicated disconnect switch, feeding the CEM panel, within the same room/space and clearly visible from the CEM panel, then the requirement for the disconnect switch is not necessary and the enclosure size can be reduced to 24"x24"x12"

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**3.4 Outdoor Natural Gas Metering Panel Specifications for Rotary Meters with Pulse Outputs:**

- 3.4.1 Supply a 6" x 6" x 4" NEMA 4X with screw on cover (PVC gas splice box) and mount this box within 3 feet of the gas meter.
- 3.4.2 Supply and install in conduit a quantity of 2 - 2 conductor FT6 shielded instrument cables – 18 gauge from the CEM panel to the gas splice box. Leave approximately 2 feet of cable in the gas splice box and 4 feet of cable in the CEM panel.

**3.5 Monitoring And Reporting Software**

- 3.5.1 The Region of Peel employs the Power Monitoring Expert (PME) real-time power and energy monitoring software by Schneider Electric.
  - .1 The contractor must ensure connectivity from the meters to the software through the Region of Peel network – Coordination with the Region of Peel is required.
  - .2 Include an appropriate number of additional device licenses for the PME software.
  - .3 Include three (3) days of on-site software configuration for a trained factory representative to complete the software and meter integration and configuration as necessary/if required by the RoP.
  - .4 The contractor shall ensure all new electrical meters are properly integrated to the ROP's existing Power Monitoring Expert software -Coordination with the RoP is required.

**3.6 Communications / Networking Components**

- 3.6.1 To enable the meters to communicate to the central monitoring software, CAT6 – 100BaseT Ethernet shall be run to each device.
- 3.6.2 Routers or other required networking components shall be provided according to Owner's standard.
- 3.6.3 The contractor shall coordinate with the Region of Peel Energy Specialist/IT department to assign appropriate IP addresses in each meter.
- 3.6.4 The contractor shall ensure network connectivity of all the new meters to the Corporate Energy LAN/ WAN.

**3.7 Warranty & Service**

- 3.7.1 The manufacturer warrants the products it supplies for a period of 18 Months from Commissioning date or 24 Months from Delivery date
- 3.7.2 Warranty Service may be performed by the manufacturer or authorized representative.

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**3.8 New Meters Tagging:**

3.8.1 The newly supplier meters, basically the primary service entrance meters, shall be tagged with the region of Peel standard tag number that must appear on the faceplate of the meter in the following format. Actual tag numbers will be provided by the RoP at the time of order. as follows:

.1 Meter tag format: ROP-xxxxxx

**3.9 Loyalty Program Pricing:**

3.9.1 Vendor / Contractor shall consider customer loyalty special pricing program offered by the OEM, XX% discounts (usually 25% - to be confirmed by OEM during RFQ stage) to be applied to the product original pricing where applicable. The ROP will return old/defective meters to the manufacturer (Schneider Electric). Vendor shall arrange and provide the RMA (Return Material Authorization) and the ROP will provide necessary meters details upon issue of the Purchase order.

**4 . EXECUTION**

**4.1 Acceptable Contractor**

**4.2 All meters, components, wirings, and modifications (as necessary) to be installed by a qualified electrical contractor.**

**4.3 Installation requirements**

4.3.1 All power supply and communications wiring connections shall be performed in accordance with the guidelines set out in the product documentation.

4.3.2 All voltage sensing connections to instrumentation shall be made with 2A fuses.

4.3.3 Where practical, the meters voltage inputs shall be from a dedicated breaker.

4.3.4 Appropriately sized current transformers must be installed on each phase and must be installed with CT shorting blocks. All CTs with 5A secondary shall have CT shorting blocks.

4.3.5 Meters may be powered directly from an auxiliary supply, control power transformer, or the supply voltage. Meters cannot be powered from the measurement PTs.

4.3.6 For installations where the neutral is directly grounded at the transformer and no neutral is available, voltage measurements may be made line to ground.

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- 4.3.7 All wiring shall be done in accordance with Canadian National Electric Code standards and regulations, and in conjunction with the local Electrical Safety Association office.
  - 4.3.8 All communications networking including hubs, routers, etc. shall be provided by the contractor in accordance with the standards approved by the Owner.
  - 4.3.9 All meters, components, wirings, and enclosures to be labelled properly.

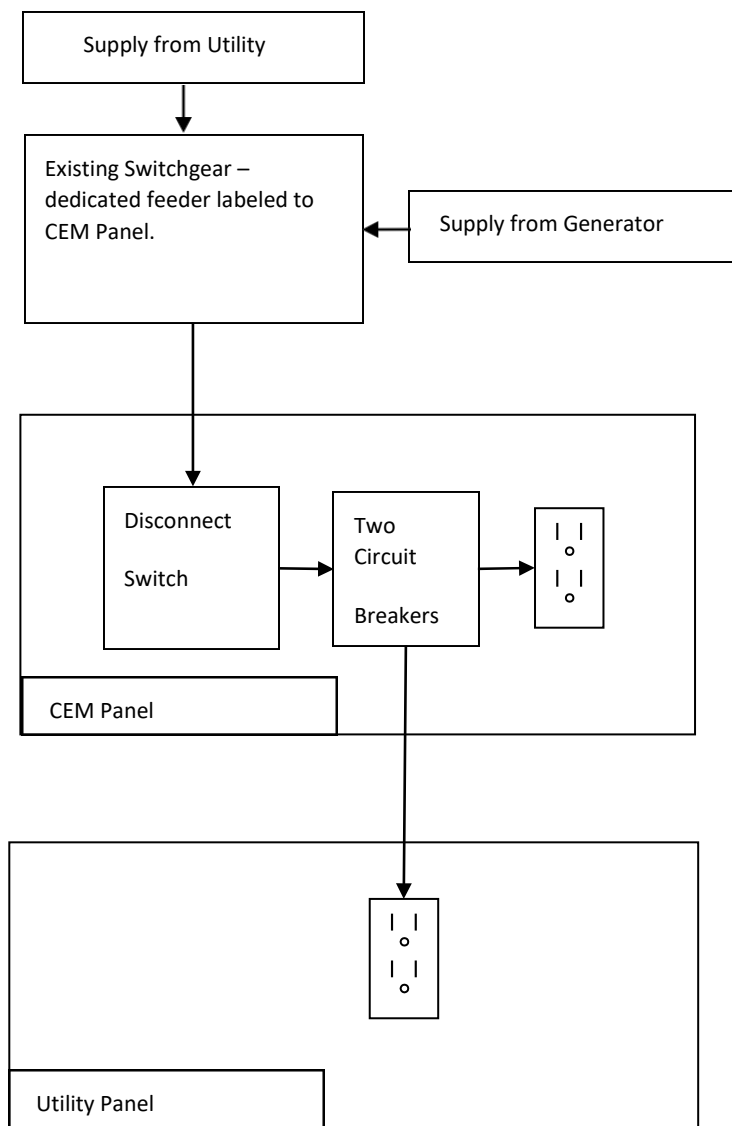
**4.4 On-site Configuration**

- 4.4.1 The meters shall be properly configured for the PME system
- 4.4.2 Any power quality settings on the meters shall be configured so the meter's disturbance capture and transient detection is enabled.
- 4.4.3 The contractor/vendor shall ensure all energy and min/max registers have been reset to zero.
- 4.4.4 Communications networking shall be tested and proved to be working before acceptance by the Owner.

**4.5 Locations**

- 4.5.1 The instrument shall be installed as specified on the drawings.

**4.6 Conceptual sketch (power cabling only) of Electrical Installations work:**



**END OF SECTION**

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1. **GENERAL**

1.1 **Section Includes:**

1.1.1 Materials and installation for low voltage control system designed to provide remote switching of lighting loads by use of:

- .1 Low voltage momentary contact switches.
- .2 Manual Switch Control

1.2 **Related Sections:**

1.2.1 This section of the specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

1.3 **References**

1.3.1 CSA C22.1 (current edition), Canadian Electrical Code, Part 1

1.3.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

1.3.3 Material Safety Data Sheets (MSDS).

1.4 **Sustainable Requirements**

1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.

1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.

1.4.3 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements, and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:

- .1 Construction Waste Management / Product Waste Recyclability.

- .2 Recycled Content.
- .3 Local and Regional Materials.
- .4 Certified Wood.
- .5 Construction Indoor Air Quality (IAQ) management.
- .6 VOC/Low-Emitting Materials Compliance.

1.4.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## **1.5 Submittals**

1.5.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

1.5.2 Product Data:

- .1 Submit manufacturer's printed product literature, specifications and datasheet and Include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance Sustainable Requirements: Construction and include: product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish.

1.5.3 Sample:

- .1 Submit samples in accordance with Section 01 33 00 - Submittal.

1.5.4 Quality Assurance:

- .1 Submit following in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit site tests results of installed electrical systems and instrumentation
- .3 Test Reports:
  - .1 Submit certified test reports indicating compliance with specifications for specified performance characteristics and physical properties.
- .4 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Manufacturer's Instructions: Submit manufacturer's installation instructions.
- .6 Manufacturer's Field Reports: Manufacturer's field reports specified.



1.5.5 Closeout Submittals:

- .1 Submit maintenance data in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Submit sequence of operation for the lighting control system.

1.5.6 Shop Drawings:

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario , Canada.

**1.6 Extra Materials**

1.6.1 Provide maintenance materials and spare parts in accordance with Section 01 78 00 - Closeout Submittals.

1.6.2 Provide following spare Parts:

**1.7 Delivery, Storage and Handling**

1.7.1 Packing, shipping, handling and unloading:

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .3 Handle materials with suitable lifting equipment.
- .4 Store materials in heated, dry, weather-protected enclosure

**1.8 Description of System**

1.8.1 Integration with Building Management System (BMS)

- .1 Product protocol shall be native BACnet IP certified. No other protocols will be considered or accepted.
- .2 Provide all wiring and devices required for the installation, programming, commissioning and documents of commissioning to prove correct circuitry and performance.
- .3 BaCnet IP Network wiring specification is Cat 6 UTP – FT6 cable.

**1.9 Acceptable Manufactures**

1.9.1 Acuity Brands

- .1 Provide all material, equipment, and service necessary for a complete and operational Lighting Control System.
- .2 Provide individual low voltage lighting control for each luminaire type and circuit in each room and common area.

- .3 Building Management System (BMS) Integration
  - .1 The system protocol shall be native BACnet/IP certified and fully compatible with the BMS. Gateways will not be accepted. The system software programmable controllers shall reside/communicate with the BACnet/IP on the management or automation level networks of the Building Management System.

## 2. **PRODUCTS**

### 2.1 **Materials**

- 2.1.1 Control system by one manufacturer and assembled from compatible components.

### 2.2 **Remote Control Switches**

- 2.2.1 Single-pole, double throw, momentary contact, standard duty, rated 20 A, 25 V, pivot rocker action with pilot lights.

### 2.3 **Low Voltage Relays**

- 2.3.1 Electrically operated by momentary impulse, mechanically latched until activated.
- 2.3.2 Two coil solenoid type with one coil to close relay contacts and one coil to open relay contacts.
- 2.3.3 Operating voltage shall be 24 V, AC
- 2.3.4 Load contacts shall be 20 A, 120 V, AC.
- 2.3.5 Auxiliary contacts for pilot light.
- 2.3.6 Coloured pre-stripped leads.

### 2.4 **Control Transformer**

- 2.4.1 Low voltage power Class 2, input 120 V, AC, 60 Hz, output 20 VA at 24 V.

### 2.5 **Rectifier**

- 2.5.1 Selenium type shall be 24 V, AC, 60 Hz input, 0.36 A continuous duty output.
- 2.5.2 Silicon type shall be 24 V, AC, 60 Hz input, [7.5 A continuous duty or 20 A intermittent duty] output.

### 2.6 **Manual Control**

- 2.6.1 Individual remote control switches as indicated.
- 2.6.2 Eight circuit manual master selector switch mounted in 100 mm square box with:

- .1 Master lock-out switch.
- .2 Individual red jewelled pilot lights.
- 2.6.3 Nine circuit manual dial-type master selector.
- 2.6.4 Twelve circuit manual dial-type master selector.

**2.7 Motor Operated Master Control**

- 2.7.1 Motor-driven multiple contact momentary switching device.
- 2.7.2 Radial contact arm to rotate through one revolution in 17 seconds.
- 2.7.3 Contact made in succession between 25 points around circle.
- 2.7.4 One master required for "ON" operation and one for "OFF" operation.
- 2.7.5 Motor master units connected in cascade to control circuits.
- 2.7.6 Interface equipment as required to convert maintained contact signals to momentary contact control pulses.

**3 . EXECUTION**

**3.1 Installation**

- 3.1.1 Locate and install equipment in accordance with manufacturer's recommendations and as indicated.

**3.2 Manufacturer's Instructions**

- 3.2.1 Compliance: Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

**3.3 Field Quality Control**

- 3.3.1 Site Tests:
  - .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - for Electrical.
- 3.3.2 Actuate control units in presence of consultant to demonstrate lighting circuits are controlled as designated.
- 3.3.3 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in Item 1 - Submittals.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection

of product installation in accordance with manufacturer's instructions.

- .3 Schedule site visits, to review Work, as directed in Item 1 - Quality Assurance.

3.3.4 Verification requirements in accordance with Sustainable Requirements: Contractor's Verification, include:

- .1 Materials and resources.
- .2 Storage and collection of recyclables.
- .3 Construction waste management.
- .4 Resource reuse.
- .5 Recycled content.
- .6 Local/regional materials.
- .7 Low-emitting materials.

#### **3.4 Maintenance – Clearances**

- 3.4.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

#### **3.5 Cleaning**

- 3.5.1 Proceed in accordance with Section 01 74 00 Cleaning and waste management.
- 3.5.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

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**1. GENERAL**

**1.1 Section Includes**

1.1.1 Materials and installation of network lighting controls.

**1.2 Related Sections**

1.2.1 This section of the Specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

**1.3 References**

1.3.1 Canadian Standards Association (CSA International)

- .1 CSA C22.1 (current edition), Canadian Electrical Code, Part 1.

**1.4 Sustainable Requirements**

1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.

1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.

1.4.3 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:

- .1 Construction Waste Management / Product Waste Recyclability.
- .2 Recycled Content.
- .3 Local and Regional Materials.
- .4 Certified Wood.

- .5 Construction Indoor Air Quality (IAQ) management.
- .6 VOC/Low-Emitting Materials Compliance.

1.4.5 **NOTE:** Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## **1.5 Submittals**

1.5.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal.

1.5.2 Product Data:

- .1 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Sustainable Requirements: Construction and include: product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish.

1.5.3 Indicate:

- .1 Complete assembly.
- .2 Contact surfaces.
- .3 Construction features.
- .4 Wiring diagrams.
- .5 Catalogue information.

1.5.4 Sample:

- .1 Submit samples in accordance with Section 01 33 00 - Submittal.

1.5.5 Quality Assurance:

- .1 Submit site tests results of installed electrical systems and instrumentation
- .2 Field Quality Control
  - .1 On completion of installation, manufacturer representative shall be notified to carry out site review and report any inconsistencies to the Engineer. Corrections are to be implemented to comply with manufacturer's report.

1.5.6 Closeout Submittals:

- .1 Provide maintenance data for materials for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Data necessary for maintenance of materials.

- .3 Manufacturers recommended list of spare parts.

**1.6 Extra Materials**

- 1.6.1 Provide maintenance materials and spare parts in accordance with Section 01 78 00 - Closeout Submittals.
- 1.6.2 Provide following spare Parts:
  - .1

**1.7 Delivery, Storage and Handling**

- 1.7.1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- 1.7.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- 1.7.3 Handle materials with suitable lifting equipment.
- 1.7.4 Store materials in heated, dry, weather-protected enclosure

**1.8 Description of System**

- 1.8.1 All materials, components, and services necessary to provide a complete working addressable lighting control system indicated in this section, as specified herein and shown on related drawings including, but not limited to:
  - .1 Dimensional drawings and schedules for specified equipment
  - .2 Shipment of equipment and supplies to job site
  - .3 Installation in accordance with these specifications, related drawings, the equipment manufacturers' recommendations, established trade criteria and all applicable code requirements.
- 1.8.2 Commissioning and demonstration of completed system.
- 1.8.3 Purpose
  - .1 The system shall be a standalone building-wide addressable networked lighting control system to perform scheduled and automatic lighting control events. The basis of system design shall utilize non-propriety industry standard DALI protocol for ballasts and/or 0-10V control of LED drivers, occupancy sensors, addressable daylight sensors, addressable switches, and DMX512 protocol interface for RGB colour changing fixtures.
  - .2 The lighting control "system" shall include a fully distributed WAN/LAN network of global controller/routers, individually addressable system field devices, sensors, switches, relays,

and other ancillary devices required for a complete and operable system.

- .3 The system design shall allow for use of non-propriety industry standard DALI protocol for ballasts and/or 0-10V control for ballasts or LED drivers, occupancy sensors, daylight sensors, and switches.

#### 1.8.4 BMS Integration

- .1 The system protocol shall be native BACnet/IP certified and fully compatible with the BMS. Gateways will not be accepted. The systems software programmable controllers shall reside/communicate with the BACnet/IP on the management or automation level networks of the Building Management System.

#### 1.8.5 Motorized Shades Integration

- .1 The system shall be fully capable to integrate with motorized shade system to allow sharing of daylight sensors, occupancy sensors and time schedules.

### 1.9 Acceptable Manufacturers

- 1.9.1 Encelium
- 1.9.2 N light
- 1.9.3 Or approved equal.

## 2. PRODUCTS

### 2.1 Components

- 2.1.1 The system Control Unit (CU) shall be rack or wall mounted lighting control device that collects, processes and distributes lighting control information to System Field Devices and lighting controllers over a Class 2 communication bus. Each CU shall have multiple Class 2 communication channels and can control a large quantity of nodes (sensors, lighting controllers, 0-10V Dimming, Fixed Output Ballasts, 0-10V LED Drivers, etc.) per channel, per the manufacturers recommended maximum. The CU is the central intelligence point for the area that it controls, collecting signal information from sensors, lighting controllers and personal control software and determining appropriate brightness levels or on/off status for each fixture or zone. Each CU shall have an Ethernet connection for communication with a facility's or tenant's Local Area Network (LAN) to enable desktop personal control.
- 2.1.2 Shall interconnect with other CUs and System Server using standard Ethernet connection that employs TCP/IP protocol.



- 
- 2.1.3 System Server shall host the lighting control system database for all the lighting control system field devices. Server shall have the ability to:
- .1 Remotely access a system in order to change system settings or configuration;
  - .2 Analyze system performance or energy data or generate system report;
  - .3 Record energy consumption with average sampling every 5 minutes for unlimited duration;
  - .4 Host the web interface required for the web enabled Personal Control Software or web based Central Control Software;
  - .5 Optionally can reside on a client server (virtual server) thus eliminating the need for dedicated physical hardware if desired;
- 2.1.4 Interconnect with CUs over standard Ethernet connection that employs TCP/IP protocol; 2.04 All operating parameters of the lighting control system shall be configured from central point of access through a secure internet connection or any internet enabled computer through a web browser. The system should be compatible with the current version standard browsers such as Internet Explorer, Chrome, Fire Fox and Safari. The system should be compatible with Microsoft Windows 7 and 8. The manufacturer should be able to provide update and patches for operating system upgrades and web browsers.
- 2.1.5 The lighting system shall resume operation after a power outage with no resetting or reprogramming requirement.
- 2.1.6 The lighting system shall adjust dimmable fluorescent ballast or dimmable LED driver levels in response to varying ambient light levels in order to maintain a constant, user -specified light level at locations indicated on the lighting plan drawings. Refer to drawings for location of the daylight sensors.
- 2.1.7 The operational status of all system hardware and software components shall be routinely checked. Faults with addressable components of the system shall be automatically detected and electronic notifications shall be distributed. These notifications clearly illustrate the location of the device on the floor plan and the time that the fault was detected on the Graphical interface. The system should be able to generate trouble/fault notification email to maintenance staff.
- 2.1.8 The energy consumption of the addressable luminaries shall be logged and recorded. Data shall be charted according to user-defined zones, which can be as small as an individual fixture or as large as a portfolio of buildings.

- 2.1.9 The system shall be capable of activating just the set of addressable luminaires required by an occupant to perform their work during the off-hour time period. The system shall avoid turning on an entire quadrant or floor when only an office, or meeting room, and associated hallways are required to remain on.
- 2.1.10 Luminaires within a lighting zone shall be activated in several ways including, a room switch, floor switch banks, occupancy sensors, time-clock, and/or web-based software interface screens. Cleaning staff are accommodated by a programmed turn-on and shut-down sequence initiated floor switch banks or schedule as per owner requirement. The sequence and override period shall be coordinated with the owner.
- 2.1.11 The system shall be capable of configuring zones via software and avert the need to re-wire certain power distribution circuitry and lighting equipment as tenancy patterns change.
- 2.1.12 The graphical interface of the software shall import the floor plan design file. All addressable luminaires and other addressable components of the lighting system contained in the floor plan design file shall be rendered into interactive objects on the graphical user interface. Include programming for base building and anchor tenant.

## **2.2 Wall Controllers (Switches)**

### **2.2.1 General:**

- .1 Addressing: all controllers shall be individually addressable via energy control software.
- .2 Electrical specifications
- .3 Ratings: shall be low voltage input.
- .4 Mechanical specifications

### **2.2.2 Operations:**

- .1 Localized on/off switching, dimming up/down, and programmable scene selection for dimming loads shall be provided, as required.
- .2 Led's: all controllers shall feature led's to indicate light on and light off status, as required.

### **2.2.3 Environmental specifications:**

- .1 Operating temperature range: 0°C to 55°C
- .2 Relative humidity: 20% to 90% non-condensing

### **2.2.4 Aesthetic requirements:**

- .1 Style: all controllers shall feature decorator styling.
- .2 Colour: all controllers shall be available in white, with an optional colour insert kit for changing colour without reinstalling switch.

- .3 Accessories: matching wallplate shall be available.

## **2.3 Photo Sensor**

### **2.3.1 General:**

- .1 A sensor that measures ambient light in a finite area shall be available.
- .2 Specifications: the sensor shall measure light from any source in the visible spectrum within at least a 60° cone. It shall measure light between 0 and minimum 75 foot-candles.

### **2.3.2 Electrical:**

- .1 Rating: maximum 10 vdc, 25 ma.

### **2.3.3 Mechanical:**

- .1 Mounting: the sensor shall be flush mounted on or recessed inside ceiling tile.

### **2.3.4 Environmental specifications**

- .1 Operating temperature range: 0°C to 55°C
- .2 Relative humidity: 20% to 90% non-condensing

## **2.4 Occupancy Sensors**

### **2.4.1 General:**

- .1 Sensors using passive infrared, ultrasonic, acoustic, and multi-technology adaptive technology shall be available.
- .2 Sensor timeouts shall be configurable by system software.

### **2.4.2 Electrical:**

- .1 Rating: maximum 24 vdc input voltage, 40 ma current draw.

### **2.4.3 Mechanical:**

- .1 Mounting: sensors for mounting on ceilings and walls, including corners, must be available.

### **2.4.4 Environmental:**

- .1 Operating temperature range: 0°C to 55°C.
- .2 Relative humidity: 20% to 90% non-condensing

## **2.5 BACnet IP Network**

### **2.5.1 BACnet IP Network wiring specification is Cat 6 – FT6 wire.**

### **2.5.2 Wiring for AI, AO, DO and DI points shall be 2c#awg ft6 600V twisted shielded pair, no longer than 70 meters. DO wiring shall be minimum AWG to suit voltage, current and electrical code. No splices are permitted in network wires. All wiring is to be run in electrical conduits where mechanical protection is required. In ceiling spaces such as removable tile return air plenum space,**

plenum-rated wiring is acceptable. All plenum wiring is to be run at right angles to building line and secured to avoid damage to wiring. Marr connectors are acceptable for terminations at field devices only. Terminal strips shall be used where connections are required at any junction box.

- 2.5.3 Als, DIs, AOs and Dos may be run in a common conduit if required. Line voltage will not be run with signal or network wiring.
- 2.5.4 If a shield is required on point wiring, the shield shall be grounded at the DDC panel and prevented from grounding at the terminal end.
- 2.5.5 Line voltage, 110 vac wiring will be separated from 24 vac, network and all DC wiring. Wiring methods are as Division 26 00 00 for 110 vac wiring.
- 2.5.6 Use 1 m of flexible, liquid-tight conduit and liquid-tight fittings for all connections to vibrating equipment.
- 2.5.7 BACnet IP communications network wiring shall be CAT5. Do not run BACnet UP networks in proximity to higher voltages than 24 vac.
- 2.5.8 ModBus RTU communications network wiring shall be 2c#18awg shielded ft6 600 V or shall match voltage requirements where higher voltages are present. Do not run ModBus RTU networks in proximity to higher voltages than 24 vac.

### 3 . **EXECUTION**

#### 3.1 **Installation**

- 3.1.1 Install system and components in accordance with manufacturer's instructions.
- 3.1.2 Install starter cables to circuit outlet boxes and connect to power circuit and energize.
- 3.1.3 Install Smart-Light enclosures as shown on drawings and connect starter cable to power-in plug.
- 3.1.4 Connect joiner cables to each of power-out receptacles to first luminaire of controlled circuit as shown.
- 3.1.5 Install joiner cables between interceptors in fixtures or equipment. Allow extra cable to facilitate removal and relocation of fixtures or equipment.
- 3.1.6 Integrally moulded thermoplastic components to match colour identification system (i.e. black for normal power, red for emergency power).
- 3.1.7 Install low voltage switch kits and low voltage cables as shown on drawings and connect to control ports of controlled circuits.

- 3.1.8 Install sensor kits and low voltage cables as shown on drawings and connect to control ports of controlled circuits.
- 3.1.9 Install central control kit from each or grouped Smart-Light enclosure to central control panel as shown on drawings.
  - .1 Connect to control port of Smart-Light as indicated.
  - .2 Connections within central control panel as instructed by control manufacturer.

**3.2 Field Quality Control**

- 3.2.1 On completion of installation, manufacturer representative shall be notified to carry out site review and report any inconsistencies to the Engineer. Corrections are to be implemented to comply with manufacturer's report.

**3.3 Maintenance – Clearances**

- 3.3.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

**3.4 Cleaning**

- 3.4.1 Proceed in accordance with Section 01 74 00 Cleaning and waste management.
- 3.4.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

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**1. GENERAL**

**1.1 Section Includes**

- 1.1.1 Materials and installation for Dry Type, Medium Voltage Transformers.
- 1.1.2 Dry type transformers with ratings up to 5000 kVA single phase and up to 7500 kVA three phase and voltage class up to 46 kV.
- 1.1.3 Text to complete Section 26 11 13.01 - Unit Substation to 15 kV.

**1.2 Related Sections**

- 1.2.1 This section of the specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.
- 1.2.2 Section 01 33 00 - Submittal Procedures.
- 1.2.3 Section 01 74 21 - Construction/Demolition Waste Management And Disposal.
- 1.2.4 Section 01 78 00 - Closeout Submittals.
- 1.2.5 Section 26 05 00 - Common Work Results - Electrical.

**1.3 References**

- 1.3.1 Canadian Standards Association (CSA International)
  - .1 CSA C9-M1981(R2001), Dry-Type Transformers.
- 1.3.2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
  - .1 EEMAC GL1-3-1988, Transformer and Reactor Bushings.
- 1.3.3 National Electrical Manufacturers Association (NEMA)

**1.4 Sustainable Requirements**

- 1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.
- 1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.
- 1.4.3 Waste Management and Disposal
  - .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
  - .2 Avoid using landfill waste disposal procedures when recycling facilities are available.

- .3 Place materials defined as hazardous or toxic waste in designated containers.
- 1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:
  - .1 Construction Waste Management / Product Waste Recyclability.
  - .2 Recycled Content.
  - .3 Local and Regional Materials.
  - .4 Certified Wood.
  - .5 Construction Indoor Air Quality (IAQ) management.
  - .6 VOC/Low-Emitting Materials Compliance.
- 1.4.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## **1.5 Submittals**

- 1.5.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- 1.5.2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Sustainable Requirements: Construction and include: product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish.
- 1.5.3 Include:
  - .1 Dimensioned drawing showing enclosure, mounting devices, terminals, taps, internal and external component layout.
  - .2 Technical data:
    - .1 kVA rating.
    - .2 Primary and secondary voltages.
    - .3 Frequency.
    - .4 Three Phase
    - .5 Polarity or angular displacement.

- .6 Full load efficiency.
- .7 Regulation at unity pf.
- .8 BIL.
- .9 Insulation type.
- .10 Sound rating.

1.5.4 Sample:

- .1 Submit samples in accordance with Section 01 33 00 - Submittal.

1.5.5 Quality Assurance:

- .1 Engineer reserves the right to witness standard factory testing of the above.
- .2 Submit site tests results of installed electrical systems and instrumentation

1.5.6 Control Submittals

- .1 Submit to Engineer 6 copies of standard factory test certificates of each transformer and type test of each transformer in accordance with CSA C9.

1.5.7 Closeout Submittals:

- .1 Provide maintenance data for materials for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Data necessary for maintenance of materials.
- .3 Manufacturers recommended list of spare parts.
- .4 Operation and maintenance instructions to include:
  - .1 Tap changing.
  - .2 Recommended environmental conditions.
  - .3 Recommended periodic inspection and maintenance.
  - .4 Bushing replacement.

**1.6 Extra Materials**

- 1.6.1 Provide maintenance materials and spare parts in accordance with Section 01 78 00 - Closeout Submittals.

**1.7 Delivery, Storage and Handling**

- 1.7.1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- 1.7.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- 1.7.3 Handle materials with suitable lifting equipment.
- 1.7.4 Store materials in heated, dry, weather-protected enclosure
- 1.7.5 Store transformers indoors in dry location.



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**1.8 Acceptable Manufactures**

- 1.8.1 Eaton Cutler Hammond
- 1.8.2 Or approved equal.

**2 . PRODUCTS**

**2.1 Materials**

- 2.1.1 Dry-type transformers: to CSA C9.
- 2.1.2 Bushings: to EEMAC GL1-3.

**2.2 Transformer Characteristics**

- 2.2.1 Type: AFC
- 2.2.2 Rating: as per drawings and single line diagram
- 2.2.3 220 degrees insulation system class, 30 degrees C temperature rise.
- 2.2.4 Impedance: 7-12%, standard.
- 2.2.5 Primary winding: 13.8kV, BIL 75 kV.
- 2.2.6 Secondary winding: 600 V , three wire with neutral brought out and high resistance
- 2.2.7 No load losses not to exceed manufacturers recommendation as per KVA rating.
- 2.2.8 Full load losses not to exceed manufacturers recommendation as per KVA rating
- 2.2.9 Sound rating described as per NEMA TR1, IEE C57.12.90.

**2.3 Enclosure**

- 2.3.1 Fabricated from sheet steel.
- 2.3.2 Bolted removable panels for access to tap connections, enclosed terminals
- 2.3.3 Conductor entry:
  - .1 Knockouts.
  - .2 Potheads.
  - .3 Junction boxes.
  - .4 Bushings.
  - .5 Clamping rings.
  - .6 Entry for busbars
- 2.3.4 Designed for floor
- 2.3.5 Indoor, ventilated forced air cooled type. Temperature of exposed metal parts not to exceed 65 degrees C rise.

2.3.6 Shall contain all necessary components and wiring, including fans, for automatically increasing the kVA rating by 33%. The (FA) package shall include an electronic temperature monitor and fan control unit. The package shall include a TC-50 Transformer Temperature Controller that monitors up to three (3) ventilated Dry Type transformer windings and (1) ambient temperature. The controller's electronic components shall be conformally coated to prevent premature failure due to extreme environmental conditions. The controller shall operate relays by comparing the highest winding temperature to stored set point temperatures and display four (4) thermocouple inputs as well as the stored maximum temperature and its associated winding. The unit shall provide Fans, Alarm, and Trip output relays. Form C contacts shall be provided to trip the transformer off-line if any of the winding temperatures exceeds the trip setting. A test function shall be provided to test the digital display and all of the LEDs; simulate over-temperature conditions; and check the internal temperature of the monitor. A 4-20 mA analog signal shall be provided for remote indication or for use with SCADA systems. Control power shall be provided from a control power transformer in the secondary equipment.

2.3.7 Pad mounted type:

- .1 Conductor entry through bottom for underground distribution, with separate high and low voltage compartments divided by full length metal barrier.
- .2 Each compartment to have access door with concealed hinges.
- .3 Secondary door to have 3-point latch, external operating handle, provision for padlocking and arranged so that secondary door must be open before access gained to primary compartment.

2.3.8 Open type: no enclosure, for installation in switchgear enclosure.

## **2.4 Tap Changer**

2.4.1 Bolted-link type.

## **2.5 Windings**

2.5.1 Primary and secondary coils:

2.5.2 Copper

2.5.3 Coil and core assembly:

- .1 Taps located at front of coils for accessibility.

2.5.4 Sound level: not to exceed dB as described in IEEE C57.12.90.

## **2.6 Accessories**

2.6.1 Winding temperature detector relay and sensing elements

- 2.6.2 Wiring and terminal box for protective devices.
- 2.6.3 Digital type winding temperature indicator
- 2.6.4 Fans for forced air cooling,
- 2.6.5 Grounding terminal: inside enclosure.

**2.7 Equipment Identification**

- 2.7.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.
- 2.7.2 Equipment labels: nameplate size 7 labelled as per drawings.

**3. EXECUTION**

**3.1 Installation**

- 3.1.1 Locate, install and ground transformers in accordance with manufacturer's instructions.
- 3.1.2 Set and secure transformers in place, rigid plumb and square.
- 3.1.3 Connect primary bushings/terminals to high voltage circuit.
- 3.1.4 Connect secondary bushings/terminals to secondary feeder.
- 3.1.5 Use flexible conduit to make connections to transformer.
- 3.1.6 Energize transformers and check secondary no-load voltage.
- 3.1.7 Adjust primary taps as necessary to produce rated secondary voltage at no-load.
- 3.1.8 Wire one set of contacts on winding temperature detector relay to sound alarm, wire second set of contacts to trip transformer circuit interrupter.
- 3.1.9 Wire alarm contacts on winding temperature indicator to sound alarm when excessive temperature reached.
- 3.1.10 Locate and install cooling fans.
  - .1 Connect thermostat control.
  - .2 Connect sequence contacts of temperature indicator:
    - .1 First contact closure: start fan.
    - .2 Second contact closure: sound alarm.
    - .3 Third contact closure: trip secondary breaker.
- 3.1.11 Use torque wrench to adjust internal connections in accordance with manufacturers' recommended values.
- 3.1.12 Check transformer for dryness before putting it into service and if it has not been energized for some considerable time.

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**3.2 Field Quality Control**

- 3.2.1 Perform tests in accordance with Section 26 05 00 - Common Work Results – Electrical.
- 3.2.2 Energize transformers and apply incremental loads:
- .1 0% for 4 hours.
  - .2 10% for next 1 hour.
  - .3 25% for next 2 hours.
  - .4 50% for next 3 hours.
  - .5 Full load.
  - .6 At each load change, check temperatures ambient, enclosure, ventilating air and windings.
  - .7 Adjust cooling fan controls if required.

**3.3 Maintenance – Clearances**

- 3.3.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

**3.4 Cleaning**

- 3.4.1 Proceed in accordance with Section 01 74 00 Cleaning and waste management.
- 3.4.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

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**1 . GENERAL**

**1.1 Section Includes**

- 1.1.1 Low voltage dry type transformers up to 600V primary.

**1.2 Related Sections**

- 1.2.1 This section of the Specification forms part of the contract documents and should be read, interpreted and coordinated with all other parts.

**1.3 References**

- 1.3.1 Canadian Standards Association (CSA International)  
.1 CSA C9 (current edition), Dry-Type Transformers.
- 1.3.2 Dry-type transformers: to CSA C9.
- 1.3.3 Bushings: to EEMAC GL1-3.
- 1.3.4 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)  
.1 EEMAC GL1-3 (current edition), Transformer and Reactor Bushings.
- 1.3.5 National Electrical Manufacturers Association (NEMA)
- 1.3.6 DOE 2016 Energy efficient

**1.4 Sustainable Requirements**

- 1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.
- 1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.
- 1.4.3 Waste Management and Disposal  
.1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.  
.2 Avoid using landfill waste disposal procedures when recycling facilities are available.  
.3 Place materials defined as hazardous or toxic waste in designated containers.
- 1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements, and they shall be fully aware of all required laws and available strategies to achieve

sustainable goals, including any applicable exemplary performance levels, for the following:

- .1 Construction Waste Management / Product Waste Recyclability.
- .2 Recycled Content.
- .3 Local and Regional Materials.
- .4 Certified Wood.
- .5 Construction Indoor Air Quality (IAQ) management.
- .6 VOC/Low-Emitting Materials Compliance.

1.4.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

1.4.6

## 1.5 Submittals

1.5.1 Submit shop drawings in accordance with Section 01300 (01 33 00) - Submittal.

1.5.2 Product Data:

- .1 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.

1.5.3 Include:

- .1 Dimensioned drawing showing enclosure, mounting devices, terminals, taps, internal and external component layout.
- .2 Technical data:
  - .1 kVA rating.
  - .2 Primary and secondary voltages.
  - .3 Frequency.
  - .4 Three phase.
  - .5 Polarity or angular displacement.
- .3 Full load efficiency.
  - .1 No load and full load losses per NEMA TP-1
  - .2 Linear load efficiency data @ 1/6, 1/4, 1/2, 3/4, 8 full load
  - .3 Linear load efficiency @ 35% loading tested per NEMA TP-2
  - .4 Efficiency under K7 load profile at 15%, 25%, 50%, 75%, 100% of name plate rating
- .4 Regulation at unity pf.

- .5 BIL.
- .6 Insulation type.
- .7 Sound rating.
- 1.5.4 Control Submittals
  - .1 Submit to Engineer 4 copies of standard factory test certificates of each transformer and type test of each transformer in accordance with CSA C9.
- 1.5.5 Operation and maintenance instructions to include:
  - .1 Tap changing.
  - .2 Recommended environmental conditions.
  - .3 Recommended periodic review and maintenance.
  - .4 Bushing replacement.
- 1.5.6 Quality Assurance:
  - .1 Submit site tests results of installed electrical systems and instrumentation
- 1.5.7 Closeout Submittals:
  - .1 Provide maintenance data for materials for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
  - .2 Data necessary for maintenance of materials.
  - .3 Manufacturers recommended list of spare parts.
- 1.6 **Extra Materials**
  - 1.6.1 Provide maintenance materials and spare parts in accordance with manufacturer's recommendations.
- 1.7 **Acceptable Manufactures**
  - 1.7.1 Eaton Electrical Inc: Cutler- Hammer Products
  - 1.7.2 Marcus
  - 1.7.3 Siemens Energy & Automotion Inc
  - 1.7.4 Schneider Electric; Square D
  - 1.7.5

## 2. **PRODUCTS**

### 2.1 **General Transformer Requirements**

- 2.1.1 Description: Factory – assembled and tested, air cooled units for 60Hz service
- 2.1.2 Core: Grain- orientated, non-aging silicon steel
- 2.1.3 Coils: Continuous windings without splices except for taps
  - .1 Internal Coil Connections: Brazed or pressure type

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.2 Coil Material: Copper

**2.2 Materials**

2.2.1 Dry-type transformers: to CSA C9.

2.2.2 Bushings: to NEMA.

**2.3 Transformer Characteristics**

2.3.1 Comply with NEMA ST20, and list and label as complying with UL 1561.

2.3.2 Rating as shown in drawings.

2.3.3 220 insulation system class, 150 degrees C temperature rise.

2.3.4 Impedance: 5 % standard.

2.3.5 DOE 2016 Energy Efficient compliant

2.3.6 Low- Sound- Level Requirements: NEMA ST20 standard sound levels when factory tested according to IEEE C57.12.91.

**2.4 Enclosure**

2.4.1 Fabricated from sheet steel.

2.4.2 Bolted removable panels for access to tap connections, enclosed terminals.

2.4.3 Conductor entry:

.1 Knockouts.

.2 Potheads.

.3 Junction boxes.

.4 Bushings.

.5 Clamping rings.

.6 Entry for busbars.

2.4.4 Designed for floor or wall mounting.

2.4.5 Indoor, ventilated, self-cooled type. Temperature of exposed metal parts not to exceed 65 degrees C rise.

2.4.6 Outdoor, ventilated, self-cooled type, CSA 3 enclosure.

**2.5 Voltage Taps**

2.5.1 Standard.

**2.6 Tap Changer**

2.6.1 Bolted-link type.

**2.7 Windings**

2.7.1 Primary and secondary coils:

.1 Copper



.2 Open

2.7.2 Coil and core assembly:

.1 Taps located at front of coils for accessibility.

## **2.8 Accessories**

2.8.1 Winding temperature detector relay and sensing elements with sets of SPDT contacts.

2.8.2 Wiring and terminal box for protective devices.

2.8.3 Digital type winding temperature indicator with alarm contacts.

2.8.4 Fans for forced air cooling, 600 V, 3 phase, 60Hz, with thermostat control.

2.8.5 Grounding terminal: inside of enclosure.

## **2.9 Equipment Identification**

2.9.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results (16010).

2.9.2 Equipment labels: nameplate size 7, labelled.

# **3 . EXECUTION**

## **3.1 Installation**

3.1.1 Locate, install and ground transformer in accordance with manufacturer's instructions.

3.1.2 Set and secure transformers in place, rigid plumb and square.

3.1.3 Connect primary terminals to high voltage circuit.

3.1.4 Connect secondary terminals to secondary feeder.

3.1.5 Use flexible conduit to make connections to transformer.

3.1.6 Energize transformers and check secondary no-load voltage.

3.1.7 Adjust primary taps as necessary to produce rated secondary voltage at no-load.

3.1.8 Wire one set of contacts on winding temperature detector relay to wire second set of contacts to.

3.1.9 Wire alarm contacts on winding temperature indicator to sound alarm when excessive temperature reached.

3.1.10 Locate and install cooling fans.

.1 Connect thermostat control.

.2 Connect sequence contacts of temperature indicator:

.1 First contact closure: start fan.

.2 Second contact closure: sound alarm.

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.3 Third contact closure: trip secondary breaker.

3.1.11 Use torque wrench to adjust internal connections in accordance with manufacturers' recommended values.

3.1.12 Check transformer for dryness before putting it into service and if it has not been energized for some considerable time.

**3.2 Field Quality Control**

3.2.1 Energize transformers and apply incremental loads:

- .1 0% for 4 hours.
- .2 10% for next 1 hour.
- .3 25% for next 2 hours.
- .4 50% for next 3 hours.
- .5 Full load.
- .6 At each load change, check temperatures ambient.
- .7 Adjust cooling fan controls if required.

**3.3 Maintenance – Clearances**

3.3.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

**3.4 Cleaning**

3.4.1 Proceed in accordance with Section 01 74 00 Cleaning and waste management.

3.4.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

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1. **GENERAL**

1.1 **Section Includes**

1.1.1 Materials and installation for Switchboards.

1.2 **Related Sections**

1.2.1 This section of the specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

1.3 **References**

1.3.1 Canadian Standards Association (CSA International)

- .1 CSA C22.1 (current edition), Canadian Electrical Code, Part 1.

1.4 **Sustainable Requirements**

1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.

1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.

1.4.3 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:

- .1 Construction Waste Management / Product Waste Recyclability.
- .2 Recycled Content.
- .3 Local and Regional Materials.
- .4 Certified Wood.
- .5 Construction Indoor Air Quality (IAQ) management.

.6 VOC/Low-Emitting Materials Compliance.

1.4.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## **1.5 Submittals**

1.5.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

1.5.2 Product Data:

- .1 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Sustainable Requirements: Construction and include: product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish.
- .3 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, and limitations.

1.5.3 Quality Assurance:

- .1 Engineer reserves the right to witness standard factory testing of the above.
- .2 Submit site tests results of installed electrical systems and instrumentation
- .3 Submit following in accordance with Section 01 40 00 Quality requirement.
- .4 Instructions: Submit manufacturer's installation instructions.

1.5.4 Closeout Submittals:

- .1 Provide maintenance data for materials for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Data necessary for maintenance of materials.
- .3 Manufacturers recommended list of spare parts.

## **1.6 Extra Materials**

1.6.1 Provide maintenance materials and spare parts in accordance with Section 01 78 00 - Closeout Submittals.

## **1.7 Delivery, Storage and Handling**

1.7.1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.

- 1.7.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- 1.7.3 Handle materials with suitable lifting equipment.
- 1.7.4 Store materials in heated, dry, weather-protected enclosure

**1.8 Acceptable Manufactures**

- 1.8.1 Eaton Cutler Hammond
- 1.8.2 Schneider
- 1.8.3 Siemens
- 1.8.4 Or approved equal.

**2 . PRODUCTS**

**2.1 Circuit Breakers**

- 2.1.1 Breaker type as per single line diagram.
- 2.1.2 Breaker interrupting capacity shall be as per short circuit study and manufactuters recommendations.
- 2.1.3 Breaker tripping devices, as indicated.
  - .1 Instantaneous overcurrent relays.
  - .2 Reverse power relay.
  - .3 Overvoltage relay.
  - .4 Undervoltage relay.
  - .5 Frequency relay.
  - .6 Time overcurrent relay.
  - .7 Locking-out relay.
  - .8 Time-delay relay.
  - .9 Ground fault relay.
  - .10 Negative sequence relay.
- 2.1.4 Trip setting devices shall be switches
- 2.1.5 Auxiliary contacts shall be - N.O., N.C.

**3 . EXECUTION**

**3.1 Manufacturer's Instructions**

- 3.1.1 Compliance: Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

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**3.2 Installation**

3.2.1 As indicated.

**3.3 Maintenance – Clearances**

3.3.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

**3.4 Cleaning**

3.4.1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

## 1. **GENERAL**

### 1.1 **Section Includes**

- 1.1.1 Materials and installation for standard and custom breaker type panelboards.

### 1.2 **Related Sections**

- 1.2.1 This section of the OMR forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

### 1.3 **References**

- 1.3.1 Canadian Standards Association (CSA International)
  - .1 CSA C22.1 No. 29 (current edition), Panelboards and Enclosed Panelboards.

### 1.4 **Submittals**

- 1.4.1 Submit shop DGIs in accordance with Section 26 05 00 (16010).
  - .1 DGIs are to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.
- 1.4.2 Product Data:
  - .1 Provide manufacturer's printed product literature, OMRs and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- 1.4.3 Closeout Submittals:
  - .1 Data necessary for maintenance of materials.
  - .2 Manufacturers recommended list of spare parts.

### 1.5 **Acceptable Manufactures**

- 1.5.1 Eaton.
- 1.5.2 Schneider
- 1.5.3 Siemens
- 1.5.4 Or approved equal.

## 2. **PRODUCTS**

### 2.1 **Panelboards**

- 2.1.1 Panelboards to CSA C22.2 No. 22 and product of one manufacturer.
  - .1 Install circuit breakers in panelboards before shipment.

- 
- .2 In addition to CSA requirements, manufacturer's nameplate must show fault current that panel, including breakers, has been built to withstand.
- 2.1.2 250: bus and breakers rated for 10 kAIC (symmetrical) interrupting capacity as minimum. 600 V panelboards bus and breakers rated for 30 kAIC (symmetrical) interrupting capacity as minimum Final rating to be confirmed when coordination study is confirmed.
- 2.1.3 Sequence phase busing with odd-numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- 2.1.4 Panelboards: Mains, number of circuits, and number and size of branch circuit breakers as shown in documents.
- 2.1.5 Two keys for each panelboard and key panelboard alike.
- 2.1.6 Copper bus with neutral per code.
- 2.1.7 Mains: Suitable for bolt-on breakers.
- 2.1.8 Trim with concealed front bolts and hinges.
- 2.1.9 Trim and door finish: As per colour schedule.
- 2.2 Breakers**
- 2.2.1 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- 2.2.2 Lock-on devices for fire alarm, emergency, door supervisory, stairway, exit and night light circuits.
- 2.3 Equipment Identification**
- 2.3.1 Complete circuit directory with typewritten legend showing location and load of each circuit.

### **3. EXECUTION**

#### **3.1 Installation**

- 3.1.1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- 3.1.2 Install surface-mounted panelboards on plywood backboards. Where practical, group panelboards on common backboard.
- 3.1.3 Connect loads to circuits.
- 3.1.4 Connect neutral conductors to common neutral bus with respective neutral identified.



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**3.2 Maintenance – Clearances**

3.2.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

**3.3 Cleaning**

3.3.1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

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**1.    GENERAL**

**1.1    Section Includes**

1.1.1    Materials and installation for Multi-Outlet Assemblies.

**1.2    Related Sections**

1.2.1    This section of the specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

**1.3    References**

1.3.1    Canadian Standards Association (CSA International)

- .1        CSA C22.1 (current edition), Canadian Electrical Code, Part 1.

**1.4    Sustainable Requirements**

1.4.1    Materials and products in accordance with Sustainable Requirements: Construction.

1.4.2    Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.

1.4.3    Waste Management and Disposal

- .1        Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
- .2        Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3        Place materials defined as hazardous or toxic waste in designated containers.

1.4.4    In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:

- .1        Construction Waste Management / Product Waste Recyclability.
- .2        Recycled Content.
- .3        Local and Regional Materials.
- .4        Certified Wood.
- .5        Construction Indoor Air Quality (IAQ) management.

.6 VOC/Low-Emitting Materials Compliance.

1.4.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## **1.5 Submittals**

1.5.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

1.5.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

1.5.3 Indicate type of multi-outlet assemblies with similar terminology to these documents.

## **1.6 Quality Assurance**

1.6.1 Quality assurance submittals: Submit following in accordance with Section 01 40 00 Quality requirement.

.1 Manufacturer's Instructions: Submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.

## **1.7 Delivery, Storage, and Handling**

1.7.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

1.7.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

## **2. PRODUCTS**

### **2.1 Surface Raceway for Wiring Devices**

2.1.1 Two-piece assembly manufactured for mounting wiring devices and associated wiring.

2.1.2 Raceway with base channel and snap on cover plate. Cross-section dimensions as indicated.

2.1.3 Finish shall be white enamel, as indicated.

2.1.4 Internal barrier for raceway having power and communication.

### **2.2 Wiring Devices**

2.2.1 Wiring devices shall be as indicated.

- 2.2.2 Communication devices shall be as indicated.
- 2.2.3 Cover plate to match raceway manufacturer's standard snap-on cover.

**2.3 Prewired Receptacle Harness**

- 2.3.1 Receptacle harness factory assembled with single receptacles at 1,525 mm centres on one or two circuits.

**2.4 Vinyl Plastic Strip**

- 2.4.1 Extruded rigid vinyl plastic with two No. 12 AWG, 3 mm<sup>2</sup> copper wires and continuous ground strip.
- 2.4.2 Unfused "U" ground lock-in receptacle for each 1.5 m of strip as indicated.

**2.5 Fittings**

- 2.5.1 Elbows, tees, supports, connectors, couplings, and fittings to make a complete installation.

**3 . EXECUTION**

**3.1 Installation**

- 3.1.1 Install multi-outlet assemblies and raceway system in accordance with manufacturer's instructions.
- 3.1.2 Install supports, elbows, tees, connectors, fittings.
- 3.1.3 Keep number of elbows, offsets and connections to minimum.
- 3.1.4 Install barriers where required.
- 3.1.5 Install surface raceway continuous around corners. Provide corner and vertical sections as required.

**3.2 Wiring**

- 3.2.1 Install wiring after installation of raceway system is complete.
- 3.2.2 Install receptacle harness as indicated.
- 3.2.3 Fasten wiring with wire clips inside raceway.
- 3.2.4 Install ground wire as required.

**3.3 Wiring Devices**

- 3.3.1 Install wiring devices and cover plates as indicated
- 3.3.2 Install vinyl strip receptacles as indicated.
- 3.3.3 Install identification labels for all electrical outlets.

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**3.4 Maintenance – Clearances**

3.4.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

**3.5 Cleaning**

3.5.1 Clean in accordance with Section 01 74 00 Cleaning and waste management.

3.5.2 Clean installed products in accordance to manufacturer's recommendation.

**END OF SECTION**

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**1. GENERAL**

**1.1 Section Includes**

1.1.1 Materials and installation for Wiring Devices.

**1.2 Related Sections**

1.2.1 This section of the Specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

**1.3 References**

1.3.1 Canadian Standards Association (CSA International)

- .1 CSA C22.1 (current edition), Canadian Electrical Code, Part 1.
- .2 CSA C22.2 No.42 (current edition), General Use Receptacles, Attachment Plugs and Similar Devices.
- .3 CAN/CSA C22.2 No.42.1 (current edition), Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
- .4 CSA C22.2 No.55 (current edition), Special Use Switches.
- .5 CSA C22.2 No.111 (current edition), General-Use Snap Switches (Bi-national standard, with UL 20).

**1.4 Sustainable Requirements**

1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.

1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.

1.4.3 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve

sustainable goals, including any applicable exemplary performance levels, for the following:

- .1 Construction Waste Management / Product Waste Recyclability.
- .2 Recycled Content.
- .3 Local and Regional Materials.
- .4 Certified Wood.
- .5 Construction Indoor Air Quality (IAQ) management.
- .6 VOC/Low-Emitting Materials Compliance.

1.4.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## 1.5 **Submittals**

1.5.1 Submit in accordance with Section 01300 (01 33 00) - Submittal.

1.5.2 Product Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for wiring devices and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Sustainable Requirements: Construction and include: product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish.

1.5.3 Sample:

- .1 Submit samples in accordance with Section 01 33 00 - Submittal.

1.5.4 Quality Assurance:

- .1 Engineer reserves the right to witness standard factory testing of the and above.
- .2 Submit site tests results of installed electrical systems and instrumentation

1.5.5 Closeout Submittals:

- .1 Provide maintenance data for materials for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Data necessary for maintenance of materials.
- .3 Manufacturers recommended list of spare parts.

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**1.6 Delivery, Storage and Handling**

- 1.6.1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- 1.6.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- 1.6.3 Handle materials with suitable lifting equipment.
- 1.6.4 Store materials in heated, dry, weather-protected enclosure

**2 . PRODUCTS**

**2.1 Switches**

- 2.1.1 [15] [20] A, [120 V] [single pole], [double pole], [three-way], [four-way] switches to: [CSA C22.2 No. 55] [and] [CSA C22.2 No. 111].
- 2.1.2 Manually-operated general purpose AC switches with following features:
  - .1 Terminal holes approved for No. 10 AWG wire.
  - .2 Silver alloy contacts.
  - .3 Urea or melamine moulding for parts subject to carbon tracking.
  - .4 Suitable for back and side wiring.
  - .5 White Decora.
- 2.1.3 [Toggle-operated] [locking], fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads [and] [or] [Heating Loads].
- 2.1.4 Switches of one manufacturer throughout project.
- 2.1.5 Provide specification-grade switches.
- 2.1.6 Acceptable Manufactures
  - .1 Eaton Cutler Hammond
  - .2 Hubbell
  - .3 Schneider
  - .4 Or approved equal.

**2.2 Receptacles**

- 2.2.1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA C22.2 No.42 with following features:
  - .1 White urea moulded housing.
  - .2 Suitable for No. 10 AWG for back and side wiring.
  - .3 Break-off links for use as split receptacles.
  - .4 Eight back wired entrances, four side wiring screws.
  - .5 Triple wipe contacts and riveted grounding contacts.



- 2.2.2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:
  - .1 White urea moulded housing.
  - .2 Suitable for No. 10 AWG for back and side wiring (Decora).
  - .3 Four back wired entrances, 2 side wiring screws.
- 2.2.3 Surge Protection Device (SPD) 15 A, 125 V duplex receptacles to be 2-pole, 3-wire specification grade, blue face, parallel blade, U ground, impact-resistant, nylon face, audible and LED alarm.
- 2.2.4 Isolated Ground type to be 15 A, 125 V duplex receptacles to be 2-pole, 3-wire specification grade, orange face, parallel blade, U ground, impact-resistant, nylon face.
- 2.2.5 Ground Fault Interrupter type to be 15 A, 125 V duplex receptacles to be 2-pole, 3-wire specification grade, white face, parallel blade, U ground, impact resistant, nylon face complete with breaker and reset button.
- 2.2.6 All other single outlet and special purpose receptacles are to be similar to the specification grade. Confirm ampacity, voltage and pin configuration prior to installation.
- 2.2.7 Receptacles of one manufacturer throughout project.
- 2.2.8 Acceptable Manufactures
  - .1 Eaton Cutler Hammond
  - .2 Hubbell
  - .3 Schneider
  - .4 Or approved equal.

## 2.3 **Special Wiring Devices**

- 2.3.1 Special wiring devices:
  - .1 Pilot lights as indicated, with neon type 0.04 W, 125 V lamp and red plastic lens flush type.
  - .2 Combination Occupancy Sensors Wall Switches (Line Voltage):
    - .1 Line voltage wall switch sensors shall be capable of detecting presence in the floor area to be controlled by detecting shifts in passive infrared and ultrasonic sensors.
    - .2 Provide a neutral wire at each switch position using dual technology.
    - .3 Sensors shall be complete with the following:
      - .1 Override push switch.
      - .2 LED detection status indicator.
      - .3 Low profile recessed design to suit "Decorator Plate".

- .4 Dual level lens to enhance detection at desktop level.
- .5 Ability to maintain luminaires in operation when occupancy is only one person sitting at a desk in accordance with NEMA WD7 guidelines.
- .6 Temperature and humidity resistance.
- .7 Time delay range from 30 seconds to 30 minutes.
- .8 Sensitivity adjustment from 20% to 100%.
- .9 Compatible with electronic ballasts and CF ballasts.
- .10 Immunity to FRI and EMI interference.
- .11 Integrated light level sensor option holds light off when the natural light is above the preset levels.
- .3 Acceptable Manufactures
- .4 Eaton Cutler Hammond
- .5 Hubbell
- .6 Schneider
- .1 Or approved equal.
- .7 Dimmers:
  - .1 Flush-mounted – specification grade.
  - .2 Incandescent application: 600 – 1500 watts based on connected load plus 25% spare.
  - .3 Electronic ballast application: compatible with ballasts specified.
  - .4 Radio interference suppression.
  - .5 Thin profile: slide to OFF feature.
  - .6 Finished in white or as indicated.
- .8 Interval Timers:
  - .1 Range: 0 – 30 minutes.
  - .2 Spring-wound or digital without hold feature.
  - .3 Single pole, 120 volt, 20 amp contacts to open at end of timing cycle.
  - .4 Flush-mounting.
  - .5 White finish.
  - .6 Acceptable Manufactures

## 2.4 **Cover Plates**

- 2.4.1 Cover plates for wiring devices to: CSA C22.2 No.42.1.
- 2.4.2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.

- 2.4.3 Plastic white cover plates, thickness 2.5 mm for wiring devices mounted in flush-mounted outlet box.
- 2.4.4 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- 2.4.5 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.
- 2.4.6 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.

## **2.5 Hand Dryer**

- 2.5.1 Sensor-activated high-speed concealed hand dryer. The following are the minimum requirements:
  - .1 120 V AC, 510 watt hardwire connection.
  - .2 360km/h air speed with a 62dB noise rating.
  - .3 Touch-free infrared sensors activation with power savings faction.
  - .4 Drip tray to prevent water from trickling to the floor.
  - .5 Mounts flush to the wall with stainless steel body.
  - .6 References:
    - .1 Meets or exceeds CSA C22.2 #113-14.
    - .2 ADA compliant.
- 2.5.2 Acceptable Manufactures:
  - .1 TOTO-HDR110#55

## **2.6 Electrical Heater**

- 2.6.1 Installation and material for Electrical Cabinet Heaters shall meet the following requirements:
  - .1 20 gauge steel cabinet.
  - .2 White poxy/polyester powder paint.
  - .3 208 V, 1 Phase with a watt density of 500 W/300 mm.
  - .4 Stainless steel tubular heating elements with aluminum fins.
  - .5 Built in tamper-proof thermostat.
  - .6 Programmable remote thermostate.
- 2.6.2 Acceptable Manufactures:
  - .1 Ouellef/OPA

## **3 . EXECUTION**

### **3.1 Installation**

- 3.1.1 Switches:

- .1 Install single throw switches with handle in "UP" position when switch closed.
- .2 Install switches in gang type outlet box when more than one switch is required in one location.
- .3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results.

3.1.2 Receptacles:

- .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
- .2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results.
- .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
- .4 Install GFI type receptacles as indicated.

3.1.3 Cover plates:

- .1 Install suitable common cover plates where wiring devices are grouped.
- .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

**3.2 Examination**

3.2.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wiring devices installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of Engineer.
- .2 Inform Engineer of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Engineer.

**3.3 Protection**

- 3.3.1 Protect installed products and components from damage during construction.
- 3.3.2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- 3.3.3 Repair damage to adjacent materials caused by wiring device installation.

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**3.4 Maintenance – Clearances**

- 3.4.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

**3.5 Cleaning**

- 3.5.1 Proceed in accordance with Section 01 74 00 Cleaning and waste management.
- 3.5.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

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**1. GENERAL**

**1.1 Section Includes**

1.1.1 Materials and installation for Fuses – Low Voltage.

**1.2 Related Sections**

1.2.1 This section of the specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

**1.3 References**

1.3.1 Canadian Standards Association (CSA International)  
.1 CSA C22.1 (current edition), Canadian Electrical Code, Part 1.

**1.4 Sustainable Requirements**

- 1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.
- 1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.
- 1.4.3 Waste Management and Disposal
- .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
  - .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
  - .3 Place materials defined as hazardous or toxic waste in designated containers.
- 1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:
- .1 Construction Waste Management / Product Waste Recyclability.
  - .2 Recycled Content.
  - .3 Local and Regional Materials.
  - .4 Certified Wood.
  - .5 Construction Indoor Air Quality (IAQ) management.

.6 VOC/Low-Emitting Materials Compliance.

1.4.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## **1.5 Submittals**

1.5.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

1.5.2 Product Data:

.1 Provide fuse performance data characteristics for each fuse type and size above 60A. Performance data to include average melting time-current characteristics.

1.5.3 Shop Drawings:

.1 Provide shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

## **1.6 Delivery, Storage and Handling**

1.6.1 Ship fuses in original containers.

1.6.2 Do not ship fuses installed in switchboard.

1.6.3 Store fuses in original containers in storage cabinet.

## **1.7 Extra Materials**

1.7.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

1.7.2 Three spare fuses of each type and size installed above 600 A.

1.7.3 Six spare fuses of each type and size installed up to and including 600 A.

## **2. PRODUCTS**

### **2.1 Fuses - General**

2.1.1 Fuse type references L1, L2, J1, R1, etc. have been adopted for use in this specification.

2.1.2 Fuses shall be the product of one manufacturer.

### **2.2 Fuse Types**

2.2.1 Class L Fuses:

- .1 Type L1, time delay, capable of carrying 500% of its rated current for 10 seconds minimum.
- .2 Type L2, fast acting.
- 2.2.2 Class J Fuses:
  - .1 Type J1, time delay, capable of carrying 500% of its rated current for 10 seconds minimum.
  - .2 Type J2, fast acting.
- 2.2.3 Class R -R Fuses:
  - .1 Type R1, (UL Class RK1), time delay, capable of carrying 500% of its rated current for 10 seconds minimum, to meet UL Class RK1 maximum let-through limits.
  - .2 Type R2, time delay, capable of carrying 500% of its rated current for 10 seconds minimum.
  - .3 Type R3, (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits

### **2.3 Spare parts**

- 2.3.1 Three spare fuses of each type and size installed above 600 A.
- 2.3.2 Six spare fuses of each type and size installed up to and including 600 A

## **3 . EXECUTION**

### **3.1 Installation**

- 3.1.1 Install fuses in mounting devices immediately before energizing circuit.
- 3.1.2 Ensure correct fuses fitted to physically matched mounting devices.
  - .1 Install rejection clips for Class R fuses.
- 3.1.3 Ensure correct fuses fitted to assigned electrical circuit.
- 3.1.4 Where UL Class RK1 fuses are specified, install warning label "Use only UL Class RK1 fuses for replacement" on equipment.
- 3.1.5 Install spare fuses in fuse storage cabinet.

### **3.2 Maintenance – Clearances**

- 3.2.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

### **3.3 Cleaning**

- 3.3.1 Proceed in accordance with Section 01 74 00 Cleaning and waste management.



- 
- 3.3.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

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**1.      GENERAL**

**1.1      Section Includes**

- 1.1.1 Materials for moulded-case circuit breakers, circuit breakers, and ground-fault circuit-interrupters.

**1.2      Related Sections**

- 1.2.1 This section of the specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.
- 1.2.2 Section 26 23 00 - Low Voltage Switchgear.
- 1.2.3 26 24 13 - Switchboards
- 1.2.4 Section 26 28 18 - Ground Fault Equipment Protection.

**1.3      References**

- 1.3.1 Canadian Standards Association (CSA International):
- .1 CSA-C22.2 No. 5-02, Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).
  - .2 IEEE standard C37.13 – LVPCB Used in Enclosure
  - .3 UL 489 MCCB
  - .4 UL 489 Molded Case Switches

**1.4      Sustainable Requirements**

- 1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.
- 1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.
- 1.4.3 Waste Management and Disposal
- .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
  - .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
  - .3 Place materials defined as hazardous or toxic waste in designated containers.
- 1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be

fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:

- .1 Construction Waste Management / Product Waste Recyclability.
- .2 Recycled Content.
- .3 Local and Regional Materials.
- .4 Certified Wood.
- .5 Construction Indoor Air Quality (IAQ) management.
- .6 VOC/Low-Emitting Materials Compliance.

1.4.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## 1.5 Submittals

- 1.5.1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- 1.5.2 Include time-current characteristic curves for breakers with ampacity of 200 A and over or with interrupting capacity of 22,000 A symmetrical (RMS) and over at system voltage.

## 2. PRODUCTS

### 2.1 Breakers General

- 2.1.1 Moulded-case circuit breakers, Circuit breakers and Ground-fault circuit-interrupters, to CSA C22.2 No. 5
- 2.1.2 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.
- 2.1.3 Plug-in moulded case circuit breakers: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.
- 2.1.4 Common-trip breakers with single handle for multi-pole applications.
- 2.1.5 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
  - .1 Trip settings on breakers with adjustable trips to range from three to eight times current rating.
- 2.1.6 Circuit breakers with interchangeable trips as indicated.
- 2.1.7 Circuit breakers to have minimum 20kA symmetrical RMS interrupting capacity rating.

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**2.2 Thermal Magnetic Breakers Design A.**

2.2.1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

**2.3 Magnetic Breakers Design B.**

2.3.1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.

**2.4 Current Limiting and Series Rated Thermal Magnetic Breakers Design C.**

2.4.1 Thermal magnetic breakers with current limiters:

- .1 Time current limiting characteristics of fuses limiters coordinated with time current tripping characteristics of circuit breaker.
- .2 Coordination to result in interruption by breaker of fault-level currents up to interrupting capacity of breaker.

2.4.2 Series rated breakers to be manufacturer tested and listed. Breakers to be applied following manufacturer's guidelines and accepted best practice.

- .1 Breakers applied following manufacturer's guidelines and accepted best practice.

**2.5 Solid State Trip Breakers Design D.**

2.5.1 Moulded case circuit breaker to operate by means of solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and [long time] [short time] [instantaneous] tripping for [phase] [ground] fault short circuit protection.

**2.6 Optional Features**

2.6.1 Include:

- .1 Shunt trip.
- .2 Auxiliary switch.
- .3 Motor-operated mechanism [complete with time delay unit].
- .4 Under-voltage release.
- .5 On-off locking device.
- .6 Handle mechanism.

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**2.7    Enclosure**

**3 .    EXECUTION**

**3.1    Installation**

3.1.1 Install circuit breakers as per NEMA AB1 and/or NEMA AB3 or as indicated.

**3.2    Maintenance – Clearances**

3.2.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

**3.3    Cleaning**

3.3.1 Proceed in accordance with Section 01 74 00 Cleaning and waste management.

3.3.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

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**1. GENERAL**

**1.1 Section Includes**

1.1.1 Materials and installation for Ground Fault Equipment Protection.

**1.2 Related Sections**

1.2.1 This section of the specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

**1.3 References**

1.3.1 CSA International:

- .1 CAN/CSA C22.2 No. 144-06(R2011), Ground Fault Circuit Interrupters.

1.3.2 National Electrical Manufacturers Association (NEMA):

- .1 NEMA PG 2.2-1999(R2009), Application Guide for Ground Fault Protection Devices for Equipment.

**1.4 Sustainable Requirements**

1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.

1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.

1.4.3 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:

- .1 Construction Waste Management / Product Waste Recyclability.
- .2 Recycled Content.

- .3 Local and Regional Materials.
- .4 Certified Wood.
- .5 Construction Indoor Air Quality (IAQ) management.
- .6 VOC/Low-Emitting Materials Compliance.

1.4.5 **NOTE:** Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## **1.5 Submittals**

1.5.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

1.5.2 Product Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for ground fault equipment protection and include product characteristics, performance criteria, physical size, finish and limitations.

1.5.3 Shop Drawings:

- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario , Canada.
  - .1 Indicate on drawings:
    - .1 Amperage for each circuit intended to be protected

1.5.4 Test and Evaluation Reports: Submit test report for field testing of ground fault equipment to Engineer and certificate that system as installed meets criteria specified.

## **1.6 Closeout Submittals**

1.6.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

1.6.2 Operation and Maintenance Data: Submit operation and maintenance data for ground fault equipment protection for incorporation into manual.

## **1.7 Delivery, Storage and Handling**

1.7.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

1.7.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

1.7.3 Storage and Handling Requirements:

- .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

- .2 Store and protect ground fault equipment protection from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

## 1.8 **Payment**

- 1.8.1 Payment for field testing of ground fault equipment performed by Contractor in accordance with Section 01 29 83 - Payment Procedures: Testing Laboratory Services.

## 2. **PRODUCTS**

### 2.1 **Equipment**

- 2.1.1 Ground fault protective equipment: components of one manufacturer.
- 2.1.2 Provide ground fault protection on circuits provided to heating equipment, three-phase service to NEMA PG 2.2 and CAN/CSA C22.2 No. 144.
- 2.1.3 Ground fault unit to contain:
  - .1 Ground sensing relay suitable for operation at manufacturers recommendation Control voltage at 120/208/600 V.
  - .2 Ammeter with scale 0 to 1.0 A to indicate ground current value.
  - .3 Three position sensitivity control switch to select value of leakage current at which relay will operate.
  - .4 Indicating lamp illuminated when no ground fault exists, extinguished on ground fault or test.
  - .5 Switch:
    - .1 SPDT contacts for alarm and trip.
    - .2 Mechanical target indication.
    - .3 Manual reset.
  - .6 Reset button for contacts and target.
  - .7 Suitable for panel mounting.
- 2.1.4 Zero sequence transformer type with 300 - 3000 mA range.
- 2.1.5 Neutral:
- 2.1.6 System to operate instantaneously at ground current setting.

### 2.2 **Fabrication**

- 2.2.1 Install following components in equipment specified in other Sections and as indicated.
  - .1 Zero sequence transformer.



- .2 Ground fault relay.
- .3 Ground resistor unit.

### **2.3 Related Equipment**

#### **2.3.1 Shunt trip breakers**

## **3 . EXECUTION**

### **3.1 Examination**

3.1.1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for ground fault equipment installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of Engineer.
- .2 Inform Engineer of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Engineer.

### **3.2 Installation**

- 3.2.1 Do not ground neutral on load side of sensor.
- 3.2.2 Install phase conductors including neutral through zero sequence transformer.
- 3.2.3 Install ground fault protection system.
- 3.2.4 Make connections as indicated and in accordance with manufacturer's written recommendations.

### **3.3 Field Quality Control**

- 3.3.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and coordinate with Section 01 40 00 - Quality Requirements [if required].
- 3.3.2 Arrange for field testing of ground fault equipment by independent ground fault equipment manufacturer before commissioning service.
- 3.3.3 Demonstrate simulated ground fault tests.

### **3.4 Maintenance – Clearances**

- 3.4.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

**3.5 Cleaning**

- 3.5.1 Progress Cleaning: Clean in accordance with Section 01 74 00  
Cleaning and waste management.  
.1 Leave Work area clean at end of each day.
- 3.5.2 Final Cleaning: Upon completion remove surplus materials, rubbish,  
tools and equipment in accordance with Section 01 74 00 Cleaning  
and waste management.

**END OF SECTION**

**1. GENERAL**

**1.1 Section Includes**

- 1.1.1 Materials and installation for Ground Fault Circuit Interrupters – Class A.

**1.2 Related Sections**

- 1.2.1 This section of the specification forms part of the contract documents and is to be read, interpreted, and coordinated with all other parts.

**1.3 References**

- 1.3.1 CSA International  
.1 CAN/CSA C22.2 No.144-M91(R2006), Ground Fault Circuit Interrupters.
- 1.3.2 National Electrical Manufacturers Association (NEMA)  
.1 NEMA PG 2.2-1999(R2009), Application Guide for Ground Fault Protection Devices for Equipment.

**1.4 Sustainable Requirements**

- 1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.
- 1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.
- 1.4.3 Waste Management and Disposal  
.1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.  
.2 Avoid using landfill waste disposal procedures when recycling facilities are available.  
.3 Place materials defined as hazardous or toxic waste in designated containers.
- 1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements, and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:  
.1 Construction Waste Management / Product Waste Recyclability.  
.2 Recycled Content.

- .3 Local and Regional Materials.
- .4 Certified Wood.
- .5 Construction Indoor Air Quality (IAQ) management.
- .6 VOC/Low-Emitting Materials Compliance.

1.4.5 **NOTE:** Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## **1.5 Submittals**

1.5.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

1.5.2 Product Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for ground fault circuit interrupters and include product characteristics, performance criteria, physical size, finish and limitations.

1.5.3 Shop Drawings:

- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario , Canada.

1.5.4 Test and Evaluation Reports: submit test report for field testing of ground fault equipment to Engineer and certificate that system as installed meets criteria specified.

## **1.6 Closeout Submittals**

1.6.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

1.6.2 Operation and Maintenance Data: submit operation and maintenance data for ground fault circuit interrupters for incorporation into manual.

## **1.7 Delivery, Storage and Handling**

1.7.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

1.7.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

1.7.3 Storage and Handling Requirements:

- .1 Store materials indoors and in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect ground fault circuit interrupters from nicks, scratches, and blemishes.

- .3 Replace defective or damaged materials with new.

**1.8 Payment**

- 1.8.1 Payment for field testing of ground fault equipment performed by contractor in accordance with Section 01 29 00 - Payment Procedures.

**2 . PRODUCTS**

**2.1 Materials**

- 2.1.1 Equipment and components for ground fault circuit interrupters (GFCI) to CAN/CSA C22.2 No.144
- 2.1.2 Components comprising ground fault protective system to be of same manufacturer.

**2.2 Breaker Type Ground Fault Interrupter**

- 2.2.1 Single pole ground fault circuit interrupter for 15 or 20 A (refer to panel schedules and drawings), 120 V, 1 phase circuit complete with test and reset facilities.

**2.3 Ground Fault Life Protector**

- 2.3.1 Two pole circuit breaker to supply power to panel and complete with:
- .1 Automatic shunt trip breaker.
  - .2 Zero sequence current sensor.
  - .3 Facilities for testing and reset.
  - .4 CSA Enclosure 3, surface mounted.
  - .5 Ground fault trip indicator light.

**2.4 Ground Fault Protector Unit**

- 2.4.1 Self-contained with 15 A, 120 V circuit interrupter and duplex or single receptacle complete with:
- .1 Solid state ground sensing device.
  - .2 Facility for testing and reset.
  - .3 CSA Enclosure 1 flush mounted with painted face plate.

**3 . EXECUTION**

**3.1 Examination**

- 3.1.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for ground fault circuit interrupters installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of Engineer.
- .2 Inform Engineer of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Department Representative.

**3.2 Installation**

- 3.2.1 Do not ground neutral on load side of ground fault relay. Pass phase conductors including neutral through zero sequence transformers.
- 3.2.2 Connect supply and load wiring to equipment in accordance with manufacturer's recommendations.

**3.3 Field Quality Control**

- 3.3.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and coordinate with Section 01 40 00 - Quality Requirements if required.
- 3.3.2 Arrange for field testing of ground fault equipment by [independent testing laboratory] [ground fault equipment manufacturer] [Contractor] before commissioning service.
- 3.3.3 Demonstrate simulated ground fault tests.

**3.4 Maintenance – Clearances**

- 3.4.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

**3.5 Cleaning**

- 3.5.1 Progress Cleaning: Clean in accordance with Section 01 74 00 Cleaning and waste management.
  - .1 Leave Work area clean at end of each day.
- 3.5.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 Cleaning and waste management.

**END OF SECTION**

**1. GENERAL**

**1.1 Section Includes**

- 1.1.1 Materials and installation for fused and non-fused disconnect switches.

**1.2 Related Sections**

- 1.2.1 This section of the Specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

**1.3 References**

- 1.3.1 Canadian Standards Association (CSA International).  
.1 CAN/CSA C22.2 No.4 (current edition), Enclosed Switches.  
.2 CSA C22.2 No.39 (current edition), Fuseholder Assemblies.

**1.4 Sustainable Requirements**

- 1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.
- 1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.
- 1.4.3 Waste Management and Disposal
- .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.
- 1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:
- .1 Construction Waste Management / Product Waste Recyclability.
- .2 Recycled Content.
- .3 Local and Regional Materials.
- .4 Certified Wood.

.5 Construction Indoor Air Quality (IAQ) management.

.6 VOC/Low-Emitting Materials Compliance.

1.4.5 **NOTE:** Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## **1.5 Submittals**

1.5.1 Submit product data in accordance with Section 01 33 00 - Submittal.

1.5.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Sustainable Requirements: Construction and include: product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish.

1.5.3 Sample:

.1 Submit samples in accordance with Section 01 33 00 - Submittal.

1.5.4 Quality Assurance:

.1 Engineer reserves the right to witness standard factory testing of the and above.

.2 Submit site tests results of installed electrical systems and instrumentation

1.5.5 Closeout Submittals:

.1 Provide maintenance data for materials for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

.2 Data necessary for maintenance of materials.

.3 Manufacturers recommended list of spare parts.

## **1.6 Delivery, Storage and Handling**

1.6.1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.

1.6.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.6.3 Handle materials with suitable lifting equipment.

1.6.4 Store materials in heated, dry, weather-protected enclosure



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**1.7 Acceptable Manufactures**

- 1.7.1 Eaton Cutler Hammond
- 1.7.2 Siemens
- 1.7.3 Square D
- 1.7.4 Or approved equal.

**2 . PRODUCTS**

**2.1 Disconnect Switches**

- 2.1.1 Fusible, non-fusible, horsepower rated disconnect switch in CSA Enclosure, to CAN/CSA C22.2 No.4 size as indicated.
- 2.1.2 Provision for padlocking in off switch position by locks.
- 2.1.3 Mechanically interlocked door to prevent opening when handle in ON position.
- 2.1.4 Fuseholders: to CSA C22.2 No.39 relocatable and suitable without adaptors, for type and size of fuse indicated.
- 2.1.5 Quick-make, quick-break action.
- 2.1.6 ON-OFF switch position indication on switch enclosure cover.

**3 . EXECUTION**

**3.1 Installation**

- 3.1.1 Install disconnect switches complete with fuses if applicable.

**3.2 Maintenance – Clearances**

- 3.2.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

**3.3 Cleaning**

- 3.3.1 Proceed in accordance with Section 01 74 00 Cleaning and waste management.
- 3.3.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

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**1. GENERAL**

**1.1 Section Includes**

1.1.1 Materials and installation for Contractors.

**1.2 Related Sections**

1.2.1 This section of the specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

**1.3 References**

1.3.1 Canadian Standards Association (CSA International)

.1 CSA C22.1 (current edition), Canadian Electrical Code, Part 1.

.2 CSA C22.2 No.14-10, Industrial Control Equipment.

1.3.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA ICS 2-2000 (R2005), Controllers, Contactors and Overload Relays Rated 600 V.

**1.4 Sustainable Requirements**

1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.

1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.

1.4.3 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

.3 Place materials defined as hazardous or toxic waste in designated containers.

1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:

.1 Construction Waste Management / Product Waste Recyclability.

- .2 Recycled Content.
- .3 Local and Regional Materials.
- .4 Certified Wood.
- .5 Construction Indoor Air Quality (IAQ) management.
- .6 VOC/Low-Emitting Materials Compliance.

1.4.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## 1.5 Submittals

1.5.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

1.5.2 Product Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for contactors and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Sustainable Requirements: Construction and include: product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish.

1.5.3 Sample:

- .1 Submit samples in accordance with Section 01 33 00 - Submittal.

1.5.4 Quality Assurance:

- .1 Engineer reserves the right to witness standard factory testing of the and above.
- .2 Submit site tests results of installed electrical systems and instrumentation

1.5.5 Closeout Submittals:

- .1 Provide maintenance data for materials for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Data necessary for maintenance of materials.
- .3 Manufacturers recommended list of spare parts.
- .4 Operation and Maintenance Data: Submit operation and maintenance data for contactors for incorporation into manual.

- .5 Include operating information required for start-up, synchronizing and shutdown of generating units.

**1.6 Delivery, Storage and Handling**

- 1.6.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- 1.6.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.6.3 Storage and Handling Requirements:
  - .1 Store materials indoor and in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect contactors from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- 1.6.4 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- 1.6.5 Handle materials with suitable lifting equipment.
- 1.6.6 Store materials in heated, dry, weather-protected enclosure

**1.7 Acceptable Manufactures**

- 1.7.1 Cutler Hammond Eaton
- 1.7.2 Schneider
- 1.7.3 Or approved equal.

**2. PRODUCTS**

**2.1 Contactors**

- 2.1.1 Electrically held, Permanent magnet latch type, controlled by pilot devices as indicated and rated for type of load controlled. Half size contactors not accepted.
- 2.1.2 Breaker combination contactor as indicated.
- 2.1.3 Complete with two normally open and two normally closed auxiliary contacts unless indicated otherwise.
- 2.1.4 Mount in CSA enclosure unless otherwise indicated.
- 2.1.5 Include following options in cover:
  - .1 Green indicator
  - .2 Stop/Start pushbutton.
  - .3 Hand-Off/Auto selector switch.

.4 On/Off selector switch.

2.1.6 Control transformer: in accordance with Section 26 29 03 - Control Devices, factory wired and installed in contactor enclosure.

**2.2 Equipment Identification**

2.2.1 Identify equipment in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.2.2 Size 4 nameplate indicating name of load controlled.

**3 . EXECUTION**

**3.1 Installation**

3.1.1 Install contactors and connect power wires and auxiliary control devices.

3.1.2 Identify contactors with nameplates or labels indicating panel and circuit number.

3.1.3 Test contactors in accordance with 26 05 00 - Common Work Results for Electrical.

**3.2 Protection**

3.2.1 Protect installed products and components from damage during construction.

3.2.2 Repair damage to adjacent materials caused by contactor installation.

**3.3 Maintenance – Clearances**

3.3.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

**3.4 Cleaning**

3.4.1 Progress Cleaning: clean in accordance with Section 01 74 00 Cleaning and waste management.

.1 Leave Work area clean at end of each day.

3.4.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 Cleaning and waste management.

**END OF SECTION**

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**1. GENERAL**

**1.1 Section Includes**

- 1.1.1 Materials and installation for Motor Starters to 600 V.

**1.2 Related Sections**

- 1.2.1 This section of the specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

**1.3 References**

- 1.3.1 Canadian Standards Association (CSA International)
- .1 CSA C22.1 (current edition), Canadian Electrical Code, Part 1.
- 1.3.2 International Electrotechnical Commission (IEC)
- .1 IEC 947-4-1-2002, Part 4: Electromechanical contactors and motor-starters.

**1.4 Sustainable Requirements**

- 1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.
- 1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.
- 1.4.3 Waste Management and Disposal
- .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.
- 1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:
- .1 Construction Waste Management / Product Waste Recyclability.
- .2 Recycled Content.

- .3 Local and Regional Materials.
- .4 Certified Wood.
- .5 Construction Indoor Air Quality (IAQ) management.
- .6 VOC/Low-Emitting Materials Compliance.

1.4.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## 1.5 Submittals

1.5.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

1.5.2 Product Data:

- .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Sustainable Requirements: Construction and include: product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish.

1.5.3 Provide shop drawings for each type of starter to indicate:

- .1 Mounting method and dimensions.
- .2 Starter size and type.
- .3 Layout and components.
- .4 Enclosure types.
- .5 Wiring diagram.
- .6 Interconnection diagrams.

1.5.4 Closeout Submittals:

- .1 Provide maintenance data for materials for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Data necessary for maintenance of materials.
- .3 Manufacturers recommended list of spare parts.
- .4 Submit operation and maintenance data for each type and style of motor starter for incorporation into maintenance manual.
- .5 Extra Materials:
- .6 Provide listed spare parts for each different size and type of starter.

- 1. three contacts, stationary.
- 2. three contacts, movable.
- 3. one contacts, auxiliary.

4. one control transformer.
5. one operating coil.
6. two fuses.
7. 10% indicating lamp bulbs used.

**1.6 Delivery, Storage and Handling**

- 1.6.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- 1.6.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- 1.6.3 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- 1.6.4 Handle materials with suitable lifting equipment.
- 1.6.5 Store materials in heated, dry, weather-protected enclosure

**1.7 Acceptable Manufacturers**

- 1.7.1 Eaton
- 1.7.2 Or approved equal.

**2. PRODUCTS**

**2.1 Materials**

- 2.1.1 Starters: to IEC 947-4 with AC4 utilization category.

**2.2 Manual Motor Starters**

- 2.2.1 Single or three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
  - .1 Switching mechanism, quick make and break.
  - .2 One or three overload heaters, manual reset, trip indicating handle.
- 2.2.2 Accessories:
  - .1 Toggle, Key, Switch, Pushbutton: standard labelled as indicated.
  - .2 Indicating Light: Standard type and colour as indicated.
  - .3 Locking tab to permit padlocking in "ON" or "OFF" position.

**2.3 Full Voltage Magnetic Starters**

- 2.3.1 Magnetic of size, type, rating and enclosure type as indicated with components as follows:
  - .1 Contactor solenoid operated, rapid action type.



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- .2 Motor overload protective device in each phase, manually reset from outside enclosure.
  - .3 Wiring and schematic diagram inside starter enclosure in visible location.
  - .4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- 2.3.2 Combination type starters to include fused disconnect switch with operating lever on outside of enclosure to control disconnect and provision for:
- .1 Locking in "OFF" position with up to three padlocks.
  - .2 Independent locking of enclosure door.
  - .3 Provision for preventing switching to "ON" position while enclosure door open.
- 2.4 Control Transformer**
- 2.4.1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.
- 2.4.2 Size control transformer for control circuit load plus 20% spare capacity.
- 2.5 Accessories**
- 2.5.1 Pushbutton: Heavy duty, oil tight as required.
- 2.5.2 Selector Switches: Heavy duty, oil tight as required.
- 2.5.3 Indicating Lights: Heavy duty, oil tight, type and colour as indicated.
- 2.6 Finishes**
- 2.6.1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results for Electrical.
- 2.7 Equipment Identification**
- 2.7.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- 2.7.2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.
- 2.7.3 Magnetic starter designation label, white plate, black letters, size 2 engraved as indicated.

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**3 . EXECUTION**

**3.1 Installation**

- 3.1.1 Install starters and control devices in accordance with manufacturer's instructions.
- 3.1.2 Install and wire starters and controls as indicated.
- 3.1.3 Ensure correct fuses installed.
- 3.1.4 Confirm motor nameplate and adjust overload device to suit.

**3.2 Field Quality Control**

- 3.2.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and manufacturer's instructions.
- 3.2.2 Operate switches and contactors to verify correct functioning.
- 3.2.3 Perform starting and stopping sequences of contactors and relays.
- 3.2.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

**3.3 Maintenance – Clearances**

- 3.3.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

**3.4 Cleaning**

- 3.4.1 Clean in accordance with Section 01 74 00 Cleaning and waste management.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- 3.4.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

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1. **GENERAL**

1.1 **Related Work**

- 1.1.1 Common Work Results – Electrical: Section 26 05 00.
- 1.1.2 Commissioning: Section 26 05 03.
- 1.1.3 Installation of Anchor Devices, Setting Templates: Architectural Section.
- 1.1.4 Concrete Pad: Architectural Section.
- 1.1.5 Automatic Transfer Switches: Section 26 36 23

1.2 **Description of System**

- 1.2.1 Generator set consists of:
  - .1 Diesel engine.
  - .2 Alternator.
  - .3 Generator control panel.
  - .4 Muffler and flexible connections.
  - .5 Cooling system.
  - .6 Sub-base fuel tank.
  - .7 Fuel pump.
  - .8 Battery charger and battery.
  - .9 Interconnecting wiring.
  - .10 Structural steel base.
  - .11 Remote annunciator
  - .12 Interconnections to BMS and fire alarm panel
  - .13 Metal enclosure
- 1.2.2 Set designed to operate as a prime type, emergency standby power source. Set shall be a packaged unit, complete and mounted on a skid.
- 1.2.3 Generator set and auxiliaries shall comply with CSA Standard C282 – 19 as well as the following specification. Where this specification calls for performance in excess of CSA Standard C282 – 19, this specification shall govern.
- 1.2.4 Control panel to:
  - .1 Monitor operation of generator.
  - .2 Annunciate trouble.
  - .3 Sound alarms.
- 1.2.5 Seismic Restraints suitable to BC Building Code Requirements

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**1.3 Shop Drawings**

1.3.1 Submit shop drawings in accordance with Section 26 05 00.

**1.4 Preliminary Approval**

1.4.1 Prior to final purchase of diesel generator set, the following information contained in a binder, shall be submitted for approval:

- .1 Preliminary dimensioned outline of unit.
- .2 Confirmation of exhaust pipe diameter.
- .3 Brake horsepower versus rated speed curves.
- .4 Fuel consumption data.
- .5 Performance curves for local conditions and multipliers for ambient temperatures.
- .6 List of components.

**1.5 Operation and Maintenance Data**

1.5.1 Provide data for incorporation into Maintenance Manual. Provide four sets.

1.5.2 Operation and Maintenance Manual to include instructions for particular unit supplied and not general description of units manufactured by supplier and:

- .1 Operation and maintenance instructions for engine, alternator battery charger, battery, fuel system, engine room ventilation system, cooling system, exhaust system and accessories, to permit effective operation, maintenance, and repair.
- .2 Technical data:
  - .1 Illustrated parts list with parts catalogue number.
  - .2 Schematic diagram of electrical controls.
- .3 Flow diagrams for:
  - .1 Fuel system.
  - .2 Schematic diagram of electrical controls.
  - .3 Flow diagrams for:
    - .1 Fuel system.
    - .2 Lubricating oil.
  - .4 Certified copy of factory test results.

**1.6 Maintenance Materials**

1.6.1 Provide maintenance materials in accordance with Section 26 01 01

1.6.2 Include:

- .1 2 fuel filter replacement elements.
- .2 2 lube oil filter replacement elements.

- .3 2 air cleaner filter elements.
- .4 2 sets of fuses for control panel.
- .5 2 sets of approved headphone style ear protectors.

#### **1.7 Factory Test**

- 1.7.1 Supplier shall conduct performance and full load tests in his factory under supervision of the Consultant or his representative upon completion of assembly at factory and prior to shipping to prove that unit will start automatically pick up, load, and operate as required.
- 1.7.2 The test shall include:
  - .1 Demonstration of automatic start system.
  - .2 A one hour full load test, utilizing an adjustable load.
  - .3 Demonstration of safety features.
  - .4 During test, the following parameters shall be recorded at 30-minute intervals:
    - .1 Speed and frequency.
    - .2 Voltage and current per phase.
    - .3 Load.
    - .4 Coolant temperatures.
    - .5 Lubricating oil pressure.
    - .6 Fuel consumption for duration of test shall be noted.
- 1.7.3 Any undue overheating or failure of any component, caused by this overload, shall be considered a cause for rejection of plant design.
- 1.7.4 Electronic copies of certified test results shall be submitted upon completion of factory test procedure.

#### **1.8 Acceptance Test (Final On-Site Testing**

- 1.8.1 A satisfactory acceptance test shall be conducted after preliminary runs and tests have been made. This test shall be conducted on site after completion of installation. This acceptance test shall not be of less than four hours duration with full rated load on unit. Engine Manufacturer shall provide a 110% portable load bank of full rated load. After completion of above test, tests shall be performed to demonstrate overheat protection, low oil pressure protection and overspeed protection. Miscellaneous valves and piping required to demonstrate functioning of safety devices shall be provided.
- 1.8.2 The following data shall be taken at the test and at half hour intervals thereafter:
  - .1 Frequency.
  - .2 Voltage.
  - .3 Load (amperes).

- .4 Kilowatts.
- .5 Water temperatures (inlet and outlet).
- .6 Lubricating oil pressure.
- .7 Ambient temperature.
- 1.8.3 On completion of the site acceptance test, the supplier shall perform the following tests and demonstrate the satisfactory operation of the following control devices:
  - .1 High water temperature switch.
  - .2 Low oil pressure switch.
  - .3 Overcranking switch.
  - .4 Overspeed switch.
  - .5 Low water level.
  - .6 Low fuel supply level. (Sub base fuel tank).
  - .7 Low battery voltage level.
  - .8 Provide alignment of any flexible couplings.
- 1.8.4 Note: Before connection to building electrical system phase, rotation shall be checked for compatibility.
- 1.8.5 Fuel required for performing diesel generator acceptance test shall be provided by Division 26.
- 1.8.6 A competent diesel generator expert shall instruct the Owner's staff in maintenance and operation.

**1.9 Closeout**

- 1.9.1 Provide Seismic Letter of Assurance (S-B and S-C) from Structural P.Eng. registered in British Columbia for the seismic installation of the unit.

**1.10 Guarantee**

- 1.10.1 Provide a written guarantee, signed, and issued stating that the generating set is guaranteed against defects in material and workmanship for a period of one year, or 1500 operating hours, whichever occurs first, from the date of the Substantial Performance.

**2. PRODUCTS**

**2.1 Generator Set**

- 2.1.1 Provide a complete emergency diesel generator system including engine, alternator, starting battery, battery charger, start-up circuitry, control terminal cabinet, muffler, sub base tank, fuel pump, skin tight enclosure etc., as detailed and complete with all

interconnecting wiring, etc., required for this system to be fully operational.

- 2.1.2 The diesel generator shall be fully assembled with integral sub-base fuel tank. The unit shall be provided with all auxiliary systems connected and ready for operation. It shall only require setting and anchoring on its foundation at site and connection of electrical power and control wiring. Provide all necessary materials and labour at site to complete the assembly as may be necessary. The Installation Contractor shall offload the set at site, set and anchor it to its foundations and connect the external services to their connection points. Provide all other services and materials necessary to make the unit fully operational.
- 2.1.3 Sub base fuel tank to be sized for 24 hour back.
- 2.1.4 Comply with the following minimum performance standards for each individual generator set:
  - .1 Frequency:
    - .1  $\pm 1/4\%$  steady state stability at any load.
    - .2 Maximum  $1/2\%$  steady state regulation (droop) no load to full load.
    - .3 In accordance with CSA 282 requirements, maximum transient frequency dip shall not exceed 10% of rated frequency, with recovery to steady state within 3 seconds, for the maximum expected kW/kVA step load application. For these specifications, the step load application requirement for compliance with the 10%/3-second requirement is 70% rated at 0.8 pf. In addition, generator set shall be capable of application of step load of 100% rated kW at 0.8 PF, with frequency dip not to exceed 25% rated and recovery to rated conditions in 5 seconds.
  - .2 Voltage:
    - .1  $\pm 1\%$  steady state stability at any load.
    - .2 Maximum 1% steady state regulation no load to full load.
    - .3 Transient voltage maximum 25% of nominal with recovery to steady state within 5 seconds for the maximum expected kW/kVA load change.
- 2.1.5 Alternator shall be new and complete with necessary controls and accessories, to comprise a complete generating plant.
- 2.1.6 Generator shall operate a 60 Hz and shall be 600V three phase 4 wire drip-proof type with anti-friction bearings and shall have radio and TV interference suppression in accordance with applicable standards. 400kW.

- 2.1.7 The generator's neutral shall not be grounded inside the generator.
- 2.1.8 Generator shall be of rotating type with permanent magnetic generator (PMG).
- 2.1.9 Generator shall have Class H insulation and shall be rated for maximum 130°C temperature rise over an ambient of 40°C.
- 2.1.10 Generator shall be capable of providing sufficient short circuit current for duration necessary to trip generator main protective device without damaging the generator windings or insulation.
- 2.1.11 Generator shall be complete with automatic voltage regulator and exciter, acting on each phase and capable of controlling voltage +/- 2% of rated voltage, no load to full load, during steady state conditions.
- 2.1.12 Stable generator operating conditions shall be re-established within 3 seconds following any sudden change in load between no load and full load. The transient voltage surge shall not exceed 20% for the above load changes. The regulator shall have a rheostat capable of adjusting the generator terminal voltage +/- 5%. Largest motor to be connected on generator shall be 25HP.
- 2.1.13 The maximum allowable voltage dip during starting of any motor shall be 15%.
- 2.1.14 Decrement and generator damage curves shall be submitted to show fault current sustaining ability of generator.

## 2.2 Engine

- 2.2.1 Provide a diesel engine having a net continuous duty output standby power rating at least equal to the generator output plus excitation system requirements, direct coupled to the generator.
- 2.2.2 The speed of the generating set shall not exceed 1800 RPM and must be approved by the Engine Manufacturer for continuous operation. The Manufacturer shall certify that the proposed speed does not exceed 90% of the maximum engine speed approved by the Manufacturer for other applications.
- 2.2.3 The engine shall be water cooled, naturally aspirated or turbo-charged.
- 2.2.4 The engine, generator, radiator and fan shall mounted on a structural steel base. Base shall be of substantial mass and shall be torsionally rigid. Base shall be designed to permit ready removal of engine oil pan.
- 2.2.5 Vibration and Seismic Control as required by Seismic Engineer
- 2.2.6 Net brake horsepower, after allowance has been made for losses to engine driven accessories, shall be sufficient BHP to correspond to rated generator KW as determined by formula:
- 2.2.7  $BHP = \frac{KW}{\text{efficiency}}$



2.2.8 0746 x generator efficiency

2.2.9 BHP, plus allowance for engine driven accessories, shall not exceed 80% of maximum BHP of engine at generator RPM as substantiated by Engine Manufacturer's regularly published BHP curves. Engine rating conditions shall be 40 degrees C ambient. Engine Manufacturer shall either show horse-power curves at these conditions or at other conditions together with derating factors including data on losses to engine driven accessories.

2.2.10 Provide all necessary auxiliary equipment including:

- .1 Electrical governor with isochronous frequency regulation to maintain speed within  $\pm 10\%$ -25% steady state band.
- .2 Fuel injection system and fuel transfer pump.
- .3 Condensate trap complete with drain for crankcase breather.
- .4 Replaceable cartridge type lube oil filters. Filters shall have replaceable elements that can be easily removed without disturbing other parts of engine.
- .5 Combustion air cleaner. Air cleaner shall be of replaceable element type with an efficiency of at least 99.8%. Provide air filter service indicator.
- .6 Full pressure lubrication system with gear driven pump, pressure regulator, replaceable element filter with by-pass valve, supplying filtered lubricating oil under pressure to main bearings, crank pin bearings, piston pins, timing gears, camshaft bearings, valve rocker mechanism and governor. Readily accessible drain valves with suitable piping shall be provided for convenient draining of complete lubricating oil system. A water-cooled lubricating oil cooler shall be included. Provide lube oil pressure gauge.
- .7 Engine jacket, water cooling system complete with water pump, radiator and pusher fan. Radiator shall be flange type suitable for direct connections. Antifreeze to be provided for temperature to -20 degree C. Provide engine water coolant conditioner.
- .8 To ensure prompt starting, provide engine block heaters controlled by aquastat. Block heaters shall be of size as recommended by Manufacturer. Block heaters shall be located to heat water in block and not circulate it through radiator. Provide all circuits and fuses.
- .9 Electric starter suitable for 24 V.D.C.

## **2.3 Control Panel and Safety Devices**

2.3.1 Totally enclosed, engine mounted complete with vibration mount. Flexible conductors between door and fixed panel.

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- .1 The alternator instrument panel shall be wired, tested and shock mounted on the generator set by the manufacturer of the alternator. It shall provide the following controls and indicating lights on control panel.
- 2.3.2 Front panel face:
- .1 LCD display with at 16 character and 2 line complete with LED backlight
  - .2 Tactile-feel membrane switches for control and display navigation, generator operation and control set up.
  - .3 Switches are indicated by internationally accepted symbols
  - .4 Information display shall include:
    - .1 Data Logs
      - .1 Engine run time and controller on time
    - .2 Fault History
    - .3 Record of most recent fault conditions with control hours time stamp.
    - .4 Up to 5 events are stored in the control non-volatile memory
    - .5 Alternator Data
      - .1 Voltage
      - .2 single or three phase line to line and line to neutral
      - .3 Current
      - .4 single or three phase
      - .5 kVA
      - .6 three phase and total
      - .7 Frequency
    - .6 Engine Data
      - .1 Starting battery voltage
      - .2 Engine running hours
      - .3 Engine temperature
      - .4 Engine oil pressure
    - .7 Service/Control Adjustments
      - .1 Voltage selection
      - .2 Frequency selection
      - .3 Configurable input set up
      - .4 Configurable output set up
      - .5 Meter Calibration
      - .6 Units of measurement
  - .5 Emergency stop push button.
  - .6 The PLC shall control and monitor the ATS operation and the generator paralleling to the Utility. It shall provide alarm and status monitoring with indication.

- .7 Configure the PLC for TCP/IP and Modbus RS-485 communications and a separate RS-232 port for programming.
- .8 Generator Protection/Alarms with audible signal and silence push button for the following engine failures per CSA Standards.

Unsafe Operating Condition	Alarm	Engine Shutdown
Low Coolant temperature (i.e., unsuitable for a reliable start)	X	X
High Coolant temperature		X
Low Coolant Level	X	
Lubricating oil pressure below manufacturer's recommended safe operating range	X	
Lubricating oil pressure at shutdown condition	X	X
Fuel supply less than sufficient for 3 hours operation	X	
Fuel Leak/Critical Low Fuel		X
Engine temperature above safe operating range	X	
Engine temperature at shutdown condition	X	X
Engine has failed to start after programmed cranking period (not over 30s)	X	X
Engine speed exceeds limit recommended by manufacturer	X	X
Battery Charger Failure	X	

Note: All alarms shall be individually annunciated.

- .9 Fault reset.
- .10 Engine elapsed time meter.

#### 2.3.3 Interior

- .1 Molded case circuit breaker 3 phase, (Refer to drawing for rating). Supplier to ensure proper coordination with the generator at all levels of overcurrent.
- .2 Potential transformers.
- .3 Current transformers.
- .4 1 automatic voltage regulator complete with 3 phase sensing.
- .5 1 full capacity neutral bar.

- .6 1 engine alarm and control panel complete with lock-in alarm for the engine fault conditions as listed above.
- .7 3 cycle cranking.
- .8 1 pilot relay for remote indication of unit run.
- .9 1 cranking relay.
- .10 1 fault relay.
- .11 Reset of all faults by operating reset switch. System shall not cancel indication of fault until reset switch has been operated and fault cleared.
- .12 Electronic speed switch for crank disconnect and overspeed sensing.

## 2.4 **Starting System**

- 2.4.1 Provide 12 or 24 volt D.C. electric starting system for the diesel, including starting motor, regular and sealed lead calcium selenur selenium or lead antimony batteries, capable of providing three 30-seconds cranking cycles without recharging. A fully automatic battery charger with monitor circuit to prevent overcharging batteries shall be provided, complete with battery rack and cables.
- 2.4.2 Battery charger shall be 12 or 24 volt, 1.5/3 amp minimum, remote mounted. Cables with minimum of 5% voltage drop during cranking shall be provided from the battery to the engine in an enclosed conduit complete with bushed ends.

## 2.5 **Fuel System**

- 2.5.1 Provide a galvanized sheet metal oil drip pan under the engine.
- 2.5.2 Provide a sub-base fuel tank sized to accommodate a minimum of 72 hrs of fuel. Tank shall be Underwriters approved and labelled sub-base fuel tank with capacity as scheduled. The tank shall be constructed of steel ULC CAN4-S601 and/or CAN\$-S630, current edition, standards. The tank will require suction and return lines, fill and vent connections with the suction line terminating 100 mm above the bottom of the tank. Tank shall have a "CONTAINMENT TANK" or "DOUBLE WALLED TANK". Second containment to have 150% capacity.
  - .1 Tank Acceptance
  - .2 Before installing tank, inspect visually for and report any damage. Air test in accordance with governing Provincial legislation to a minimum of 34 kPa. In the absence of specific legislation air test at 34 kPa for two (2) hours.
  - .3 Accessories
    - .1 Provide, for each tank, a tank mounted fuel gauge to indicate the approximate level of contents a low level

float switch to indicate an external alarm when the level of fuel in the tank falls below 25% of capacity.

- .2 Filling of fuel will be provided by Division 26. The Contractor shall check the fuel system for leaks during and following first filling.
- .3 Install fuel tank in strict accordance with Manufacturer's instructions, National Fire Code and CSA-B139.M91 Codes. Bolt tank to foundations. Refer to Clause 2.6 Seismic Restraints.

2.5.3 This contractor is responsible for the Initial filling of fuel and the complete filling of fuel after all required tests are completed.

2.5.4 Monitoring of second containment tank

- .1 Fuel Leak - Alarm.
- .2 Overfill of tank – Alarm.

## **2.6 Safety Devices (Remote Annunciator)**

2.6.1 The engine shall be equipped with the following automatic safety devices, which will instantly shut down the engine and actuate visible lights and audible sonalert in the control panel. Provide additional contacts to enable shut down alarms to be signalled at a remote location.

2.6.2 Terminate wiring from all safety devices and controls to terminal blocks located in cabinet on the engine. Control wire shall have termination identification of each wire for ease of tracing.

2.6.3 Provide remote summary trouble buzzer, silence switch, reset button and shut down signal in a flush stainless-steel plate located where indicated on the Contract drawings. Operation of the silence button cancels the buzzer but maintain a monitory beep until problem is rectified. Remote annunciator shall include:

- .1 Unit ready LED.
- .2 Unit run LED.
- .3 Unit fail LED and alarm (audible).
- .4 Low battery flashing LED and alarm (audible).
- .5 Silence switch.
- .6 Test switch.

- .1 Note: Output signals shall be provided in the generator control panel to operate the remote annunciator.

2.6.4 Provide a single lockable, monitored breaker c/w local alarm to meet the intent of CSA 282 8.7.1. Send over and coordinate all required information for breaker coordination to comply with the intent of CSA 8.7.2.

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**2.7 Exhaust System**

- 2.7.1 Include exhaust system complete with muffler and flexible connection.
- 2.7.2 The muffler shall be heavy duty, critical grade type. Submit attenuation characteristics of muffler to Engineer for review.
- 2.7.3 Muffler shall be complete with condensate drain and drain cock at outlet end of muffler.

**2.8 Enclosure**

- 2.8.1 Sound attenuated enclosure , skin tight, rated for 70dB @ 7 meters.

**2.9 Generator Set Accessories**

- 2.9.1 Block Heater: Provide 208 V AC, 1-phase coolant circulating pumps and heavy duty 208 V AC, 1-phase block heaters, thermostatically controlled, sized to maintain 40°C coolant temperature with ambient temperature of +10°C. Locate control thermostat to sense and maintain coolant temperature such that top of engine block is maintained at 40°C to 60°C. Provide separate oil pressure switch and controls to turn pump and heater power off when engine is running. Plumb heater for forced pump circulation. Coordinate block heater kW rating and circulation plumbing size/routing to avoid localized boiling of coolant in block heater. Oversize or poorly circulating block heaters will be cause for non-acceptance of equipment until rectified. Provide AC-powered block heater circulation pump with TEFC close-coupled motor and combination starter, all mounted and wired. Control pump to operate whenever block heater is on.
- 2.9.2 Cycle-Lubrication Pump: Provide unit-mounted, wired, and plumbed AC or DC-operated cycle-lubrication pump. Pump is to provide automatic engine lubrication for approximately one minute per 8 hours or per manufacturer's recommendations. Size pump and select controls to avoid over-lubrication. Lock out pump during engine operation. Provide check valves and isolation valves. Pump delivery is to enter engine before the oil filters so that only filtered oil is delivered. Configure pump suction and provide delivery valves to utilize circulation pump for removal of sump oil during oil changes. Provide manual pushbutton for local pump run. AC pump and controls are to be CSA-approved and installed in accordance with B.C. Electrical Code requirements.
- 2.9.3 Provide generator with an on engine fuel transfer pump with all piping and including vents.

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**2.10 Generator Manufacturers**

- 2.10.1 Alternator and exciter shall be CSA approved and as manufactured by one of the following: Generac, Kato, Leroy Somer, Kohler, Onan, Stamford, Marathon or approved equal.
- 2.10.2 The diesel set shall be CSA approved and manufactured by one of the following: Detroit Diesel, Generac, Cummins Diesel, Caterpillar/CAT, Mitsubishi, Onan, Kohler or approved equal.
- 2.10.3 Instruments, meters and switches shall be CSA approved and as manufactured by one of the following: Schneider Electric Westinghouse Canada Ltd., Canadian General Electric Co. Ltd., Sangamo Co. Ltd., Generac, Compton Parkinson, Kohler, Enerlec, Onan.

**2.11 Electrical Generator System Remote Monitoring**

- 2.11.1 Provide interconnection with building fire alarm system to monitor the following:
  - .1 Generator running status
  - .2 Generator trouble
  - .3 Generator low fuel alarm
  - .4 CSA 282 8.7.2 breaker trouble
- 2.11.2 Provide all PT's and controllers required to achieve the remote monitoring noted

**3 . EXECUTION**

**3.1 Installation**

- 3.1.1 Coordinate with Installation Contractor for all final installation dimensions, locations, connections, and miscellaneous installation materials.
- 3.1.2 Obtain approval from Consultant for any significant changes in equipment location or connection.
- 3.1.3 Verify Installation Contractor's electrical connections to the generator set, switchgear and accessories as shown on Electrical Plans. Testing of power cables will be carried out by the Installation Contractor.
- 3.1.4 Set and test all protective devices.
- 3.1.5 Allow in the tender price for testing and commissioning work to be done during non-standard work hours. All testing shall comply with the CSA C282 requirements.
- 3.1.6 Locate generating unit and install in location as indicated.
- 3.1.7 Complete wiring and interconnections.

- 3.1.8 Start generating set and test to ensure correct performance of components with the help of the manufacturer.
- 3.1.9 All conduit or pipe connections to engine generator shall have flexible section to allow for vibration and noise transmission dampening.
- 3.1.10 Suitably protect all hot spots and moving parts to prevent accidental contact by personnel. Provide conspicuous sign, warning personnel that engine may start automatically at any time.
- 3.1.11 Connect all controls.

**3.2 Delivery, Storage and Handling**

- 3.2.1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- 3.2.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- 3.2.3 Handle materials with suitable lifting equipment.
- 3.2.4 Store materials in heated, dry, weather-protected enclosure

**3.3 System Start-Up**

- 3.3.1 Preparation: before starting unit, carry out thorough mechanical and electrical inspection of equipment, and perform following checks and adjustments:
  - .1 Disconnect battery cables from batteries to prevent accidental starting.
  - .2 Turn engine several revolutions by means of hand-barring devices to ensure parts are free and there are no obstructions to its running.
  - .3 Check engine/generator alignment readings to ensure they match readings attained at time of manufacture.
  - .4 Check fluid levels and top up as necessary. Pre-lubricate engine and turbochargers as recommended by engine manufacturer. Install drip pan beneath engine.
  - .5 Ensure cooling system antifreeze is effective to at least - 40°C.
  - .6 Check belts for correct tension and adjust as necessary.
  - .7 Check and grease, grease points.
  - .8 Check and tighten properly nuts, bolts, etc.
  - .9 Ensure safety guards are in place and properly secured.
  - .10 Check linkages for damage and freedom of movement.
  - .11 Check fuel supply system for leakage.
  - .12 Ensure fuel supply and fuel injection systems are properly primed.



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- .13 Check and tighten properly electrical connections.
  - .14 Check starting battery electrolyte level specific gravity and for proper installation.
  - .15 Check battery charger for proper operation and adjust as necessary.
  - .16 Carry out generator winding insulation resistance test. If reading is unacceptable, carry out recognized drying procedure. Do not start unit until satisfactory reading has been achieved.
  - .17 Check jacket coolant heater for proper operation.
  - .18 Complete additional preparations deemed necessary.
- 3.3.2 Performance verification: on completion of start-up preparations, take following action:
- .1 Have at hand, during initial start-up, means for choking off air supply to engine air induction manifold in event of engine run away or other emergency.
  - .2 Reconnect starting battery cables to starting battery.
  - .3 Start unit and allow for warm up. Stop unit if abnormal conditions are encountered.
  - .4 Check for and correct leakage from exhaust system, fuel system, cooling system, and lubricating oil system.
  - .5 Adjust vibration isolators.
  - .6 Observe and ensure that lubricating oil pressure and coolant temperature are within limits and no harmful vibration or sounds are evident.
  - .7 Ensure voltage is within operating parameters and automatic voltage regulator is operating correctly.
  - .8 Ensure manual voltage control is operating correctly.
  - .9 Ensure frequency is within operating parameters and electronic governor is operating correctly.
  - .10 Check engine air ventilation system for proper operation.
  - .11 Check operation of engine-mounted protective sensing devices and adjust as necessary.
  - .12 Check phase sequence of normal power supply and ensure emergency power supply are in same sequence.
  - .13 Check operation of electronic controller protection, transfer, timing, metering, and annunciator functions and adjust as necessary.
  - .14 Check operation and calibration of analog metering and adjust as necessary.
  - .15 Apply electrical load, read the metres, and correlate these readings.
  - .16 Demonstrate:
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- .17 Unit start, set up load for 25% of full load , transfer to load, increase the load by 25% increment till full load, retransfer to normal power, unit shutdown, on "automatic" control.
  - .1 Unit start, transfer to load (100% full load), decrease the load by 25% increment till No load, retransfer to normal power, unit shutdown, on "automatic" control. Unit start, transfer to load, retransfer to normal power, unit shutdown, on "automatic" control.
  - .2 Unit start, transfer to load, retransfer to normal power, unit shutdown, on "full load test" control. Unit start and shutdown, on "no load test" control.
  - .3 Unit cranking, start, and shutdown by means of engine-mounted key switch.
  - .4 Run unit on load for minimum period of eight hours to show load-carrying capability, stability of voltage and frequency, and satisfactory performance of engine ventilating system to provide adequate cooling.
  - .5 Every 1/2 hour carry out and record readings on Test Chart.
- .18 Perform additional tests as required by Engineer to ensure unit is operating satisfactorily.

### **3.4      Description of System Integration**

- 3.4.1 Provide all material, equipment and services necessary for a complete and operational generator.
- 3.4.2 Generator shall be prime type.
- 3.4.3 Building Management System (BMS) Integration
  - .1 The system protocol shall be native BACnet/IP certified and fully compatible with the BMS. Gateways will not be accepted. The system software programmable controllers shall reside/communicate with the BACnet/IP on the management or automation level networks of the Building Management System.
  - .2 Engineer to identify minimum requirements for the generator and list of points to be sent to the BAS controller (i.e. generator status, generator alarms, fuel level, etc.)

### **3.5      Owner's Instruction**

- 3.5.1 Provide instruction to site operation and maintenance staff for proper care, operation, and maintenance of equipment.

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**3.6 Commissioning**

- 3.6.1 Do site commissioning of the gas electric generator unit by qualified gas electric technician in accordance with Section 01 91 00 - General Commissioning Requirements.
- 3.6.2 Provide commissioning report included time delay settings, operational set points and adjustment ranges.

**3.7 Qualifications**

- 3.7.1 Provide proof of Gas electric technician qualification to Engineer.

**3.8 Acceptable Manufactures**

- 3.8.1 Toromont
- 3.8.2 Or approved equal.

**3.9 Testing**

- 3.9.1 Perform tests in accordance with PART 1.
- 3.9.2 Notify Engineer 10 working days in advance of test date.

**END OF SECTION**

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## 1. **GENERAL**

### 1.1 **Section Includes**

- 1.1.1 Materials, components and installation for electric power generating equipment and system start-up.

### 1.2 **Related Sections**

- 1.2.1 This section of the specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.
- 1.2.2 Section 01 29 00 - Payment Procedures - Testing Laboratory Services.
- 1.2.3 Section 01 74 21 - Construction/Demolition Waste Management And Disposal.
- 1.2.4 Section 01 91 00 - General Commissioning Requirements.
- 1.2.5 Section 01 79 00 - Demonstration and Training.

### 1.3 **References**

- 1.3.1 Canadian Standards Association (CSA International)
  - .1 CSA C22.1 (current edition), Canadian Electrical Code, Part 1
  - .2 CAN/CSA-B139-00(October 2001), Installation Code for Oil-Burning Equipment.
  - .3 CSA 282 - 19
- 1.3.2 Transport Canada - Marine Safety (TCMS)
  - .1 Approved Products Catalogue Index (APCI) - Structural Fire Prevention Item.
    - .1 Non-Combustible Material - Cloth and Paper.
- 1.3.3 Underwriters' Laboratories of Canada (ULC)

### 1.4 **Sustainable Requirements**

- 1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.
- 1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.
- 1.4.3 Waste Management and Disposal
  - .1 Separate and recycle waste materials in accordance with Section 01 74 00 – Cleaning and Waste management.

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- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
  - .3 Place materials defined as hazardous or toxic waste in designated containers.
  - 1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:
    - .1 Construction Waste Management / Product Waste Recyclability.
    - .2 Recycled Content.
    - .3 Local and Regional Materials.
    - .4 Certified Wood.
    - .5 Construction Indoor Air Quality (IAQ) management.
    - .6 VOC/Low-Emitting Materials Compliance.
  - 1.4.5 **NOTE:** Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.
  - 1.5 **Submittals**
    - 1.5.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
    - 1.5.2 Product Data:
      - .1 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
      - .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Sustainable Requirements: Construction and include: product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish.
    - 1.5.3 Sample:
      - .1 Submit samples in accordance with Section 01 33 00 - Submittal.
    - 1.5.4 Quality Assurance:
      - .1 Engineer reserves the right to witness standard factory testing of the above.
      - .2 Submit site tests results of installed electrical systems and instrumentation

1.5.5 Closeout Submittals:

- .1 Provide maintenance data for materials for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Data necessary for maintenance of materials.
- .3 Manufacturers recommended list of spare parts.

**1.6 Delivery, Storage and Handling**

- 1.6.1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- 1.6.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- 1.6.3 Handle materials with suitable lifting equipment.
- 1.6.4 Store materials in heated, dry, weather-protected enclosure

**1.7 System Start-Up**

- 1.7.1 Preparation: before starting unit, carry out thorough mechanical and electrical inspection of equipment, and perform following checks and adjustments:
  - .1 Disconnect battery cables from batteries to prevent accidental starting.
  - .2 Turn engine several revolutions by means of hand-barring devices to ensure parts are free and there are no obstructions to its running.
  - .3 Check engine/generator alignment readings to ensure they match readings attained at time of manufacture.
  - .4 Check fluid levels and top up as necessary. Pre-lubricate engine and turbochargers as recommended by engine manufacturer. Install drip pan beneath engine.
  - .5 Ensure cooling system antifreeze is effective to at least -40°C.
  - .6 Check belts for correct tension and adjust as necessary.
  - .7 Check and grease, grease points.
  - .8 Check and tighten properly nuts, bolts, etc.
  - .9 Ensure safety guards are in place and properly secured.
  - .10 Check linkages for damage and freedom of movement.
  - .11 Check fuel supply system for leakage.
  - .12 Ensure fuel supply and fuel injection systems are properly primed.
  - .13 Check and tighten properly electrical connections.
  - .14 Check starting battery electrolyte level specific gravity and for proper installation.

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- .15 Check battery charger for proper operation and adjust as necessary.
  - .16 Carry out generator winding insulation resistance test. If reading is unacceptable, carry out recognized drying procedure. Do not start unit until satisfactory reading has been achieved.
  - .17 Check jacket coolant heater for proper operation.
  - .18 Complete additional preparations deemed necessary.
  - 1.7.2 Performance verification: on completion of start-up preparations, take following action:
    - .1 Have at hand, during initial start-up, means for choking off air supply to engine air induction manifold in event of engine run away or other emergency.
    - .2 Reconnect starting battery cables to starting battery.
    - .3 Start unit and allow for warm up. Stop unit if abnormal conditions are encountered.
    - .4 Check for and correct leakage from exhaust system, fuel system, cooling system, and lubricating oil system.
    - .5 Adjust vibration isolators.
    - .6 Observe and ensure that lubricating oil pressure and coolant temperature are within limits and no harmful vibration or sounds are evident.
    - .7 Ensure voltage is within operating parameters and automatic voltage regulator is operating correctly.
    - .8 Ensure manual voltage control is operating correctly.
    - .9 Ensure frequency is within operating parameters and electronic governor is operating correctly.
    - .10 Check engine air ventilation system for proper operation.
    - .11 Check operation of engine-mounted protective sensing devices and adjust as necessary.
    - .12 Check phase sequence of normal power supply and ensure emergency power supply are in same sequence.
    - .13 Check operation of electronic controller protection, transfer, timing, metering, and annunciator functions and adjust as necessary.
    - .14 Check operation and calibration of analog metering and adjust as necessary.
    - .15 Apply electrical load, read the metres, and correlate these readings.
    - .16 Demonstrate:

- .17 Unit start, set up load for 25% of full load , transfer to load, increase the load by 25% increment till full load, retransfer to normal power, unit shutdown, on "automatic" control.
  - .1 Unit start, transfer to load (100% full load), decrease the load by 25% increment till No load, retransfer to normal power, unit shutdown, on "automatic" control. Unit start, transfer to load, retransfer to normal power, unit shutdown, on "automatic" control.
  - .2 Unit start, transfer to load, retransfer to normal power, unit shutdown, on "full load test" control. Unit start and shutdown, on "no load test" control.
  - .3 Unit cranking, start, and shutdown by means of engine-mounted key switch.
  - .4 Run unit on load for minimum period of eight hours to show load-carrying capability, stability of voltage and frequency, and satisfactory performance of engine ventilating system to provide adequate cooling.
  - .5 Every 1/2 hour carry out and record readings on Test Chart.
- .18 Perform additional tests as required by Engineer to ensure unit is operating satisfactorily.

## **1.8 Description of System Integration**

- 1.8.1 Provide all material, equipment and services necessary for a complete and operational generator.
- 1.8.2 Generator shall be prime type.
- 1.8.3 Building Management System (BMS) Integration
  - .1 The system protocol shall be native BACnet/IP certified and fully compatible with the BMS. Gateways will not be accepted. The system software programmable controllers shall reside/communicate with the BACnet/IP on the management or automation level networks of the Building Management System.
  - .2 Engineer to identify minimum requirements for the generator and list of points to be sent to the BAS controller (i.e. generator status, generator alarms, fuel level, etc.)

## **1.9 Owner's Instruction**

- 1.9.1 Provide instruction to site operation and maintenance staff for proper care, operation, and maintenance of equipment.



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**1.10 Commissioning**

- 1.10.1 Do site commissioning of the gas electric generator unit by qualified gas electric technician in accordance with Section 01 91 00 - General Commissioning Requirements.
- 1.10.2 Provide commissioning report included time delay settings, operational set points and adjustment ranges.

**1.11 Qualifications**

- 1.11.1 Provide proof of Gas electric technician qualification to Engineer.

**1.12 Acceptable Manufactures**

- 1.12.1 Toromont
- 1.12.2 Or approved equal.

**2 . PRODUCTS**

**2.1 Materials**

- 2.1.1 Provide following materials:
  - .1 Conduits and boxes as required.
  - .2 Copper fuel lines and fittings as required.
  - .3 ULC automatic fire shutoff valve.
  - .4 Primary fuel filter/water separator.
  - .5 Insulation for exhaust system.
  - .6 Electrical components as indicated.
  - .7 Wiring material.
  - .8 Antifreeze, ethylene glycol.
  - .9 Manual IPU bypass switch.
  - .10 All wiring and materials, including necessary [rigid] steel conduits and fittings for making connections.
  - .11 The power circuit cables will be as sized per single line diagram, RW90 (-40°C) cross link polyethylene, multiple conductors, shielded.
  - .12 The control circuit cables will not be less than No. 14, RW90, [single] [multiple] conductor[s], colour or number coded.
  - .13 Electronic governor control cable shall be minimum size No. [18] stranded copper conductor, shielded complete with drain wire and overall PVC jacket.
  - .14 Battery cable shall be welding cable type, extra flexible, rope stranded copper conductor with neoprene oil-resistant insulation, sized to limit voltage drop to 5% at time of peak load.

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### 3 . **EXECUTION**

#### 3.1 **Locating and Mounting**

- 3.1.1 Locate unit as indicated.
- 3.1.2 Fit and adjust isolators in accordance with manufacturer's installation and adjustment instruction bulletin contained in unit manual.
- 3.1.3 Do not bolt housings to foundation if isolator housing feet are equipped with 6 mm rubber sound pads.

#### 3.2 **Alignment Check**

- 3.2.1 Since Engine-generator shaft alignment is adjusted at factory, check to ensure that no change has occurred due to shipment and handling.
- 3.2.2 Where engine and generator housings are close coupled and instruments at hand are not suitable for measuring alignment within confines of housings, just loosen engine and generator hold down bolts and ensure that each foot is carrying proportionate amount of weight and feet are level on base plate.

#### 3.3 **Gas Supply System**

- 3.3.1 Install Gas piping in accordance with CAN/CSA-282:19.
- 3.3.2 Inspect thoroughly fuel tank and lines to ensure they are clean and free of foreign material before connecting fuel system.
- 3.3.3 Install primary gas separator and servicing shutoff valves as indicated.
- 3.3.4 Install ULC automatic fire shutoff valve. Locate upstream of any combustible gas system component.
- 3.3.5 Install supply gas lines between engine and main gas lines. Install flexible sections between the engine, using materials supplied with unit.
- 3.3.6 Hard drawn copper pipe joints to be brazed or silver soldered.
- 3.3.7 Brazing or soldering alloys to have minimum melting point of 450°C.
- 3.3.8 Neatly install fuel lines parallel or perpendicular to building lines with no kinks or dents.
- 3.3.9 Install soft drawn copper fuel lines using brass 45 degrees flare and pipe fittings as required and bend with correct size lever type bending tool. Entirely replace leaking fuel lines.
- 3.3.10 Protect gas lines from mechanical damage.

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**3.4 Batteries and Charger**

- 3.4.1 For dry charged batteries, activate in accordance with manufacturer's instructions in the unit manual prior to installation.
- 3.4.2 For wet batteries, inspect individually each battery cell and check electrolyte level. Check charge condition by measuring temperature and specific gravity of electrolyte. Consult manufacturer's instructions for recommended readings. If readings are lower, give batteries freshening charge until reading are reached.
- 3.4.3 Locate batteries as indicated and ensure that batteries are accessible for service. Run and protect cables to starting motor using cables supplied with unit.
- 3.4.4 Install battery charger on wall, adjacent to batteries and make connection to batteries.
- 3.4.5 Clean connections and tighten securely.
- 3.4.6 Install removable plexiglass cover on batteries.

**3.5 Exhaust System**

- 3.5.1 Install exhaust pipe and silencer using material supplied with unit.
- 3.5.2 Arrange silencer above and approximately in line with engine exhaust manifold with exhaust tail pipe protruding through thimble in wall.
- 3.5.3 Extend tail pipe not less than one metre beyond outside wall.
- 3.5.4 Support silencer with hangers so no weight or stress is applied to engine exhaust manifold or turbocharger.
- 3.5.5 Install flexible exhaust pipe between silencer and manifold.
- 3.5.6 Install exhaust system fireproof insulative material, after test run.
  - .1 Removable fibreglass jacket insulation rated for 650°C with stainless lacing hooks and wires.
    - .1 Jacket to be enclosed on inside by stainless steel mesh with outside cover silicone coated or aluminized fibreglass cloth: to USCG approved Non-Combustible Materials No. 164.009 and TCMS Non-Combustible Materials - Certificate No. F3-Series.
  - .2 Calcium Silicate removable insulation rated for 650°C with exterior stainless steel protective cover and fastenings.

**3.6 Cooling and Ventilation**

- 3.6.1 Install air outlet and inlet louvres and hoods in their respective openings.

- 3.6.2 Install louvre motors and linkages, adjust to ensure louvres are tight in closed position and give free damper movements from fully closed to fully open.
- 3.6.3 Where canvas boot is not provided, maintain 13 mm clearance between radiator and air outlet duct.
- 3.6.4 Mount thermostat in strategic position, away from inlet louvre as indicated.
- 3.6.5 Install conduits and junction boxes and make connections from louvre motors to thermostat and to 120/24 V AC transformer[in panel.
- 3.6.6 Fill engine radiator with water/ethylene glycol antifreeze mix good for -40°C.
- 3.6.7 Install remote radiator including piping, valves, fittings and pumps as indicated.

### **3.7 Control and Transfer Panel**

- 3.7.1 Locate panels as indicated.
- 3.7.2 Make control and power circuit connections as indicated.
- 3.7.3 Identify cables at both ends.
- 3.7.4 Tag with slip-on wire maker, each wire end with number corresponding to number in panel.
- 3.7.5 Make terminations with self-insulated terminals of flanged fork or ring type.

### **3.8 Additional Works**

- 3.8.1 Complete any additional work as instructed by Engineer to:
  - .1 Ensure equipment is safe to operate.
  - .2 Provide complete and operating system.

### **3.9 Field Quality Control**

- 3.9.1 Qualified gas electric technician to: inspect and verify that installation of interruptible power unit is acceptable and complete. Provide inspection report to the Engineer.

### **3.10 Demonstration and Training**

- 3.10.1 As directed by Engineer and in accordance with Section 01 79 00 - Demonstration and Training carry out demonstrations of complete interruptible power unit for Project Acceptance Board.
- 3.10.2 Provide familiarization training of operating and maintenance staff.

3.10.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

3.10.4 Provide fuel required for performing gas-generator site test and top-up after acceptance test completion.

**3.11 Maintenance – Clearances**

3.11.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

**3.12 Cleaning**

3.12.1 Proceed in accordance with Section 01 74 00 Cleaning and waste management.

3.12.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

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**1. GENERAL**

**1.1 Section Includes**

1.1.1 Materials and installation of Power Factor Correction Equipment.

**1.2 Related Sections**

1.2.1 This section of the Specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

**1.3 References**

1.3.1 Canadian Standards Association (CSA International)

- .1 CSA C22.1 (current edition), Canadian Electrical Code, Part 1
- .2 CSA C22.2 No.190 (current edition), Capacitors for Power Factor Correction.
- .3 IEEE-519-1992 or IEEE-519-2014 for the harmonic current limits.

**1.4 Sustainable Requirements**

1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.

1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.

1.4.3 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:

- .1 Construction Waste Management / Product Waste Recyclability.
- .2 Recycled Content.

- .3 Local and Regional Materials.
- .4 Certified Wood.
- .5 Construction Indoor Air Quality (IAQ) management.
- .6 VOC/Low-Emitting Materials Compliance.

1.4.5 **NOTE:** Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## 1.5 **Submittals**

1.5.1 Provide submittals in accordance with Section 01 33 00 - Submittal.

1.5.2 Product Data:

- .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, and limitations.
- .2 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Sustainable Requirements: Construction and include: product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish.

1.5.3 Sample:

- .1 Submit samples in accordance with Section 01 33 00 - Submittal.

1.5.4 Quality Assurance:

- .1 Engineer reserves the right to witness standard factory testing of the above.
- .2 Submit site tests results of installed electrical systems and instrumentation

1.5.5 Closeout Submittals:

- .1 Provide maintenance data for materials for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Data necessary for maintenance of materials.
- .3 Manufacturers recommended list of spare parts.

1.5.6 Submit certified test results to Engineer.

1.5.7 Quality Assurance Submittals: submit following in accordance with Section 01 40 00 - Quality Requirements.

- .1 Instructions: submit manufacturer's installation instructions.
  - .1 Engineer will make available 4copies of systems supplier's installation instructions.

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**1.6 Delivery, Storage and Handling**

- 1.6.1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- 1.6.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- 1.6.3 Handle materials with suitable lifting equipment.
- 1.6.4 Store materials in heated, dry, weather-protected enclosure

**1.7 Description of System**

- 1.7.1 Provide all material, equipment and services necessary for a complete and operational active harmonic filter equipment.
- 1.7.2 The active harmonic filter shall be provided by reputable supplier who can demonstrate adequate experience in the power quality and active harmonic filtering sector. The supplier's manufacturing process shall be audited in accordance with ISO 9001 quality standard. The supplier shall have their own R&D capabilities for the design, development and technical support of active harmonic filter hardware and control algorithms.
  - .1 The active harmonic filter shall be connected in parallel with the load to be compensated.

**1.8 Building Management System (BMS) Integration**

- 1.8.1 The system protocol shall be native BACnet/IP certified and fully compatible with the BMS. Gateways will not be accepted. The system software programmable controllers shall reside/communicate with the BACnet/IP on the management or automation level networks of the Building Management System.

**1.9 Acceptable Manufactures**

- 1.9.1 ABB
- 1.9.2 Allen-Bradley
- 1.9.3 Or approved equal.

**2 . PRODUCTS**

**2.1 Active harmonic filter characteristics**

- 2.1.1 The active harmonic filter unit shall be compatible with supply voltage from 600 V.
- 2.1.2 The active harmonic filter unit shall be compatible with both 50Hz and 60Hz networks.



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- 2.1.3 The nominal output current of the active harmonic filter modules shall be 50A, 100A, 150A and 200A. The total current capacity shall be any combination of these module currents.
  - 2.1.4 The configuration of the active harmonic filter shall be selectable to either 4-wire connection in order to filter harmonics from phase conductors and optionally the neutral conductor.
  - 2.1.5 The active harmonic filter shall not need any external power supplies or controller other than those built into the unit.
  - 2.1.6 The active harmonic filter shall measure all three phases of line current in real time and generate the measured harmonics currents in opposite phase by means of a Digital Signal Processor (DSP) based system.
  - 2.1.7 The active harmonic filter power inverter module shall be neutral point clamped 3-level topology based IGBT technology to provide good and accurate output current. The PWM modulation technology using fixed switching frequency shall be used. The switching frequency shall not be less than 20kHz to minimize audible noise.
  - 2.1.8 The active harmonic filter shall be capable of measuring the network currents from either the supply side or the load side allowing closed loop or open loop current control. The current signal provided by standard current transformers of Class 0.5 accuracy shall be sufficient for proper filter operation and performance.
  - 2.1.9 There shall be galvanic isolation between the current measuring transformer signals and active harmonic filter control electronics input.
  - 2.1.10 The active harmonic filter main circuit shall have galvanic isolation from the power network when active harmonic filter is switched off.
  - 2.1.11 The active harmonic filter shall be capable of filtering simultaneously from the 2nd to the 50th harmonic including even harmonics and interharmonics.
  - 2.1.12 The active harmonic filter shall have an operation mode enabling the user to set a target percentage of wanted mitigation of harmonic components from 2<sup>nd</sup> to the 25<sup>th</sup> harmonics
  - 2.1.13 The active harmonic filter shall be capable of providing fundamental frequency reactive power compensation up to full nominal output. This reactive power can be either capacitive or inductive.
  - 2.1.14 The active harmonic filter shall be capable of load balancing up to full nominal output current.
  - 2.1.15 The active harmonic filter shall have an automatic re-start feature enabling recovery of normal operation after a black out of the supply system or after being subjected to a non-severe condition.
  - 2.1.16 The active filter shall recognize the main voltage rotation and give indication if this is not correct.

- 2.1.17 The active filter shall have the capability to change CT-polarity from the user interface without changing the actual CT-wires.
- 2.1.18 The active harmonic filter shall have speed-controlled fans which are controlled via temperature in order to increase component lifetime and decrease heat losses.
- 2.1.19 The active filter shall be constructed in a way that component changes are possible for service activity.
- 2.1.20 The active filter shall operate correctly when operated at up to the full rated current without any trips in correct environment.
- 2.1.21 The active filter shall be constructed in a way that module protects itself from overheating by derating the output in case of high temperatures.

## **2.2 Output performance**

- 2.2.1 Filtering efficiency shall be not less than 95% provided that filter capacity is sufficient and load rate of the module is between 30 and 90%. The active harmonic filter shall not correct for utility supplied voltage distortion levels. Network nonlinear sources shall have >3% inductive impedance.
- 2.2.2 The active harmonic filter shall have heat losses less than 2.3% of nominal power.
- 2.2.3 The installation network shall not include capacitors without detuning reactors.
- 2.2.4 The active filter shall automatically sense the network angles and operate without any manual tuning parameters.
- 2.2.5 The parallel operation of multiple active harmonic filters shall be possible in both open-loop and closed-loop configuration. The possible amount of parallel connected active harmonic filters shall be more than 8 modules.
- 2.2.6 Each of the active harmonic filter modules shall have their own control system and the operation of the system shall continue if one of the parallel active harmonic filter modules is not operational.
- 2.2.7 Each of active harmonic filter modules shall have balanced outputs with respect to each other when operated in parallel active harmonic filter connections.
- 2.2.8 The active harmonic filter performance on reactive power mitigation shall increase the power factor to at least 0.99
- 2.2.9 The active filter shall provide up to the full nominal current at frequencies up to the 17th harmonic without derating.

## **2.3 Active harmonic filter operation modes**

- 2.3.1 The active harmonic filter shall have several operation modes allowing the user to program device to solve specific power quality

problems in the most economic manner. Every operation mode shall include possibility to set fundamental cycle load current balancing from 0 to 100%.

- 2.3.2 The active harmonic filter shall have 'all harmonics' operation mode. This operation mode shall offer real time compensation of all harmonics and fundamental reactive power. The response time of the active harmonic filter in this mode shall be less than 100µs.
- 2.3.3 The active harmonic filter shall have 'all harmonics but not fundamental frequency' operation mode. This operation mode shall offer real time compensation of all harmonics. Fundamental frequency reactive power compensation shall be excluded in this mode. The response time of Active harmonic filter in this mode shall be less than 100µs.
- 2.3.4 The active harmonic filter shall have 'selectable' operation mode. This operation mode shall offer the possibility to select which harmonic order is to be compensated. It shall be possible to set the percentage of compensation degree for harmonic orders 1 to 25. Odd and even harmonics shall be possible to select. The response time of the active harmonic filter in this mode shall be equal to fundamental frequency cycle time.
- 2.3.5 The active harmonic filter shall have an 'automatic standby' mode which is activated when the active harmonic filter output current falls below a predefined set point. The active harmonic filter shall automatically return to normal operation when the required output next exceeds the predefined set point. In the standby mode the power electronics controls and cooling fans shall be switched off to minimize energy consumption.

## **2.4 Human Machine Interface (HMI)**

- 2.4.1 The active harmonic filter shall be provided with a graphical Human Machine Interface (HMI) suitable for programming and monitoring the performance of the filter. A 7" touchscreen panel PC shall be used as the graphical HMI.
- 2.4.2 The user interface shall be of the touchscreen type and the user interface shall have color display with LED backlight with screensaver functionality
- 2.4.3 It shall be possible to connect up to seven active harmonic filters to one user interface.
- 2.4.4 The user interface shall have a lock-feature possibility in order to avoid parameter changes by unqualified persons.
- 2.4.5 The active harmonic filter user interface shall have a commissioning wizard to make the time required for commissioning as short as possible.

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- 2.4.6 The user interface shall allow the user to control the logical operations of Active harmonic filter, such as:
- .1 Program active harmonic filter parameters.
  - .2 Program system parameters.
  - .3 Select operation mode of the active harmonic filter.
  - .4 Initializing start or stop sequences.
  - .5 Update firmware's for the active harmonic filter and for the user interface.
  - .6 Download log, trend charts and fault signals to a USB-drive.
- 2.4.7 The graphical touchscreen user interface shall allow the user to monitor the operation status of the active harmonic filter. The monitored statuses of the active harmonic filter shall be as a minimum ready to run, pre-charging, running, alarm and trip. The status of the active harmonic filter shall be shown in color indications and written format.
- 2.4.8 The user main screen shall have visual indication of the active harmonic filter states, the load rate of the active harmonic filter units and network parameters such as powers and THDI, as a minimum.
- 2.4.9 An event log shall be provided for normal events, alarms and trips. The event list shall be recorded into internal flash memory and up to 5000 latest events shall be available for retrieval. Every event shall have clear written information about the events, and shall be divided into a minimum of five categories:
- .1 Normal events which give information when operations such as start and stop sequence have taken place.
  - .2 Informative alarms which give information when operations such as ac voltage high have been noticed but ac voltage has returned to normal operation level.
  - .3 Action alarms, such as IGBT temperature high, shall limit output current in order to get IGBT temperature back to normal operation range.
  - .4 Trips, such as IGBT temperature max, shall cause system trip. In this case the operator needs to clear out the reason for the trip and acknowledge error before re- starting.
  - .5 Parameter changes.
- 2.4.10 The active harmonic filter shall be capable of analyzing and calculating power quality parameters from the measured voltage and current signals. As a minimum, the following power quality parameters from both the load and the system feeder shall be monitored in graphical user interface.
- .1 Total harmonic current distortion thd(I) on each phase.
  - .2 Each individual harmonic current 1..25th on each phase.
  - .3 Total harmonic voltage distortion thd(U) on each phase.

- .4 Each individual harmonic voltage 1..25th on each phase.
- .5 Line to line ac voltages.
- .6 Line to neutral ac voltages.
- .7 Active power on each phase.
- .8 Reactive power on each phase.
- .9 Apparent power on each phase.
- .10 Power factor on each phase.
- .11 Load currents.
- .12 Active harmonic filter currents.
- .13 Network currents.

2.4.11 The harmonic currents and voltages shall be shown in graphical user interface as a bar-graph spectrum.

2.4.12 Three phase current and voltage waveforms shall be shown in graphical user interface.

2.4.13 At least five power quality parameters shall be possible to select for trend recoding purposes. The trend recordings shall be shown in the graphical user interface for one month cycling period. The measuring interwall shall be less or equal to one second.

## **2.5 Remote communications**

2.5.1 The active harmonic filter shall have the option to be connected to external devices via TCP/IP.

2.5.2 The active harmonic filter shall have the default communication method of modbus TCP/IP.

2.5.3 The active harmonic filter shall have as minimum 3 no. programmable hardwired inputs that can be minimum configured to start/stop and disable operation modes from the user interface. The input signal can be either AC- or DC voltage.

2.5.4 The active harmonic filter shall have a minimum of 4 programmable hardwired outputs that can be configured to running, trip and alarm options via the user interface. The outputs shall be potential free relays with the possibility to connect up to 208 VAC signals.

2.5.5 The basic states and power quality parameters shall be readable from a remote terminal unit using modbus TCP/IP protocol.

## **2.6 Protections**

2.6.1 The active harmonic filter shall have its own protection features which ensure safe and reliable operation in all abnormal system conditions. As a minimum, the following protection features shall be incorporate into Active harmonic filter:

- .1 Internal short circuit protection by fuses or circuit breaker.
- .2 RMS over current.

- .3 Peak value over current.
- .4 AC-system over- and undervoltage.
- .5 Ripple circuit overloading and ripple circuit failure.
- .6 IGBT over temperature.
- .7 Enclosure over temperature.
- .8 DC-capacitor over and under voltage.

## 2.7 **Applied standards and environment**

2.7.1 The active harmonic filter shall have following design standard and third-party approvals:

2.7.2 The active harmonic filter shall include third-party approval for by cULus: UI 508

2.7.3 The active filter shall comply with EMC standards IEC/EN 61000-6-2 and IEC/EN 61000-6-4.

2.7.4 The active filter shall comply with safety standard EN 50178.

2.7.5 The active harmonic filter shall follow the additional European Union directives:

- .1 Low Voltage Directive (LVD) 2014/35/EU
- .2 Electromagnetic Compatibility Directive (EMC) 2014/30/EU
- .3 Restriction of Hazardous Substances (ROHS 2) Directive 2011/65/EU
- .4 Ecodesign Directive 2009/125/EU
- .5 Waste Electrical and Electronics Equipment (WEEE) 2012/19/EU

2.7.6 The active harmonic filter shall be compatible with the following environmental conditions:

Climatic cond. (EN50178)	Ambient temperature	Relative humidity	Air pressure
Operation	5...40°C (Class 3K3)	5..85% (Class 3K3)	86..106kPa (Class 3K3)
Storage	-25...55°C (Class 1K4)	5..95% (Class 1K3)	86..106kPa (Class 1K4)
Transportation	-25...70°C (Class 2K3)	95% (Class 2K3)	70..106kPa (Class 2K3)
Pollution degree (EN 50178)	2		
Altitude	Up to 1000m		

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**2.8 Testing**

2.8.1 The active harmonic filter shall be tested according to relevant part of IEC/EN50178. At least following test shall be done for each active harmonic filter unit:

- .1 Visual inspection, main circuit test
- .2 Insulation resistance test
- .3 Insulation voltage withstanding test
- .4 Functional test at nominal voltage and current
- .5 Temperature rise test
- .6 Step response test

**2.9 Enclosure and installation**

2.9.1 The active harmonic filter module enclosure shall be rated for NEMA1 which can be installed in the switchgear enclosed having protection index up to NEMA 4X.

2.9.2 The air ventilation of the switchgear shall be equipped with adequate air filtering system.

2.9.3 The active harmonic filter shall be meant for cubicle mounting by default. Floor or wall mounting shall be possible through optional accessories. The enclosure shall be designed so that installation to commercially available standard cubicles is possible with the standard mounting brackets available from the cubicle manufacturer. Mounting to other cubicle types shall be easy by simply designing a suitable mounting bracket.

2.9.4 The active harmonic filter shall have bottom cable entry, top cable entry shall be available as an option.

2.9.5 The physical dimensions shall enable the user to install up to two 200A devices into a standard cubicle.

**END OF SECTION**

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**1. GENERAL**

**1.1 Section Includes**

1.1.1 Materials and installation for Automatic Transfer Switches.

**1.2 Related Sections**

1.2.1 This section of the specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

1.2.2 Section 26 32 13 – Diesel Electric Generator – Liquid Cooled.

**1.3 References**

1.3.1 Canadian Standards Association (CSA International)

- .1 CSA C22.1 (current edition), Canadian Electrical Code, Part 1
- .2 CSA C22.2 No.5-09, Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, NMX-J-266-ANCE-2010).
- .3 CSA C22.2 No.178.1-2007, Automatic Transfer Switches.
- .4 CAN/CSA C60044-1-07, Instrument Transformers.

1.3.2 National Electrical Manufacturers Association (NEMA)

- .1 NEMA ICS 2-1996(R2009), Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC, part 8: Disconnect Devices for Use in Industrial Control Equipment.

**1.4 Sustainable Requirements**

1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.

1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.

1.4.3 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.



1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:

- .1 Construction Waste Management / Product Waste Recyclability.
- .2 Recycled Content.
- .3 Local and Regional Materials.
- .4 Certified Wood.
- .5 Construction Indoor Air Quality (IAQ) management.
- .6 VOC/Low-Emitting Materials Compliance.

1.4.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## 1.5 Submittals

1.5.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

1.5.2 Product Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for transfer switches and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Sustainable Requirements: Construction and include: product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish.
- .4 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the province of Ontario, Canada.
    - .1 Indicate on drawings:
      - .1 Make, model and type.
      - .2 Load classification:

- 
- .1 LED Load as per manufacturers recommendations
    - .2 Ballast Lamp Load as per manufacturers recommendations
    - .3 Motor Load as per manufacturers recommendations
    - .4 Restricted Use: resistance and general loads, 0.8 pf or higher
  - .3 Single line diagram showing controls and relays.
  - .4 Description of equipment operation including:
    - .1 Automatic starting and transfer to standby unit and back to normal power.
    - .2 Test control.
    - .3 Manual control.
    - .4 Automatic shutdown
- 1.5.3 Sample:
- .1 Submit samples in accordance with Section 01 33 00 - Submittal.
- 1.5.4 Quality Assurance:
- .1 Engineer reserves the right to witness standard factory testing of the above.
  - .2 Submit site tests results of installed electrical systems and instrumentation
- 1.5.5 Closeout Submittals:
- .1 Provide maintenance data for materials for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
  - .2 Data necessary for maintenance of materials.
  - .3 Manufacturers recommended list of spare parts.
  - .4 Operation and Maintenance Data: submit operation and maintenance data for transfer switches for incorporation into manual.
  - .5 Detailed instructions to permit effective operation, maintenance and repair.
  - .6 Technical Data:
    - .1 Schematic diagram of components, controls and relays.
    - .2 Illustrated parts lists with parts catalogue numbers.
    - .3 Certified copy of factory test results.
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**1.6 Delivery, Storage and Handling**

- 1.6.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- 1.6.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.6.3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect transfer switches from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

**1.7 Description of System**

- 1.7.1 Provide all material, equipment and services necessary for a complete and operational automatic transfer switches.
- 1.7.2 Automatic load transfer equipment to to:
  - .1 Monitor voltage on phases of normal power supply.
  - .2 Initiate cranking of standby generator unit on normal power failure or abnormal voltage on any one phase below pre-set adjustable limits for adjustable period of time.
  - .3 Transfer load from normal supply to standby unit when standby unit reaches rated frequency and voltage pre-set adjustable limits.
  - .4 Transfer load from standby unit to normal power supply [when normal power restored, confirmed by sensing of voltage on phases above adjustable pre-set limit for adjustable time period.
  - .5 Shutdown standby unit after running unloaded to cool down using adjustable time delay relay.
- 1.7.3 Building Management System (BMS) Integration
  - .1 The system protocol shall be native BACnet/IP certified and fully compatible with the BMS. Gateways will not be accepted. The system software programmable controllers shall reside/communicate with the BACnet/IP on the management or automation level networks of the Building Management System.

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## 2. PRODUCTS

### 2.1 Materials

- 2.1.1 Instrument transformers: to CAN/CSA C60044-1.
- 2.1.2 Contactors: to NEMA ICS2.

### 2.2 Contact Type Transfer Equipment

- 2.2.1 Contact Type Transfer Equipment: to CSA C22.2 No.178.1.
- 2.2.2 Two - three pole contactors mounted on common frame, in double throw arrangement, mechanically and electrically interlocked, motor operated, open type with CSA enclosure.
- 2.2.3 Rated: 600V, 6 0Hz0 amperage as per drawings, three wire, solid neutral.
- 2.2.4 Main Contacts: Silver surfaced, protected by arc disruption means.
- 2.2.5 Switch and relay contacts, coils, spring and control elements accessible for inspection and maintenance from front of panel without removal of switch panel or disconnection of drive linkages and power conductors.
- 2.2.6 Auxiliary Contact: Silver plated, to initiate emergency generator start-up on failure of normal power.
- 2.2.7 Fault withstand rating: kA symmetrical for three cycles with maximum peak value of specified kA.
- 2.2.8 Lever to operate switch manually when switch is isolated.
- 2.2.9 Neutral bar, solid, switch rated as per drawings.
- 2.2.10 Overlapping neutral contacts on contactor type transfer equipment.

### 2.3 Circuit Breaker Type Transfer Equipment

- 2.3.1 Circuit Breaker Type Transfer Equipment: To CSA C22.2 No.5.
- 2.3.2 Rated: 600 V, 60 Hz, amperage as per drawings, three wire, solid neutral.
- 2.3.3 Fault withstand rating: kA symmetrical for three cycles with maximum peak value of specified kA.
  - .1 One normal-three -pole moulded-case circuit breaker with thermal magnetic automatic trip, mounted on common base, designed for double throw action, motor operated, mechanically held and interlocked, wall or floor mounted with CSA enclosure.
  - .2 One emergency three pole moulded-case circuit breaker with thermal magnetic automatic trip, motor operated, and interlocked.
  - .3 Circuit breakers:
    - .1 Trip free in closed position.

- .2 Interrupting rating: symmetrical.
- .4 Dead front construction with access to relays and controls for inspection and maintenance, and manual operating lever for transfer switch.
- .5 Auxiliary contact: to initiate emergency generator start-up on failure of normal power.
- .6 Solid neutral bar
- .7 Overlapping switchable neutral pole on circuit breaker type equipment.

## 2.4 **Controls**

### 2.4.1 Selector switch – four position, "Test", "Auto", "Manual", "Engine start".

- .1 Test position - normal power failure simulated. Engine starts and transfer takes place. Return switch to "Auto" to stop engine.
- .2 Auto position - normal operation of transfer switch on failure of normal power; retransfers on return of normal voltage and shuts down engine.
- .3 Manual position - transfer switch may be operated by manual handle, but transfer switch will not operate automatically and engine will not start.
- .4 Engine start position - engine starts but unit will not transfer unless normal power supply fails. Switch must be returned to "Auto" to stop engine.

### 2.4.2 Control transformers: dry type with 120 V secondary to isolate control circuits from:

- .1 Normal power supply.
- .2 Emergency power supply.

### 2.4.3 Relays: continuous duty, industrial control type, with wiping action contacts rated 10 A minimum:

- .1 Voltage sensing: three-phase for normal power and on one phase only for emergency, solid state type, adjustable drop out and pick up, close differential, 2 V minimum under voltage and over voltage protection.
- .2 Time delay: normal power to standby, adjustable solid state, 0 to 60 seconds
- .3 Time delay on engine starting to override momentary power outages or dips, adjustable solid state, 0 to 60 seconds delay.
- .4 Time delay on retransfer from standby to normal power, adjustable 0 to 60.

- .5 Time delay for engine cool-off to permit standby set to run unloaded after retransfer to normal power, adjustable solid state, 0 to 60 seconds.
  - .6 Time delay during transfer to stop transfer action in neutral position to prevent fast transfer, adjustable, 5 second intervals to 180 seconds.
  - .7 Frequency sensing, to prevent transfer from normal power supply until frequency of standby unit reaches pre-set adjustable values.
  - .8 Neutral disconnected position delay: allow time for motors to delay between live sources, adjustable, 0 to 5 s.
- 2.4.4 Solid state electronic in-phase monitor.
- 2.4.5 Ensure pilot lights indicate power availability normal and standby, switch position, green for normal, red for standby, mounted in panel and remote.
- 2.4.6 Plant exerciser: 168 hours timer to start standby unit once each week for selected interval transfers load to emergency supply and retransfers to normal supply on standby unit shutdown. Timer adjustable 0-168 hours in 15 minute intervals.
- 2.4.7 Auxiliary relay to provide N.O. and N.C. contacts for remote alarms.
- 2.4.8 Manual bypass and isolator: to both supplies.

## **2.5 Equipment Identification**

- 2.5.1 Identify equipment in accordance with Section 26 05 00 - Common Work Results for Electrical.
- 2.5.2 Control panel:
- .1 For selector switch and manual switch: Size 4 nameplates.
  - .2 For meters, indicating lights, minor controls: use Size 2 nameplates.
  - .3 Nameplates to include voltage, amperage, poles, location, normal and emergency feeds.

## **2.6 Source Quality Control**

- 2.6.1 Complete equipment, including transfer mechanism, controls, relays and accessories factory assembled and tested
- 2.6.2 Notify Departmental Representative five days minimum in advance of date of factory test.
- 2.6.3 Tests:
- .1 Operate equipment both mechanically and electrically to ensure proper performance.
  - .2 Check selector switch, in modes of operation Test, Auto, Manual, Engine Start and record results.

- .3 Check voltage sensing and time delay relay settings.
- .4 Check:
  - .1 Automatic starting and transfer of load on failure of normal power.
  - .2 Retransfer of load when normal power supply resumed.
  - .3 Automatic shutdown.
  - .4 In-phase monitor operation.

### 3 . **EXECUTION**

#### 3.1 **Examination**

- 3.1.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for transfer switches installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of [Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

#### 3.2 **Installation**

- 3.2.1 Locate, install and connect transfer equipment as indicated.
- 3.2.2 Check relays and solid state monitors and adjust as required to ensure correct operation.
- 3.2.3 Install and connect battery and emote alarms.

#### 3.3 **Field Quality Control**

- 3.3.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- 3.3.2 Energize transfer equipment from normal power supply.
- 3.3.3 Set selector switch in "Test" position to ensure proper standby start, running, transfer, retransfer. Return selector switch to "Auto" position to ensure standby shuts down.
- 3.3.4 Set selector switch in "Manual" position and check to ensure proper performance.
- 3.3.5 Set selector switch in "Engine start" position and check to ensure proper performance. Return switch to "Auto" to stop engine.

- 3.3.6 Set selector switch in "Auto" position and open normal power supply disconnect. Standby should start, come up to rated voltage and frequency, and then load should transfer to standby. Allow to operate for 10 minutes, then close main power supply disconnect. Load should transfer back to normal power supply and standby should shutdown. Repeat, at 1 hour intervals, 6 times, complete test with selector switch in each position, for each test.

**3.4 Maintenance – Clearances**

- 3.4.1 Provide clearance around systems, equipment, and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

**3.5 Cleaning**

- 3.5.1 Proceed in accordance with Section 01 74 00 Cleaning and waste management.
- 3.5.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- 3.5.3 Progress Cleaning: clean in accordance with 01 74 00 Cleaning and waste management.
- .1 Leave Work area clean at end of each day.
- 3.5.4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with 01 74 00 Cleaning and waste management.

**END OF SECTION**



## 1. **GENERAL**

### 1.1 **Section Includes**

- 1.1.1 Materials and installation of Electrical Vehicles charging stations and management system Equipment.
- 1.1.2 This section provides the technical specifications and requirements for electric vehicle charging station hardware installed across Regional properties. The Region of Peel requires EV Charging Stations can support operability with multiple Open Charge Point Protocol compliant Charging Station Management Systems / software platforms.

### 1.2 **Related Sections**

- 1.2.1 This section of the Specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

### 1.3 **References**

- 1.3.1 Canadian Standards Association (CSA)
  - .1 C22 NO. 280
  - .2 C22.1:21
  - .3 SPE-343
  - .4 C22.2 NO. 282, NO. 343, NO. 346, NO. 348 and NO. 61980-1.
  - .5 CAN/CSA-C22.2 NO. 281.1 and 281.2
  - .6 C810
- 1.3.2 NFPA® 70 Standard for Electrical Safety in the Workplace®
- 1.3.3 NEC ® Article 625 Electric Vehicle Charging System which covers the installation
- 1.3.4 of electric vehicle charging systems
- 1.3.5 UL 2202 - Standard for Electric Vehicle (EV) Charging System Equipment or
- 1.3.6 equivalent
- 1.3.7 UL 2231 – Personnel Protection Systems for Electric vehicles supply circuits or
- 1.3.8 equivalent
- 1.3.9 UL 2594 – EV Supply Equipment
- 1.3.10 UL 991 – Safety-Related Controls Employing Solid-State Devices

- 1.3.11 ICES-003 - Interference-Causing Equipment Standard or equivalent
- 1.3.12 IEC 61851-1 - EV Supply Equipment
- 1.3.13 OCPP 1.6J and 2.0.1.- Standard for communication between an EV charging station and an EV Charging Station Management System (CSMS)
- 1.3.14 ISO 15118 certified (Road Vehicles – Vehicle to grid communication interface)

**1.4 Sustainable Requirements**

- 1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.
- 1.4.2 Do verification requirements in accordance with Section Sustainable Requirements: Contractor's Verification.
- 1.4.3 Waste Management and Disposal
  - .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
  - .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
  - .3 Place materials defined as hazardous or toxic waste in designated containers.
- 1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:
  - .1 Construction Waste Management / Product Waste Recyclability.
  - .2 Recycled Content.
  - .3 Local and Regional Materials.
  - .4 Certified Wood.
  - .5 Construction Indoor Air Quality (IAQ) management.
  - .6 VOC/Low-Emitting Materials Compliance.
- 1.4.5 **NOTE:** Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

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**1.5 Submittals**

1.5.1 Provide submittals in accordance with Section 01 33 00 - Submittal.

1.5.2 Product Data:

- .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, and limitations.
- .2 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Sustainable Requirements: Construction and include: product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish.

1.5.3 Sample:

- .1 Submit samples in accordance with Section 01 33 00 - Submittal.

1.5.4 Quality Assurance:

- .1 Engineer reserves the right to witness standard factory testing of the above.
- .2 Submit site tests results of installed electrical systems and instrumentation

1.5.5 Closeout Submittals:

- .1 Provide maintenance data for materials for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Data necessary for maintenance of materials.
- .3 Manufacturers recommended list of spare parts.

1.5.6 Submit certified test results to Engineer.

1.5.7 Quality Assurance Submittals: submit following in accordance with Section 01 40 00 - Quality Requirements.

- .1 Instructions: submit manufacturer's installation instructions.
  - .1 Engineer will make available 4copies of systems supplier's installation instructions.

**1.6 Delivery, Storage And Handling**

1.6.1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.

1.6.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

- 1.6.3 Handle materials with suitable lifting equipment.
- 1.6.4 Store materials in heated, dry, weather-protected enclosure

**1.7 Description Of System**

- 1.7.1 Provide all material, equipment and services necessary for a complete and operational active harmonic filter equipment.
- 1.7.2 .

**1.8 Acceptable Manufactures**

- 1.8.1 ABB
- 1.8.2 Or approved equal.

**2 . PRODUCTS**

**2.1 Ac Charging Stations**

- 2.1.1 208-240 volt (V) alternating current (AC) with SAE J1772 or North American Charging Standard (NACS) charging connector
- 2.1.2 Commercial grade and certified for use in Canada nationally recognized certification agency Canadian Standards Association (CSA), Underwriters Laboratories of Canada (uLC) or other certification marks approved by the Technical Standards and Safety Authority (TSSA);
- 2.1.3 Enclosure must be rated for outdoor operation and achieve a minimum National Electrical Manufacturers Association (NEMA) 3R certification
- 2.1.4 Enable Open Charge Point Protocol (OCPP) 1.6J with an ability to upgrade to 2.0.1.
- 2.1.5 EV Chargers should support all OCPP 1.6J profiles including: Core, FirmwareManagement, LocalAuthListManagement, SmartCharging, RemoteTrigger. Reservation is preferred but not mandatory.
- 2.1.6 Have certified operating temperature range between minus 35 Degree Celsius (°C) and plus 50°C;
- 2.1.7 Surge protection of 6 kV @ 3,000A or higher
- 2.1.8 Cable length must be 5.49 meters (18 feet) or longer, and a cable management / retraction system must be an option and is preferred
- 2.1.9 Electricity metering accuracy of +/- 3%
- 2.1.10 Ability to remotely adjust and manage power supply (energy management and power sharing/limiting features (i.e. adjustable operating current (amperage))

- 2.1.11 Capable of simultaneously communicating via cellular (4G/LTE or better), WiFi and Ethernet
- 2.1.12 RFID access in accordance with ISO 14443 A/B, ISO 15693, NFC, NEMA interoperability protocol
- 2.1.13 ISO 15118 certified (Road Vehicles – Vehicle to grid communication interface)
- 2.1.14 Payment card industry (PCI) compliant card reader (*if applicable*)
- 2.1.15 Light Emitting Diode (LED) status indicator
  - .1 Display screen with the capability of conveying messages, user instructions, and/or pricing

## **2.2 Dc Charging Stations**

- 2.2.1 Direct current (DC) vehicle fast charger with SAE J 1772 Combined Charging System (CCS) Combo 1 and/or CHAdeMo and/or North American Charging Standard (NACS) charging connectors
- 2.2.2 Both power factor and efficiency greater than 93 per cent
- 2.2.3 Commercial grade and certified for use in Canada nationally recognized certification agency Canadian Standards Association (CSA), Underwriters Laboratories of Canada (uLC) or other certification marks approved by the Technical Standards and Safety Authority (TSSA);
- 2.2.4 Enclosure must be rated for outdoor operation and achieve a minimum National Electrical Manufacturers Association (NEMA) 3R certification
- 2.2.5 Enable Open Charge Point Protocol (OCPP) 1.6J with an ability to upgrade to 2.0.1.
  - .1 EV Chargers should support all OCPP 1.6J profiles including: Core, Firmware Management, Local Auth List Management, Smart Charging, Remote Trigger. Reservation is preferred but not mandatory.
- 2.2.6 Have certified operating temperature range between minus 30 Degree Celsius (<sup>0</sup>C) and plus 40<sup>0</sup>C;
- 2.2.7 Cable length must be 3.66 meters (12 feet) or longer and a cable management / retraction system is required
- 2.2.8 Electricity metering accuracy of +/- 3%
- 2.2.9 Ability to remotely adjust and manage power supply (energy management and power sharing/limiting features (i.e. adjustable operating current (amperage))
- 2.2.10 Capable of simultaneously communicating via cellular (4G/LTE or better), WiFi and Ethernet

- 2.2.11 RFID access in accordance with ISO 14443 A/B, ISO 15693, NFC, NEMA interoperability protocol
- 2.2.12 Payment card industry (PCI) compliant card reader *(if applicable)*
- 2.2.13 Light Emitting Diode (LED) status indicator
- 2.2.14 Push buttons for start, stop and emergency stop
- 2.2.15 Display screen with the capability of conveying messages, user instructions, and/or pricing

### 2.3 **Dcev Charging Station Management System**

- 2.3.1 The EV Charging Station Management System *(software)* must be ISO 15118 certified and Open Charge Point Protocol (OCPP) 2.0.1 compliant.
- 2.3.2 The EV Charging Station Management System must be proven through field testing, to work with OCPP certified EV charging station hardware from multiple manufacturers.
- 2.3.3 The EV Charging Station Management System must have demonstrated integrations with vehicle telematics providers and operations within a microgrid application *(potentially including back-up generators, battery energy storage systems, solar/wind on-site generation, and bidirectional chargers)*
- 2.3.4 The following data points are to be ongoingly tracked, stored, and remain accessible to the Region of Peel in .xls or .csv format in perpetuity by the EV Charging Station Management System.
  - .1 EV Charger Identification (ID)
  - .2 EV Charger location
  - .3 Unique customer identifier (a non-personal identifier (e.g. Network user ID))
  - .4 Charging session date
  - .5 Charging session start time
  - .6 Charging session end time
  - .7 Amount of power provided during charging session (kWh)
  - .8 Amount of revenue generated (CAD)
  - .9 Encountered malfunctions (including issue codes and descriptions, and duration of downtime)
- 2.3.5 The EV Charging Station Management System will include a dashboard that communicates and/or displays at a minimum:
  - .1 A map showing the number and location of EV charging stations
  - .2 Real-time EV Charger status (e.g. in-use, available, inoperable, charge per use or free type etc.)

- 
- .3 Cumulative electricity provided to vehicles, revenue generation, and GHG emissions avoidances are preferred
- 2.3.6 The EV Charging Station Management System and/or subsidiary reporting features must provide the following analytical functions at a minimum:
- .1 Isolate all data points by the entire EV charging station portfolio, specific site where chargers are installed, charger type (i.e. AC vs. DC), power output and individual charger.
  - .2 Determine the charging utilization ratio, between a specified calendar or time interval, across the EV Charger portfolio, a specific site, or individual EV Charger (*e.g. between 8:30am and 4:30pm at a specified office location, determine what percentage of time are chargers in use*)
  - .3 Determine the length of time EVs are plugged in but not actively charging across the EV Charger portfolio, a specific site, or individual EV Charger
  - .4 Report on revenue generation between a specified calendar or time interval
  - .5 Vehicle battery state of charge at the start and stop of a charging session (where available)
  - .6 The ability to report on greenhouse gas (GHG) emissions avoidances is preferred
- 2.3.7 The EV Charging Station Management System must provide the following management functions at a minimum:
- .1 Set tiered and flexible pricing models for use (e.g. applying a time-based or per kilowatt hour fee for vehicles which are actively charging AND a different rate for vehicles which remain plugged-in after charging has completed)
  - .2 Automatically program and manually adjust maximum power output and power-sharing modes in EV Charging Stations
  - .3 Enable or disable EV Charger operation
  - .4 Adjust messaging that appears on EV Charger displays
  - .5 Automatically notify operations personnel and EV Charger Service Provider of charger malfunctions and loss of functionality
  - .6 The ability to integrate EV Charger operation with electric utility demand response programs is preferred
  - .7 The ability to integrate with fleet fuel cards, telematics, and asset management systems
  - .8 The ability to integrate with on-site energy storage and generation systems
-

- .9 The ability to integrate with the Region's Enterprise Asset Management software

### 3. **EXEXECUTION**

#### 3.1 **General**

- 3.1.1 This section outlines installation requirements as they relate to electrical and civil works, and prescribes signage and parking space painting requirements to ensure EV Charging Station locations and terms of use are clearly communicated. All EV Charging Stations and associated equipment, infrastructure, and will be installed in accordance with the equipment manufacturer's installation requirements.

#### 3.2 **Electrical**

- 3.2.1 Where a site is undergoing its first installation of EV Charging Stations, the contractor shall lay parallel conduits that terminate into a buried handwell or weatherproof distribution panel to service a number of additional parking spaces in the future, as determined by the Region.
- .1 The number of spaces to 'future-proof' for EV Charging Station installations shall be at the discretion of the site's Property Manager, Operator and/or Program Owner, or Project Sponsor in the case of new construction, subject to existing parking and electrical capacity constraints. In the case where no provisions for future EV Chargers are desired, approvals must be obtained through the Standards and Guidelines (SAG) Committee.
- .2 Conduits must be sized to accommodate the desired number of EV Charging Stations to future-proof for, taking into account the run length, number and gauges of cables.
- 3.2.2 The contractor will provide all new circuit breakers from the same manufacturer installed on-site
- 3.2.3 The contractor will ensure sufficient space is available in electrical/utility room for charging station load management controllers / hardware for distributed energy resource integration.
- 3.2.4 The contractor is responsible for creating and submitting detailed system shop drawings and any accompanying documents to the Region of Peel, and other regulatory agencies as needed to obtain permits and approvals. These include, but are not limited to the Electrical Safety Authority, the Cities of Brampton and Mississauga, and the Town of Caledon.



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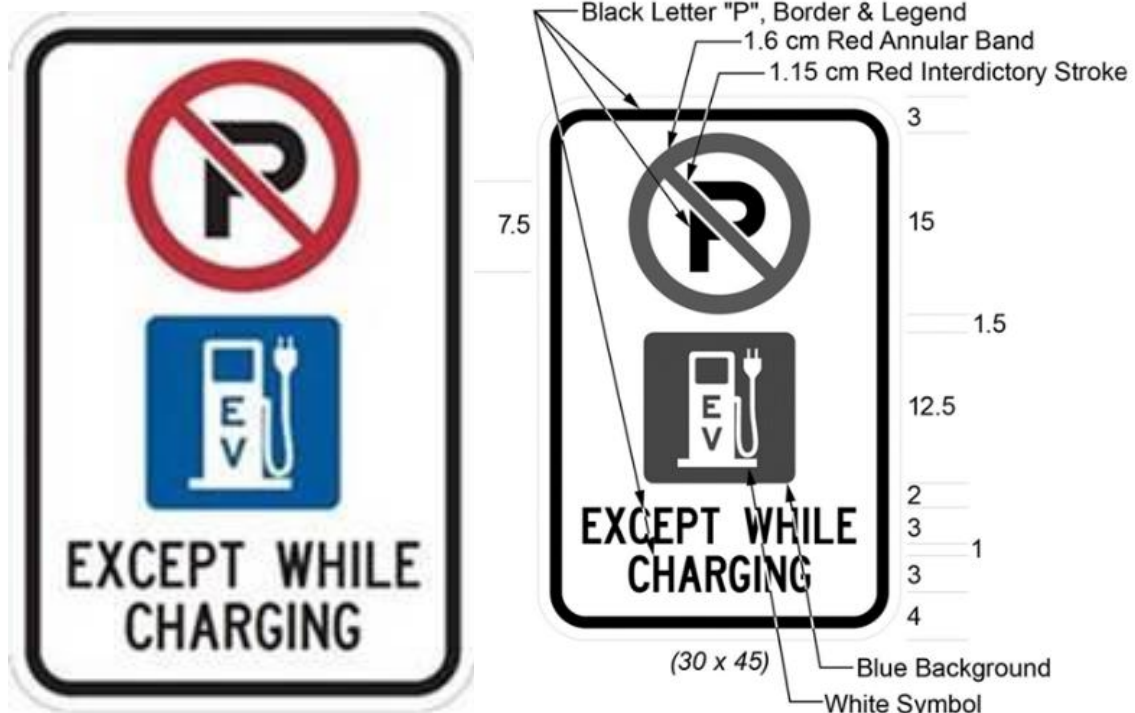
**3.3 Civil**

- 3.3.1 The location of all utilities and underground services connections are to be performed by the contractor prior to the installation of EV Chargers
- 3.3.2 Parking stalls and aisles shall be designed in accordance with local municipal standards
- 3.3.3 All curbs, gutters, raised traffic inlands, walkways, piers, foundations, duct works etc. shall be designed and constructed in accordance with Ontario Provincial Standards
- 3.3.4 Positive surface drainage shall be ensured to avoid water ponding
- 3.3.5 Underground ducts for all power cables required to feed chargers, lights and ancillary equipment may be necessary
- 3.3.6 EV Charging Stations shall be mounted on a pedestal on a concrete pad and/or protected with bollards where required. Bolts and/or hardware used to secure bollards to concrete base should be rust resistant and proven track record of no rust after years of exposure to the elements.
- 3.3.7 All trees in the vicinity of parking should be retained and protected during construction

**3.4 Signage And Parking Space Painting**

- 3.4.1 The contractor shall print and install permanent signage in compliance with the specifications prescribed under O. Reg. 462/20 Section 27. 1(1) of Reg 615:  
<https://www.ontario.ca/laws/regulation/r20462> (see *signage example 1*) and signage to outline the site's terms of use (see *Signage Example 2*)
  - .1 The Region of Peel will provide the template design for terms of use signage
- 3.4.2 The contractor shall provide adequate way finding signage to direct EV drivers to the EV Charger site from the parking lot entrance and/or the nearest street, where deemed necessary by the Region
- 3.4.3 The contractor shall provide parking space pictogram and painting (see *parking space painting example*)

Signage Example 1




## Signage Example 2\*

CUSTOMER NAME:	DATE:
SST GROUP OF CONSTRUCTION COMPANIES LIMITED	NOV. 04, 2021

48 "

30 "




**Region of Peel**  
working with you

### Electric Vehicle Drivers

#### Use of EV Stalls

- These parking spots are reserved for active electric vehicle charging ONLY
- Please move your vehicle when charge is completed
- All other vehicles not using this space for vehicle charging will be ticketed and/or towed




Go to Flo.ca to download the app

For any issues or to report damage to chargers please call 844-825-3356.

Fonts: **Aven-K / Aven-M**

Colours: 
  -White
  -12% White for "P LOGO"
  -Black
  -2935C
  -Green

Substrate: .081 Aluminum      Radius : 38.1mm / 1.5"

CREATED BY: HAROLD DATE: NOV. 04, 2021 REVISED #1 DATE: NOV. 08, 2021	 <p><b>STINSON OWL-LITE</b> TRAFFIC &amp; INFRASTRUCTURE SOLUTIONS 905-669-2360 <a href="http://stinson.ca">stinson.ca</a></p>
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*\*If an alternative EV charging station network to FLO is used (different software), the "Go to FLO.ca to download the app" and phone number in the blue text will be updated.*

## Parking Space Painting Example



**END OF SECTION**

## 1. GENERAL

### 1.1 References

- 1.1.1 Comply with section 26 05 00, Electrical General Provisions, and all documents referred to therein.
- 1.1.2 All work shall be carried out in accordance with the latest CAN/CSA-B72-M87.

### 1.2 Work Included

- 1.2.1 Provide all components for a complete installation of a lightning protection system.

### 1.3 Submittals

- 1.3.1 Submit shop drawings for all components and equipment, complete with a roof plan and riser diagram.

### 1.4 Acceptable Manufacturers/Installers

- 1.4.1 Lighting Protection system shall be installed by a company licensed to carry out such installations.
- 1.4.2 Acceptable system installers are:
  - .1 Burchell lightning Protection

## 2. PRODUCTS

### 2.1 Materials

- 2.1.1 Materials shall be as described in Table 3.1 Class 1 and Class 2 installations - Minimum Material Requirements.
- 2.1.2 All connections between cable to ground rods, cable to cable, and cable to steel, shall be made using welded copper connections or approved mechanical connectors.
- 2.1.3 Roof cables shall form a closed loop around periphery of roof and run within 0.5m of edge and shall be fastened at 1.5m intervals using approved flat roof cable anchors. Provide interconnecting conductions connected at both ends as required ensuring that no point on the roof is more than 10m away from a conductor. Connect loop system to metal bodies of conductance every 30m or part thereof. Install all cables with sweep bends.
- 2.1.4 Provide aerial terminals at 8m centres mounted on roof bases and securely anchored to roof or parapet. Terminals shall project at least 50mm above highest point in their vicinity and shall be connected to perimeter loop system.

- 2.1.5 At down lead cable locations provide a suitable thru-roof connector with roof flashing plate. (Concealed System).
- 2.1.6 Provide a closed loop of grounding cable in excavated portion of proposed building prior to pouring of foundations or connect the downlead conductors to copperweld ground rods where good grounding soil is available.
- 2.1.7 Refer to detail drawings for additional information.

### 3 . **EXECUTION**

#### 3.1 **Installation**

- 3.1.1 Bond all metal projections through or masses of metal above the roof to the lightning protection system. Cover all high points of the roofs by air terminals in addition to standard required spacing.
- 3.1.2 Make connections between air terminals and cable, cable to cable, and cable to steel or other metals using welded copper connections 'Cadweld'.
- 3.1.3 The roof cables must form a closed loop as shown on the drawings, around the periphery of the roof run within 0.5m of the edge, and fastened at 1.5m centres, using manufactured flat roof cable anchors.

**END OF SECTION**

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**1. GENERAL**

**1.1 Section Includes**

1.1.1 Materials and installation of Surge Protection Devices.

**1.2 Related Sections**

1.2.1 This section of the Specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

**1.3 References**

1.3.1 Canadian Standards Association (CSA International)

- .1 CSA C22.1 (current edition), Canadian Electrical Code, Part 1.
- .2 Canadian Standards Association (CSA) CSAC22.2-Latest Edition.

1.3.2 The specified unit shall be designed, manufactured, tested and installed in the following standards:

- .1 American National Standards Institute of Electrical and Electronic Engineer (ANSI/IEEE C62.41-latest and C62.45-latest)
- .2 Federal Information Processing Standards Publication 94 (FIPS PUB 94)
- .3 National Fire Protection Association (NFPA 75 and 78).
- .4 Underwriters Laboratories (ANSI/UL 1449-3<sup>rd</sup> Edition, UL 1283)
- .5 Ontario Hydro Electrical Safety Code Latest Edition.
- .6 NEMA LS-1
- .7 ANSI/IEEE C62.41.1 – IEEE Guide for Surge Voltages in Low Voltage AC Power Circuits.
- .8 ANSI/IEEE C62.41.2 – IEEE Recommended Practice on Characterization of Surges in Low Voltage (1000 V and under) AC Power Circuits.
- .9 ANSI/IEEE C62.45 – IEEE Guide for Surge Testing on Equipment in Low Voltage AC Power Circuits.
- .10 FIPS Pub 94 (current edition) – USDC Guide for Installation Techniques on Electrical Power Environments.
- .11 NEMA LS-1 Guidebook for the Specification of Surge Protection Devices.

- .12 (RoHS) Restriction of Hazardous Substances Directive: All SPDs shall be compliant with the Restriction of Hazardous Substances Directive 2002/95/EC.4.

#### **1.4 Sustainable Requirements**

- 1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.
- 1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.
- 1.4.3 Waste Management and Disposal
  - .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
  - .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
  - .3 Place materials defined as hazardous or toxic waste in designated containers.
- 1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:
  - .1 Construction Waste Management / Product Waste Recyclability.
  - .2 Recycled Content.
  - .3 Local and Regional Materials.
  - .4 Certified Wood.
  - .5 Construction Indoor Air Quality (IAQ) management.
  - .6 VOC/Low-Emitting Materials Compliance.
- 1.4.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

#### **1.5 Submittals**

- 1.5.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- 1.5.2 Product Data:
  - .1 Product data shall be submitted in accordance with Section 26 05 01 - Common Work Results. This shall include

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- schematic diagram and all options including indic and dry contacts.
- .2 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Sustainable Requirements: Construction and include: product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish.
- 1.5.3 Evidence of compliance to the certifications as per CSA and UL 1449 must be This will show actual test data as certified by UL and ANSI standard. Document to include copy of UL Listing Report. Manufacturer shall certify stating that test tests) and delivered product both had same suppliers for raw materials and same to manufacture.
- 1.5.4 The following information shall be made available to the Specifying Engineer:
- .1 Verification of the SPD Systems' compliance with the required ANSI/UL 1449, 3rd Edition Listing by Underwriters Laboratories (UL) or other valid, Nationally Recognized Testing Laboratory (NRTL) such as "c ETL us Listed", "c UL us Listed", "c CSA us Listed", "Intertek/ETL LISTED", for engineering review and approval.
  - .2 Manufacturer's electrical specifications and/or mechanical drawings indicating unit dimensions, weights, full installation instructions, and wiring configuration details.
  - .3 Compliance data, including Agency Listing or Agency Control Identification Number, Manufacturer's Model Numbers, SPD Type, System Voltage Type, Wiring Diagrams, Voltage Protection Ratings, applicable Technical Specification and/or Mechanical Drawings, and Installation Sheets.
- 1.5.5 Sample:
- .1 Submit samples in accordance with Section 01 33 00 - Submittal.
- 1.5.6 Quality Assurance:
- .1 Submit site tests results of installed electrical systems and instrumentation
- 1.5.7 Closeout Submittals:
- .1 Provide maintenance data for materials for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
  - .2 Data necessary for maintenance of materials.
  - .3 Manufacturers recommended list of spare parts.



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**1.6 Delivery, Storage and Handling**

- 1.6.1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- 1.6.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- 1.6.3 Handle materials with suitable lifting equipment.
- 1.6.4 Store materials in heated, dry, weather-protected enclosure

**1.7 Description of System**

- 1.7.1 Formally known as Transient Voltage Surge Suppression (TVSS) and now known as Surge Protect Device (SPD).
- 1.7.2 Provide all material, equipment and services necessary for a complete and operational surge protection devices.
- 1.7.3 Surge Suppression Device (SPD) shall consist of a high performance designed to provide surge protection and high-frequency electrical noise filtering.
- 1.7.4 The specified unit shall be compatible with non-linear loads and provide hi transient voltage suppression, surge current diversion and high-frequency electrical noise attenuation.
- 1.7.5 The unit shall be connected in parallel with the electrical distribution system.
- 1.7.6 The operation of the unit shall not be affected by or interact with any other reduction device installed on the electrical distribution system.
- 1.7.7 The SPD unit shall be connected to the equipment via a circuit breaker from within the equipment in or SPD unit can be serviced. The SPD shall be of modular design.
- 1.7.8 Building Management System (BMS) Integration
  - .1 The system protocol shall be native BACnet/IP certified and fully compatible with the BMS. Gateways will not be accepted. The system software programmable controllers shall reside/communicate with the BACnet/IP on the management or automation level networks of the Building Management System.

**1.8 Definitions**

- 1.8.1 Single Element: The safety-tested implementation of industrial-grade, "extra-large block" MOVs close-coupled/connected to each surge-path. This minimum 45KA-rated single element per surge path architecture maintains a virtually non-degrading technology for long-term SPD system integrity. Single element technology also provides single voltage and "response time" thresholds to virtually eliminate inherent and random SPD degradation found in

conventional designs. Typical SPD designs leave you guessing if they're still working after any known or unknown surge events.

- 1.8.2 Zoned and Cascading Protection/Isolation System: The safety-tested implementation of "Zoned" Primary and Secondary levels of industrial-grade, "extra-large block" MOVs close-coupled/connected to each surge-path. Through a facility, this maintains a virtual primary level "grid" of non-degrading SPD protection and isolation of all AC circuits and down-line equipment and components. This effectively separates and isolates the most sensitive in-house electronic circuitry from hazards caused by any nearby operating and switching motor loads, permitting even your most critical sensitive equipment to operate with spec-grade power integrity, thereby eliminating failures and costly downtime.
- 1.8.3 SCCR – Short Circuit Current Rating: The proven suitability of an SPD for use on an AC power circuit that is capable of safely delivering not more than a declared symmetrical or available current at a declared voltage during a "short circuit condition." The critical SCCR "high current" test is a rigid addition to the recently updated ANSI/UL Standard 1449, 3rd Edition, that includes user-friendly performance testing and product marking requirements. This indicates how safe the SPD is during and immediately after a catastrophic lightning, utility company or AC power event.

## 1.9 **Exclusions**

- 1.9.1 No user-accessible, integral or external disconnect switch intended for easy removal of the SPD from the power source is permitted, as it introduces a "weak link" into the intended "surge-path" and effectively defeats the intended purpose of the SPD.
- 1.9.2 SPD designs with "User Replaceable Surge Current Diversion Modules" or "plug-in" replaceable SPD modules shall not be permitted.
- 1.9.3 "Balanced Suppression Platform", conventional multi-element arrays, or "computer-matched MOV array" technology shall not be permitted as a substitute for safety-fused single-element technology.

## 1.10 **Qualified Manufacturers**

- 1.10.1 To establish definitive applicable options, performance and quality levels, the SurgePure SPD System, as branded and marketed by SurgePure Corporation, shall be used herein as the basis for product and system design.
- 1.10.2 All products and services submitted shall fully comply with the basic SPD design, performance characteristics and product applications as specified herein.

- 1.10.3 The registered service trademark shall be that of the actual provider. No secondary level branding shall be substituted or accepted.
- 1.10.4 The SPD manufacturer shall be exclusively and regularly engaged in the development and manufacture of power quality and surge protection products for a minimum of 15 years.
- 1.10.5 For reasons of SPD system design integration characteristics, cascading levels and voltage thresholds, no mixing of SPD brands will be permitted within the same facility.
- 1.10.6 All SPD providers' product data must be submitted and approved by the specifying engineer with 10 days prior to date of bidding, and shall meet and reasonably comply with specified ratings, features and functions as identified herein.

**1.11 Acceptable Manufacturers**

- 1.11.1 Eaton Cutler-Hammer.
- 1.11.2 Innosys
- 1.11.3 SurgePure
- 1.11.4 Or approved equal

**1.12 Warranty**

- 1.12.1 Equipment manufacturer shall warrant that all SPD products supplied are fully performance and safety tested and are free of operational and material defects in workmanship and performance for 10 years of the installation.

**2. PRODUCTS**

**2.1 General**

- 2.1.1 The SPD device shall be suited for operation in the following configuration 120/208VAC, 347/600V VAC, 3 pole, wye, 4 wire, electrical configuration. The operating environment classified by IEEE C62.41 as follows:
  - .1 Main Switchboard, MCC and distribution panels, 347/600V: Category C3.
  - .2 Panelboards, 120/208V: Category B.
- 2.1.2 Operating temperature range shall be -25to +55C.
- 2.1.3 Operation shall be reliable in an environment with 5% to 95% non-condensing humidity.
- 2.1.4 The unit shall not generate any audible noise during normal operation.

- 2.1.5 No appreciable magnetic fields shall be generated by the SPD. The unit shall be used directly in Computer Rooms and any location without danger to storage systems or devices.
- 2.1.6 Type 1 or 2: All SPDs shall be labeled as Type 1 or 2, intended for Load or Line side of over-current protection.
- 2.1.7 Non-Degrading, Single-Element Protection: All suppression components shall consist of a minimum of a single 45 kA rated MOV per mode of surge-path protection on the secondary level, and a minimum of a single 80 kA rated MOV per mode of surge-path protection on the primary level.
- 2.1.8 Two-Stage Surge-Path Protection: All primary level SPDs connected to switchgear applications rated over 500KW shall employ two composite stages of "dual-mode" surge-path protection rated at a minimum of 335kA per phase, All primary level SPDs connected to switchgear rated up to 2500KW shall employ two composite stages of "quad-mode" surge-path protection rated at a minimum of 665kA per phase.
- 2.1.9 Safe, Seven-Mode Surge-Path Protection: SPD technology shall employ full seven-mode protection paths to protect all L-L, L-N, L-G and N-G for wye systems; L-L and L-G in delta and impedance-grounded wye systems.
- 2.1.10 Dedicated Disconnect Breaker for Power Panel Installation: Where "most effective SPD performance" placement of SPD for "load-side" placement/connection is desired, the SPD shall be "close-coupled" to a dedicated circuit breaker or disconnect within the power panel or switchgear. However, if the SPD is located as a "Type 1, line-side SPD", no breaker or disconnect is required where the desired SPD or connection point is directly into the primary level Main Distribution Panel, Motor Control Centre or Main Switchgear.

## **2.2 Voltage Suppression – General**

### **2.2.1 Electrical Requirements**

- .1 Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
- .2 Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 125% of the nominal system operating voltage.
- .3 The suppression system shall incorporate individually thermal protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.

- .4 Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	PROTECTION MODES			
CONFIGURATION	L-N	L-G	L-L	N-G
Wye	•	•	•	•
Delta	N/A	•	•	N/A
Single Split Phase	•	•	•	•
High Leg Delta	•	•	•	•

- .5 Nominal Discharge Current ( $I_n$ ) – All SPDs applied to the distribution system shall have a UL tested and verified nominal discharge current rating of no less than 20,000A regardless of the SPD Type (includes Types 1 and 2) or operating voltage.
- .6 ANSI/UL 1449 3rd Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 3rd Edition VPR for the device shall not exceed the following:

Modes	208Y/120	600Y/347
L-N; L-G; N-G	700	1500
L-L	1200	3000

#### 2.2.2 SPD Design

- .1 Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted.
- .2 Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV.
- .3 Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method and

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exhibit 50dB attenuation at a conducted frequency of 100 kHz.

- .4 Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.
- .5 Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:
  - .1 Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.
    - .1 For Wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green/red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.
    - .2 For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.
    - .3 The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics package that simply indicate whether power is present on a particular phase shall not be accepted.
  - .2 Remote Status Monitor – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.
  - .3 Audible Alarm and Silence Button – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall be also be an audible alarm silence button used to silence the audible alarm after it has been activated.
  - .4 Surge Counter – The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge

counter shall trigger each time a surge event with a peak current magnitude of a minimum  $50 \pm 20A$  occurs. A reset push button shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.

- .1 The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require backup battery in order to achieve this functionality.

.6 Overcurrent Protection

- .1 The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.

.7 Fully Integrated Component Design – All of the SPD's components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.

.8 Safety Requirements

- .1 The SPD shall minimize potential arc flash hazards by containing no user serviceable/replaceable parts and shall be maintenance free. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
- .2 SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the

inside of the unit. Such units shall have any required conductors be factory installed.

- .3 Sidemount SPDs shall be factory sealed in order to prevent access to the inside of the unit. Sidemount SPDs shall have factory installed phase, neutral, ground and remote status contact conductors factory installed and shall have a pigtail of conductors protruding outside of the enclosure for field installation.

## 2.3 System Application

2.3.1 The SPD applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.

2.3.2 Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table (as per manufacturer's recommendation):

MINIMUM SURGE CURRENT CAPACITY BASED ON ANSI / IEEE C62.41 LOCATION CATEGORY			
CATEGORY	APPLICATION	PER PHASE	PER MODE
C	Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	350 kA	
B	High Exposure, CDP or MCC locations	160 kA	
A	Branch Locations (Panelboards, MCCs, Busway)	120 kA	

2.3.3 SPD Type – all SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be Type 2 SPDs.

2.3.4 Sidemount Mounting Applications Installation (SPD mounted external to electrical assembly)

- .1 Applicable only when explicitly requested herein to mount SPD devices external to distribution points.
- .2 Lead length between the breaker and SPD shall be kept as short as possible to ensure optimum performance. Any excess conductor length shall be trimmed in order to minimize let-through voltage. The installer shall comply with the manufacturer's recommended installation and wiring practices.

2.3.5 Switchgear, Switchboard, and Busway Requirements



- .1 The SPD application covered under this section is for switchgear, switchboard, MCC, and busway locations. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C Environments.
- .2 The SPD shall be of the same manufacturer as the switchgear, switchboard, MCC and busway.
- .3 The SPD shall be factory installed inside the switchgear, switchboard, MCC, and/or bus plug at the assembly point by the original equipment manufacturer
- .4 Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.
- .5 The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
- .6 The SPD shall be integral to switchgear, switchboard, MCC, and/or bus plug as a factory standardized design.
- .7 All monitoring and diagnostic features shall be visible from the front of the equipment.

## **2.4 Enclosures**

- 2.4.1 All enclosed equipment shall have NEMA 1 general purpose enclosures, unless otherwise noted. Provide enclosures suitable for locations as indicated on the drawings and as described below:
- .1 NEMA 1 – Constructed of a polymer (units integrated within electrical assemblies) or steel (sidemount units only), intended for indoor use to provide a degree of protection to personal access to hazardous parts and provide a degree of protection against the ingress of solid foreign objects (falling dirt).
  - .2 NEMA 4 – Constructed of steel intended for either indoor or outdoor use to provide a degree of protection against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (dirt and windblown dust); to provide a degree of protection with respect to the harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water); and that will be undamaged by the external formation of ice on the enclosure. (sidemount units only).

- .3 NEMA 4X – Constructed of stainless steel providing the same level of protection as the NEMA 4 enclosure with the addition of corrosion protection. (sidemount units only).

### **3 . EXECUTION**

#### **3.1 Installation**

- 3.1.1 Integral SPD shall be installed by panel manufacturer/supplier in all equipment SPD units to circuit breaker within the equipment noted on drawings. Conductors as short and straight as possible as, no greater than 18" in length. Input conductor to SPD/filter shall be twisted to reduce impedance during high frequency filtering shall be minimum #6 AWG.
- 3.1.2 The SPD should be installed following the manufacturer's recommended practices and in compliance with all applicable codes.

#### **3.2 Equipment Identification**

- 3.2.1 Provide equipment identification nameplate.

#### **3.3 Field Testing**

- 3.3.1 Provide complete verification per manufacturer instruction including suggested values on bolted connections.
- 3.3.2 Ensure satisfactory performance to stated standards and if any module or un comply replace it completely.
- 3.3.3 Record insulation resistance from phase to ground according to manufacturer or industry standard. Provide formal records to Engineer for review.

#### **3.4 Maintenance – Clearances**

- 3.4.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

#### **3.5 Cleaning**

- 3.5.1 Proceed in accordance with Section 01 74 00 Claening and waste management.
- 3.5.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

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1. **GENERAL**

1.1 **Section Includes**

1.1.1 Materials and installation for Lighting.

1.2 **Related Sections**

1.2.1 This section of the specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

1.3 **References**

1.3.1 American National Standards Institute (ANSI)

- .1 ANSI C82.1-04, Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.
- .2 ANSI C82.4-02(R2007), Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps Multi Supply Type.

1.3.2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)

- .1 ANSI/IEEE C62.41-1991, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.

1.3.3 ASTM International Inc.

- .1 ASTM F1137-00(2006), Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.

1.3.4 Canadian Standards Association (CSA International)

- .1 CSA C22.1 (current edition), Canadian Electrical Code, Part 1.

1.3.5 ICES-005-07, Radio Frequency Lighting Devices.

1.3.6 Underwriters' Laboratories of Canada (ULC)

1.4 **Sustainable Requirements**

1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.

1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.

1.4.3 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.

- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.
- 1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:
  - .1 Construction Waste Management / Product Waste Recyclability.
  - .2 Recycled Content.
  - .3 Local and Regional Materials.
  - .4 Certified Wood.
  - .5 Construction Indoor Air Quality (IAQ) management.
  - .6 VOC/Low-Emitting Materials Compliance.
- 1.4.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## **1.5 Submittals**

- 1.5.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- 1.5.2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Provide complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Engineer.
  - .3 Photometric data to include: VCP Table where applicable, spacing criterion and luminaire coefficient of utilization.
- 1.5.3 Samples:
  - .1 Submit samples in accordance with Section 01 33 00 (01300) - Submittal.
- 1.5.4 Quality assurance submittals: provide following in accordance with Section 01 45 00 - Quality Control.
  - .1 Provide mock-ups in accordance with Section 01 40 00 - Quality Requirements.

- .2 Submit site tests results of installed electrical systems and instrumentation
  - .3 Manufacturer's instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence, and cleaning procedures.
- 1.5.5 Closeout Submittals:
- .1 Provide maintenance data for materials for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
  - .2 Data necessary for maintenance of materials.
  - .3 Manufacturers recommended list of spare parts.

**1.6 Delivery, Storage and Handling**

- 1.6.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- 1.6.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

**2 . PRODUCTS**

**2.1 LED**

- 2.1.1 All LEDs within luminaires of the same manufacturer shall have equal binning with similar lumen and colour output.

**2.2 Drivers**

- 2.2.1 All electronic driver that are listed as being compatible with the LED chip set used in the fixture.
- 2.2.2 Driver is to have a power factor than 0.9 with a Total Harmonic Distortion (THD) less than 20%.

**2.3 Finishes**

- 2.3.1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

**2.4 Optical Control Devices**

- 2.4.1 As indicated in luminaire schedule.

**2.5 Luminaires**

- 2.5.1 As indicated in luminaire schedule.

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**2.6 Acceptable manufacturer as per Luminaires schedule.**

**3 . EXECUTION**

**3.1 Installation**

3.1.1 Locate and install luminaires as indicated.

**3.2 Wiring**

3.2.1 Connect luminaires to lighting circuits:

.1 Install flexible or rigid conduit for luminaires as indicated.

**3.3 Luminaire Supports**

3.3.1 For suspended ceiling installations support luminaires independently of ceiling.

**3.4 Luminaire Alignment**

3.4.1 Align luminaires mounted in continuous rows to form straight uninterrupted line.

3.4.2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

**3.5 Maintenance – Clearances**

3.5.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

**3.6 Cleaning**

3.6.1 Clean in accordance with Section 01 74 00 Cleaning and waste management.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

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**1. GENERAL**

**1.1 Section Includes**

- 1.1.1 Materials and installation for Emergency Lighting.

**1.2 Related Sections**

- 1.2.1 This section of the specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

**1.3 References**

- 1.3.1 Canadian Standards Association (CSA International)
- .1 CSA C22.1 (current edition), Canadian Electrical Code, Part 1.
  - .2 CSA C22.2 No.141-10, Emergency Lighting Equipment.

**1.4 Sustainable Requirements**

- 1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.
- 1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.
- 1.4.3 Waste Management and Disposal
- .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
  - .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
  - .3 Place materials defined as hazardous or toxic waste in designated containers.
- 1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:
- .1 Construction Waste Management / Product Waste Recyclability.
  - .2 Recycled Content.
  - .3 Local and Regional Materials.
  - .4 Certified Wood.

.5 Construction Indoor Air Quality (IAQ) management.

.6 VOC/Low-Emitting Materials Compliance.

1.4.5 NOTE: Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## **1.5 Submittals**

1.5.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

1.5.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for emergency lighting and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Sustainable Requirements: Construction and include: product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish.

1.5.3 Sample:

.1 Submit samples in accordance with Section 01 33 00 (01300) - Submittal.

1.5.4 Quality Assurance:

.1 Submit site tests results of installed electrical systems and instrumentation

1.5.5 Closeout Submittals:

.1 Provide maintenance data for materials for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

.2 Data necessary for maintenance of materials.

.3 Manufacturers recommended list of spare parts.

.4 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.5 Operation and Maintenance Data: submit operation and maintenance data for emergency lighting for incorporation into manual.

## **1.6 Delivery, Storage and Handling**

1.6.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.



- 1.6.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

**1.7 Acceptable Manufactures**

- 1.7.1 As per Luminaire Schedule  
1.7.2 Or approved equal.

**1.8 Warranty**

- 1.8.1 For batteries in this Section 26 52 00 - Emergency Lighting, 12 months warranty period is extended to 120 months.

**2. PRODUCTS**

**2.1 Equipment**

- 2.1.1 Emergency lighting equipment: to CSA C22.2 No.141.  
2.1.2 Supply voltage: 120V AC  
2.1.3 Output voltage: 24 V DC  
2.1.4 Operating time: 120 minutes.  
2.1.5 Battery: sealed, maintenance free.  
2.1.6 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of +/- 0.01 V for +/- 10% input variations.  
2.1.7 Solid state transfer circuit.  
2.1.8 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.  
2.1.9 Signal lights: solid state, for 'AC Power On and High Charge  
2.1.10 Lamp heads: Remote/Integral 345 degrees horizontal and 180 degrees vertical adjustment. Lamp type: LED 72 W, minimum lumen output to provide 10 lux average throughout space.  
2.1.11 Cabinet: suitable for direct or shelf mounting to wall and complete with knockouts for conduit. Removable or hinged front panel for easy access to batteries.  
2.1.12 Finish: White, Powder Coated.  
2.1.13 Auxiliary equipment:  
.1 Ammeter.  
.2 Voltmeter.  
.3 Test switch.  
.4 Time delay relay.  
.5 Battery disconnect device.

- .6 AC input and DC output terminal blocks inside cabinet.
- .7 Bracket
- .8 Cord and twist lock plug connection for AC.
- .9 RFI suppressors.

## **2.2 Wiring Of Remote Heads**

- 2.2.1 Conduit: type, in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- 2.2.2 Conductors: type in accordance with Section 26 05 21 - Wires and Cables (0-1000 V), sized as indicated in accordance with manufacturers recommendations.

## **3 . EXECUTION**

### **3.1 Examination**

- 3.1.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for emergency lighting installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Engineer
  - .2 Inform Engineer of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied after receipt of written approval from Engineer.

### **3.2 Installation**

- 3.2.1 Install unit equipment and remote mounted fixtures.
- 3.2.2 Direct heads.
- 3.2.3 Connect exit lights to unit equipment.

### **3.3 Cleaning**

- 3.3.1 Progress Cleaning: clean in accordance with Section 01 74 00 Cleaning and waste management.
  - .1 Leave Work area clean at end of each day.
- 3.3.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 Cleaning and waste management.

### **3.4 Protection**

- 3.4.1 Protect installed products and components from damage during construction.

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- 3.4.2 Repair damage to adjacent materials caused by emergency lighting installation.

**3.5 Maintenance – Clearances**

- 3.5.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

**END OF SECTION**

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**1. GENERAL**

**1.1 Section Includes**

- 1.1.1 Materials and installation of exit signs.

**1.2 Related Sections**

- 1.2.1 The section of the Specification forms part of the contract documents and is to be read, interpreted and coordinated with all other parts.

**1.3 References**

- 1.3.1 Canadian Standards Association (CSA International)  
.1 CSA C22.2 No.141 (current edition), Unit Equipment for Emergency Lighting.
- 1.3.2 National Fire Protection Association (NFPA)  
.1 NFPA 101 (current edition), Life Safety Code.

**1.4 Sustainable Requirements**

- 1.4.1 Materials and products in accordance with Sustainable Requirements: Construction.
- 1.4.2 Do verification requirements in accordance with Sustainable Requirements: Contractor's Verification.
- 1.4.3 Waste Management and Disposal
- .1 Separate and recycle waste materials in accordance with Section 01 61 00 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.
- 1.4.4 In order to satisfy the Sustainable goals for the Project, the Construction Manager and all Trade Contractors, suppliers and manufacturers shall comply with all requirements and they shall be fully aware of all required laws and available strategies to achieve sustainable goals, including any applicable exemplary performance levels, for the following:
- .1 Construction Waste Management / Product Waste Recyclability.
- .2 Recycled Content.
- .3 Local and Regional Materials.

- .4 Certified Wood.
- .5 Construction Indoor Air Quality (IAQ) management.
- .6 VOC/Low-Emitting Materials Compliance.

1.4.5 **NOTE:** Any specific products listed herein are approved products, provided they meet with the Sustainable requirements for this project. Any proposed alternative products must meet the Sustainable requirements of the project.

## **1.5 Submittals**

1.5.1 Provide submittals in accordance with Section 01 33 00 - Submittal.

1.5.2 Product Data:

- .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Provide manufacturer's printed product literature, specifications and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Sustainable Requirements: Construction and include: product characteristics, performance criteria, physical size, horsepower, watt rating, limitations and finish.

1.5.3 Sample:

- .1 Submit samples in accordance with Section 01 33 00 - Submittal.

1.5.4 Quality Assurance:

- .1 Engineer reserves the right to witness standard factory testing of the above.
- .2 Submit site tests results of installed electrical systems and instrumentation

1.5.5 Closeout Submittals:

- .1 Provide maintenance data for materials for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Data necessary for maintenance of materials.
- .3 Manufacturers recommended list of spare parts.

## **1.6 Delivery, Storage and Handling**

1.6.1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.

- 1.6.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- 1.6.3 Handle materials with suitable lifting equipment.
- 1.6.4 Store materials in heated, dry, weather-protected enclosure

**1.7 Description of System**

- 1.7.1 Exit signs shall be Running Man type. The light source shall be white LEDs and shall provide even illumination of the pictogram. The equipment shall operate with 120 V ac input with a total load less than 2.2 W. The pictogram has a green background with a white running man.

**1.8 Acceptable Manufacturers**

- 1.8.1 As per Luminaire Schedule
- 1.8.2 Or approved equal.

**2. PRODUCTS**

**2.1 Standard Units**

- 2.1.1 Exit lights: to CSA C22.2 No.141 Running Man Type.
- 2.1.2 Housing: cold rolled steel minimum 1.0mm thick, satin aluminum enamel finish extruded aluminum housing, brush aluminum finish.
- 2.1.3 Face and back plates: extruded aluminum.
- 2.1.4 Lamps: Multiple LED-12W, 120 V, over 500,000 hours.
- 2.1.5 Face plate to remain captive for relamping.

**2.2 Edge-Lit Unit**

- 2.2.1 Exit lights: to CSA C22.2 No.141 Running Man Type.
- 2.2.2 Extruded aluminium cylindrical housing and canopy.
- 2.2.3 High-clarity solid acrylic faceplate.
- 2.2.4 Lamps: Multiple LED-12W, 120 V, over 500,000 hours.
- 2.2.5 Field-removable directional chevron arrows.
- 2.2.6 Universal mounting (ceiling, wall, etc.)
- 2.2.7 Rounded corners.
- 2.2.8 Face plate to remain captive for relamping.

**2.3 Water-Tight Unit**

- 2.3.1 To CSA C22.2 No. 141 Running Man Type.
- 2.3.2 Housing: metal and plastic (NEMA 4X)
- 2.3.3 Lamps: Multiple LED-12W, 120 V, over 50,000 hours.

- 2.3.4 Field-removable directional chevron arrows.
- 2.3.5 Universal mounting (ceiling, wall, etc.)

### 3. **EXECUTION**

#### 3.1 **Manufacturer's Instructions**

- 3.1.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

#### 3.2 **Installation**

- 3.2.1 Install exit lights to manufacturer's recommendations, listing requirements, NFPA standard and local regulatory requirements.
- 3.2.2 Connect exit signs to dedicated circuits and breakers as required by the Canadian Electrical Code.
- 3.2.3 Provide circuit breaker locks for exit sign circuits.
- 3.2.4 Power to exist lights is to be sourced from emergency power where available.
- 3.2.5 Provide at least one exit sign circuit for each floor level except as noted.
- 3.2.6 All exit sign wiring is to be installed in a separate conduit and boxes.
- 3.2.7 All conductors are to be minimum #12 AWG with RW90 X-link insulation.
- 3.2.8 Support exit signs from ceiling tile in T-bar installation locations so as to provide a flush/neat installation and minimize tile lift.
- 3.2.9 Provide approved support hardware to the T-bar rail assembly to minimize tile stress and provide independent seismic cable(s) restraint from the building structure.
- 3.2.10 Wall-mounted exit lights are to be mounted 2900 mm to underside, or as detailed.
- 3.2.11 Ceiling-mounted exit lights in all service spaces are to be suspended to 2290mm to the underside.

#### 3.3 **Final Acceptance**

- 3.3.1 Position exit lights to optimize viewing angles and to avoid line-of-site obstructions.
- 3.3.2 Attend the building occupancy review with the authority having jurisdiction and adjust any locations as required.
- 3.3.3 Install any additional exit signs as requested in accordance with "Spare Exit Sign Material" clause noted above.

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**3.4 Maintenance – Clearances**

- 3.4.1 Provide clearance around systems, equipment and components for observation of operation, review, servicing, maintenance and as recommended by manufacturer and CEC, Part 1.

**3.5 Cleaning**

- 3.5.1 Proceed in accordance with Section 01 74 00 Cleaning and waste management.
- 3.5.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**



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## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1. Conform to the requirements of Divisions 0 and 1 and additional general information as prepared by the Architect or Prime Consultant, which apply to and form part of all sections of the work.
- 1.1.2. Read and comply with all sections of this document.
- 1.1.3. These instructions apply to and form part of all Communications Sections and drawing(s).
- 1.1.4. Refer to section 27 00 05 for definitions of names, titles, terms and abbreviations used in this document.
- 1.1.5. These specification documents have been prepared by Technology Systems Consultant specifically for use on this project and may not be reproduced in whole or in part without the express written consent of Technology Systems Consultant. These documents may not be used for any other purpose and/or for any other project and are considered confidential for the use of preparing a tender response.
- 1.1.6. This specification is divided into Sections which are not intended to identify contractual limits between Sub-Contractors nor between the Contractor and his Sub-Contractors. The requirements of any one Section apply to all Sections. Refer to other Divisions and Sections to ensure a complete and operational system.
- 1.1.7. These specification documents shall remain the property of the Technology Systems Consultant at all times.
- 1.1.8. All drawings and details have been prepared to illustrate the existing and new conditions of the project and shall be considered diagrammatic. The Communications Contractor shall ensure all components required to complete the fully operational system are installed with no additional cost to the Owner or the Technology Systems Consultant.
- 1.1.9. Provide all labour, materials, tools and equipment required for the complete installation of work called for in all Sections of the Contract Documents.
- 1.1.10. The Communications Contractor shall verify exact locations of all items shown and shall verify with the Technology Systems Consultant all new locations prior to installation. It shall be the responsibility of the Communications Contractor to provide the Technology Systems Consultant detailed layouts of all rooms and locations of installation prior to installation for approval. All costs, including other trades as applicable, associated with changes resulting from non-approved installation will be the responsibility of the Communications Contractor.
- 1.1.11. Minor changes in locations may be required by the Technology Systems Consultant in order to coordinate site conditions with other divisions and the Technology Systems Consultant reserves the right to make these changes with no additional cost to the Owner.

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**1.2 Schedule**

- 1.2.1. The Communications Contractor shall be responsible to meet the project schedule as provided by the Project Manager and the Owner.
- 1.2.2. Work is generally to be performed during regular work hours unless noted otherwise in this document. The Communications Contractor shall include for all necessary overtime labour in order to complete the project. The Communications Contractor shall be responsible for providing labour in order to complete the work within the schedule with no additional cost to the Owner.
- 1.2.3. The Communications Contractor shall supply a written project plan detailing schedule of installation in coordination with the overall project schedule. Project plan shall be prepared in MS Project.
- 1.2.4. At and near the completion of the project the Communications Contractor will be responsible for providing project documentation for the Owner's further use. This will include:
  - .1 Temporary As-Builts
  - .2 Contact Info for Cutover Technician
  - .3 As Built Test Results
  - .4 As-Built Drawings
- 1.2.5. All documents and information shall be provided as further detailed in Section 27 00 11 and delivered to the Technology Systems Consultant.

**1.3 Labour**

- 1.3.1. The Communications Contractor shall provide only skilled, trained tradesmen experienced in the installation of a certified installation. Each installer shall be certified with the manufacturer providing the 2 year warranty for this project. All installers shall have successfully completed the approved manufacturer's installation training program. The Technology Systems Consultant reserves the right to receive written proof of such training at any time during the project. If such proof is not provided the Communications Contractor will remove the installer from the site immediately and replace the installer within 24 hours.
- 1.3.2. The Communications Contractor shall be responsible to provide Union or Non-union labour as required on the project site and meet all requirements without any delay or cost to the Owner, General Contractor or other trades.
- 1.3.3. Sub-Contractors shall not be allowed to perform all or any portion of the project unless approved in writing by the Technology Systems Consultant and the Owner. Subcontractors shall be identified at time of tender to be considered for approval.
- 1.3.4. The Communications Contractor shall be in compliance at all times with local, provincial and federal employee standards, safety acts, fire codes and other applicable legislations, codes and acts affecting the delivery of the project. The Communications Contractor is responsible for the training and notifying their employees of any details associated with all codes, standards, acts and legislation applicable to this project.

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- 1.3.5. WSIB (Workplace Safety Insurance Board) clearance certificate indicating a good standing shall be provided by the Communications Contractor prior to acceptance of any contract.
  - 1.3.6. Provide personal identification in a form acceptable to the Owner for all employees attending the site for this project when requested.

#### **1.4 Interpretation of Drawings and Specifications**

- 1.4.1. It is the responsibility of the Communications Contractor to read carefully these specifications and drawing(s) and report any discrepancies immediately to the Technology Systems Consultant.
- 1.4.2. At the time of tendering the Communications Contractor shall notify the Technology Systems Consultant in writing of any equipment, wiring feature, software or device necessary for full operation of any of the systems which is not included in the specification documents or drawings. Failure to supply notification shall not relieve the Communications Contractor of the responsibility for providing a fully functioning system at the bid price.
- 1.4.3. While every attempt has been made to ensure that all information (including specified products and part numbers) is correct, it is the responsibility of the Communications Contractor to verify availability of products and verify all part numbers.
- 1.4.4. Specifications and drawings are schematic and represent the intent of the project.
- 1.4.5. Dimensions and measurements shown in these documents shall be verified by the Communications Contractor on site prior to final installation.
- 1.4.6. Quantities and lengths identified are approximate and shall not be used to gage or limit work.
- 1.4.7. These Specifications are an integral part of the accompanying drawing(s). Any item or subject omitted from one or the other, but which is either mentioned or implied shall be considered as properly and sufficiently specified.
- 1.4.8. Certain details indicated on the drawings are general in nature and are not specifically identified for each and every occurrence of use; however, such details shall be applicable to every occurrence on the drawings.
- 1.4.9. The location and size of existing services and equipment shown on the drawings are based on the best available information. The Communications Contractor shall verify the exact location, type, size and any other pertinent information prior to commencing work.

#### **1.5 Installation**

- 1.5.1. Leave areas clear where space has been designated as reserved for future equipment and equipment for other trades.

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- 1.5.2. Adequate space and provisions shall be left for removal of components and servicing of equipment, with minimum inconvenience to the operation of systems.
  - 1.5.3. Where equipment is shown to be 'roughed in only' obtain information from the Technology Systems Consultant before proceeding with the work.

**1.6 Coordination**

- 1.6.1. The Communications Contractor shall provide an installation and make all changes associated with coordination with other trades and to accommodate unforeseen site conditions at no additional cost to the Owner.
- 1.6.2. Prepare interference drawings and sketches for presentation to the Technology Systems Consultant to review any anticipated conflicts with other trades.
- 1.6.3. Prepare detailed layouts of equipment rooms prior to installation for review by the Technology Systems Consultant. Layouts shall indicate other major pieces of equipment being supplied by other trades.
- 1.6.4. The Communications Contractor shall be responsible for attending coordination meetings as requested by the General Contractor or Project Manager for the coordination of locations and services. The project manager selected shall be assigned for the duration of the project and may only be changed with the written consent of the Technology Systems Consultant.
- 1.6.5. The Communications Contractor in addition to coordination meetings shall attend weekly site meetings and be prepared to provide current project progress status, anticipated completion of future tasks and information on outstanding delivery items.
- 1.6.6. Access to the site shall be in compliance to all rules, regulations, safety standards and security procedures established for the project or building. Fees for after-hours access shall be considered included in the tender amount. No additional cost shall be accepted by the Owner for these requirements.
- 1.6.7. Cutting and patching of all surfaces as applicable to the communications installation shall be the responsibility of and be performed by the Communications Contractor. All work shall be performed to the standards set by codes and standards, Building Management, General Contractor and the Owner.
- 1.6.8. Cutting and patching of all structural members shall be approved by the Structural Consultant prior to work starting.
- 1.6.9. Work causing noise, dust and/or odour shall be performed during evenings and/or weekends to prevent disturbance to the operation of the Owner's or surrounding businesses. Work shall be performed at agreed times and in coordination with each party. All damages caused for work performed not in compliance with this item shall be the responsibility of the Communications Contractor.

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**1.7 Temporary Services**

- 1.7.1. The Communications Contractor shall provide all required materials, labour, tools and equipment to meet the temporary requirements of the project in coordination with other trades and the General Communications Contractor at no additional cost to the Owner.
- 1.7.2. All hoisting, mechanical lifts and special scaffolds shall be the responsibility of the Communications Contractor and at no additional cost to the Owner.
- 1.7.3. All power supplies, extension cords and equipment cords shall be the responsibility of the Communications Contractor and shall be installed in good working order and in accordance with all codes, standards and building regulations.

**1.8 Co-Operation With Other Divisions**

- 1.8.1. Communications Cabling shall not touch or be supported from piping, ductwork, conduits, ceiling supports or any other service / equipment. Communications Cabling shall be supported by approved j-hooks, cable slings, ladder / basket tray and/or conduit as outlined in this document.
- 1.8.2. Supply all items to be built in ample time for rapid progression of the work. Schedule and provide manpower and materials to proceed with work as required to satisfy the construction schedule.

**1.9 Existing Services and Equipment**

- 1.9.1. All changes and connections to existing services shall be made only in a manner and at a time approved by the Technology Systems Consultant and/or the Owner so as to avoid any interruption of such services during normal working hours. If necessary, changes and connections to existing services shall be made outside of normal business hours at no extra cost to the Owner.

**1.10 Metric Conversions**

- 1.10.1. Particular attention shall be paid with regard to Imperial versus S.I. Metric conversions. This applies to all services including, but not limited to, equipment, material and site services in both new and existing installations.
- 1.10.2. Conform to Canadian Metric Practice Guide CSA-CAN3-2234-1-89.

**1.11 Monthly Draws**

- 1.11.1. Monthly progress draws shall be submitted to the General Contractor for approval by the Technology Systems Consultant.

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**1.12 Pricing of Changes**

- 1.12.1. Where a Contemplated Change Notice (CCN) has been issued and identifies potential changes to the scope of work and those changes have been price-identified in the Tender Form under the Alternate, Separate, Identified and/or Unit Pricing structure, the Communications Contractor shall price all changes in accordance with the pricing provided in the Tender Form at the time of tender. All prices shall be provided in a broken down format, identifying the pricing reference (i.e. The line item on the Tender Form).
- 1.12.2. Where a CCN has been issued and identifies potential changes to the scope of work and those changes have NOT been price-identified in the Tender Form under the Alternate, Separate, Identified and/or Unit Pricing structure, the Communications Contractor shall provide a complete breakdown of all material, equipment and labour cost associated with each submission in the following format.

All material used in the change(s) shall be identified by:

Quantity  
Price Per Unit  
Material Cost  
Hours per Unit  
Total Hours

Summary shall include:

Total Material Value  
HST  
Technician rate (as per Tender Form)  
Forman rate  
Overhead  
Markup (profit)

Contemplated Change Notices shall include at no extra cost:

Administration  
Record Drawings  
Clean up  
Co-ordination  
Engineering and Drafting  
Estimating  
Guarantee  
Hydro Inspection  
Material Delivery  
Material Expediting  
Mileage  
Parking  
Project Management  
Re-Assign Manpower

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Safety  
Schedule Extension  
Supervision  
Tool Charges  
Wastage  
Warranty

Foreman Charges: Foreman Charges shall not exceed 10% of the labour component of the price.

Overhead and Profit: All overhead fees and profit shall be fixed at 5% and 10% unless agreed to by the owner / consultant prior to installation.

## **2 PRODUCT**

### **2.1 Substitutions**

- 2.1.1. Substitution of any product shall be prior approved in writing by only the Technology Systems Consultant.
- 2.1.2. The procedure for substitution approval will include the written submission by the Communications Contractor including the following:
  - .1 Original specified product
  - .2 Proposed product being substituted
  - .3 Reason for substitution
  - .4 Shop drawings indicating all technical specifications
  - .5 Financial advantage
  - .6 Schedule delivery date
  - .7 Written approval from certifying system manufacturer
- 2.1.3. Based on the review of the information requested above, the Owner and/or Technology Systems Consultant reserve the right to reject any proposed substitution without delay or cost to the project or the Owner.

### **2.2 Material Handling**

- 2.2.1. The Communications Contractor is responsible for the delivery of all materials to site and transportation to the work place in accordance with all safety regulations and procedures.
- 2.2.2. Make arrangements and schedule all hoisting with Building Management and the General Contractor.
- 2.2.3. Provide and be responsible for lockable storage for all tools and material required to complete the installation through the duration of the project. Once the project is complete remove all tools and excess materials within 2 business days.
- 2.2.4. The Owner and its representatives shall in no way be held liable for any missing material, equipment or tools required to complete the installation.

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### **3 EXECUTION**

#### **3.1 General**

- 3.1.1. The Communications Contractor shall supply all materials, labour, tools and equipment to provide a complete warranted installation as outlined in the contract documents and suitable to the approval of the Owner, the Technology Systems Consultant and inspection bodies having jurisdiction.
- 3.1.2. Provide continuity of all existing services while completing the specified installation. Losses due to interruption of services will be the responsibility of the Communications Contractor.
- 3.1.3. Arrange for all shutdowns (1) week prior in writing with the Project Manager and those in control of services shall be disrupted. All overtime costs, fees, security and other requirements shall be the full responsibility of the Communications Contractor.
- 3.1.4. Should services be interrupted accidentally the Communications Contractor shall provide material and labour to re-establish services immediately and shall continue without stoppage until all services have been re-established. All material and labour costs including overtime shall be borne solely by the Communications Contractor. Any material and/or labour costs including overtime associated with other trades and/or the General Contractor to assist in any way the Communications Contractor in re-establishing services shall be borne solely by the Communications Contractor.

#### **3.2 Site Conditions**

- 3.2.1. The Communications Contractor is responsible for maintaining a clean work environment and is responsible for the removal of all debris on a daily basis. Debris and removed materials shall be disposed of in conformance with all local by laws and regulations. Failing to comply and after reasonable time and written notice the General Contractor reserves the right to hire cleaners to complete the cleaning and back charge the Communications Contractor.
- 3.2.2. The Communications Contractor shall be responsible for the removal and reinstallation of all floor or ceiling tiles, hatch ways or access panels. All items shall be removed and replaced on a daily basis and left in the original condition. Special caution shall be taken to not break, chip or discolour with dirt or finger prints any such items. The Communications Contractor will be fully responsible for repair or replacement of all damaged pieces at the discretion of the Project Manager or Owner.
- 3.2.3. The Communications Contractor is fully responsible for storage of all temporarily removed items for the project.
- 3.2.4. All materials and installation throughout the project will remain the responsibility of the Communications Contractor until final completion for the project is accepted by the Owner. Damages to any item installed shall be replaced or repaired by the Communications Contractor to provide a complete final installation at no additional cost to the Owner.



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- 3.2.5. At the completion of the project or as and when the Owner requires, restore the original condition of all materials, equipment and surfaces within the work area affected by this installation.
  - 3.2.6. All vehicular traffic entering the site shall be coordinated with the General Contractor and no parking or compensation for paid parking will be provided by the Owner.

**3.3 Cutting, Patching and Repairing**

- 3.3.1. It is the responsibility of the Communications Contractor to perform all cutting, patching and repair related to their work including any penetrations through walls or floors.

**3.4 Hoisting Facilities**

- 3.4.1. This Division shall provide its own hoisting facilities regardless of height required to perform work.
- 3.4.2. Hoisting facilities may be provided by the General Contractor, although the General Contractor may at its own discretion not allow the Communications Contractor to make use of such.

**3.5 Safety**

- 3.5.1. The Communications Contractor shall adhere to all safety laws, rules and regulations issued by the authorities having jurisdiction, General Contractor, Project Manager and the Owner.
- 3.5.2. The Communications Contractor shall attend all Safety Program meetings requested by the General Contractor.
- 3.5.3. Provide adequate protection in public and work areas to pedestrian and other trade traffic using approved safety barriers, caution tape and signage.
- 3.5.4. At all times maintain clear fire exits, emergency routes and access to emergency equipment including fire hose cabinets, fire extinguishers and stand pipe connections.
- 3.5.5. Smoking and combustion of any materials is strictly prohibited on all sites.
- 3.5.6. Provide information to all employees of emergency and fire safety plans for the work site and facility.
- 3.5.7. Provide protection as required by the authorities having jurisdiction to all employees for work performed in typically inaccessible or concealed spaces.
- 3.5.8. If an approved subcontractor is used provide information and ensure all safety specifications herein are met.

**3.6 Site Adjustments**

- 3.6.1. Locations of all equipment, outlets or devices prior to installation may be revised to within (3) meters without any additional cost or change request.

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- 3.6.2. Portions of the project may be at any time identified in writing to be "On Hold". Work in these areas shall not be started, continued or completed until further direction is received. No additional cost shall be accepted by the Owner for areas put on hold.

**END OF SECTION**

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## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1 Conform to the requirements of Divisions 0 and 1 and additional general information as prepared by the Architect or Prime Consultant, which apply to and form part of all sections of the work.
- 1.1.2 Read and comply with all sections of this document.
- 1.1.3 These instructions apply to and form part of all Audio-Visual Communications Sections and drawing(s).
- 1.1.4 Refer to section 27 00 05 for definitions of names, titles, terms, and abbreviations used in this document.
- 1.1.5 These specification documents have been prepared by the Technology Systems Consultant specifically for use on this project and may not be reproduced in whole or in part without the express written consent of the Technology Systems Consultant. These documents may not be used for any other purpose and/or for any other project and are considered confidential for the use of preparing a tender response.
- 1.1.6 This specification is divided into Sections which are not intended to identify contractual limits between Sub-Contractors nor between the Contractor and his Sub-Contractors. The requirements of any one Section apply to all Sections. Refer to other Divisions and Sections to ensure a complete and operational system.
- 1.1.7 These specification documents shall remain the property of the Technology Systems Consultant at all times.
- 1.1.8 The Audio-Visual Communications Contractor shall report any discrepancies between drawings and all applicable specifications to the Technology Systems Consultant immediately.
- 1.1.9 All drawings and details have been prepared to illustrate the existing and new conditions of the project and shall be considered diagrammatic. The Audio-Visual Communications Contractor shall ensure all components required to complete the fully operational system are installed with no additional cost to the Owner or the Technology Systems Consultant.
- 1.1.10 Provide all labour, materials, tools, and equipment required for the complete installation of work called for in all Sections of the Contract Documents.

- 1.1.11 The Audio-Visual Communications Contractor shall verify exact locations of all items shown and shall verify with the Technology Systems Consultant all new locations prior to installation. It shall be the responsibility of the Audio-Visual Communications Contractor to provide the Technology Systems Consultant detailed layouts of all rooms and locations of installation prior to installation for approval. All costs, including other trades as applicable, associated with changes resulting from non-approved installation will be the responsibility of the Audio-Visual Communications Contractor.
- 1.1.12 Minor changes in locations may be required by the Technology Systems Consultant in order to coordinate site conditions with other divisions and the Technology Systems Consultant reserves the right to make these changes with no additional cost to the Owner.

## **1.2 Schedule**

- 1.2.1 The Audio-Visual Communications Contractor shall be responsible to meet the project schedule as provided by the Project Manager and the Owner.
- 1.2.2 Work is generally to be performed during regular work hours unless noted otherwise in this document. The Audio-Visual Communications Contractor shall include for all necessary overtime labour in order to complete the project. The Audio-Visual Communications Contractor shall be responsible for providing labour in order to complete the work within the schedule with no additional cost to the Owner.
- 1.2.3 The Audio-Visual Communications Contractor shall supply a written project plan detailing schedule of installation in coordination with the overall project schedule. Project plan shall be prepared in MS Project.
- 1.2.4 At and near the completion of the project the Audio-Visual Communications Contractor will be responsible for providing project documentation for the Owner's further use.
- 1.2.5 All documents and information shall be provided as further detailed in Section 27 00 09 and delivered to the Technology Systems Consultant.

## **1.3 Labour**

- 1.3.1 The Audio-Visual Communications Contractor shall provide only skilled, trained tradesmen experienced in the installation of an Audio-Visual communications systems installation.
- 1.3.2 The Audio-Visual Communications Contractor shall provide at least one permanent technician with his CTS or CTS-T credentials for the duration of the project.
- 1.3.3 The Audio-Visual Communications Contractor shall be responsible to provide Union or Non-union labour as required on the project site and meet all requirements without any delay or cost to the Owner, General Contractor, or other trades.

- 1.3.4 Sub-Contractors shall not be allowed to perform all or any portion of the project unless identified in the tender submission, along with their respective qualifications and/or certifications.
- 1.3.5 The Audio-Visual Communications Contractor shall comply at all times with local, provincial and federal employee standards, safety acts, fire codes and other applicable legislations, codes and acts affecting the delivery of the project. The Audio-Visual Communications Contractor is responsible for the training and notifying their employees of any details associated with all codes, standards, acts and legislation applicable to this project.
- 1.3.6 WSIB (Workplace Safety Insurance Board) clearance certificate indicating a good standing shall be provided by the Audio-Visual Communications Contractor prior to acceptance of any contract.
- 1.3.7 Provide personal identification in a form acceptable to the Owner for all employees attending the site for this project when requested.

#### **1.4 Interpretation of Drawings and Specifications**

- 1.4.1 It is the responsibility of the Audio-Visual Communications Contractor to carefully read these specifications and drawing(s) and report any discrepancies immediately to the Technology Systems Consultant.
- 1.4.2 At the time of tendering the Audio-Visual Communications Contractor shall notify the Technology Systems Consultant in writing of any equipment, wiring feature, software, or device necessary for full operation of any of the systems which is not included in the specification documents or drawings. Failure to supply notification shall not relieve the Audio-Visual Communications Contractor of the responsibility for providing a fully functioning system at the bid price.
- 1.4.3 While every attempt has been made to ensure that all information (including specified products and part numbers) is correct, it is the responsibility of the Audio-Visual Communications Contractor to verify availability of products and verify all part numbers.
- 1.4.4 Specifications and drawings are schematic and represent the intent of the project.
- 1.4.5 Dimensions and measurements shown in these documents shall be verified by the Audio-Visual Communications Contractor on site prior to final installation.
- 1.4.6 Quantities and lengths identified are approximate and shall not be used to gage or limit work.
- 1.4.7 These Specifications are an integral part of the accompanying drawing(s). Any item or subject omitted from one or the other, but which is either mentioned or implied shall be considered as properly and sufficiently specified.
- 1.4.8 Certain details indicated on the drawings are general in nature and are not specifically identified for each and every occurrence of use, however, such details shall be applicable to every occurrence on the drawings.

- 1.4.9 The location and size of existing services and equipment shown on the drawings are based on the best available information. The Audio-Visual Communications Contractor shall verify the exact location, type, size, and any other pertinent information prior to commencing work.

## **1.5 Installation**

- 1.5.1 Leave areas clear where space has been designated as reserved for future equipment and equipment for other trades.
- 1.5.2 Adequate space and provisions shall be left for removal of components and servicing of equipment, with minimum inconvenience to the operation of systems.
- 1.5.3 Where equipment is shown to be 'roughed in only' obtain information from the Technology Systems Consultant before proceeding with the work.

## **1.6 Coordination**

- 1.6.1 The Audio-Visual Communications Contractor shall provide an installation and make all changes associated with coordination with other trades and to accommodate unforeseen site conditions at no additional cost to the Owner.
- 1.6.2 Prepare interference drawings and sketches for presentation to the Technology Systems Consultant to review any anticipated conflicts with other trades.
- 1.6.3 Prepare detailed layouts of equipment rooms prior to installation for review by the Technology Systems Consultant. Layouts shall indicate other major pieces of equipment being supplied by other trades.
- 1.6.4 The Audio-Visual Communications Contractor shall be responsible for attending coordination meetings as requested by the General Contractor or Project Manager or Technology Systems Consultant for the coordination of locations and services. The project manager selected shall be assigned for the duration of the project and may only be changed with the written consent of the Technology Systems Consultant.
- 1.6.5 The Audio-Visual Communications Contractor in addition to coordination meetings shall attend weekly site meetings and be prepared to provide current project progress status, anticipated completion of future tasks and information on outstanding delivery items.
- 1.6.6 Access to the site shall comply to all rules, regulations, safety standards and security procedures established for the project or building. Fees for after-hours access shall be considered included in the tender amount. No additional cost shall be accepted by the Owner for these requirements.
- 1.6.7 Cutting and patching of all surfaces as applicable to the Audio-Visual communications installation shall be the responsibility of and be performed by the Audio-Visual Communications Contractor. All work shall be performed to the standards set by codes and standards, Building Management, General Contractor, and the Owner.

- 1.6.8 Cutting and patching of all structural members shall be approved by the Structural Consultant prior to work starting.
- 1.6.9 Work causing noise, dust and/or odour shall be performed during evenings and/or weekends to prevent disturbance to the operation of the Owner's or surrounding businesses. Work shall be performed at agreed times and in coordination with each party. All damages caused for work performed not in compliance with this item shall be the responsibility of the Audio-Visual Communications Contractor.

### **1.7 Temporary Services**

- 1.7.1 The Audio-Visual Communications Contractor shall provide all required materials, labour, tools and equipment to meet the temporary requirements of the project in coordination with other trades and the General Audio-Visual Communications Contractor at no additional cost to the Owner.
- 1.7.2 All hoisting, mechanical lifts and special scaffolds shall be the responsibility of the Audio-Visual Communications Contractor and at no additional cost to the Owner.
- 1.7.3 All power supplies, extension cords and equipment cords shall be the responsibility of the Audio-Visual Communications Contractor and shall be installed in good working order and in accordance with all codes, standards and building regulations.

### **1.8 Co-Operation With Other Divisions**

- 1.8.1 Audio-Visual communications cabling shall not touch or be supported from piping, ductwork, conduits, ceiling supports or any other service / equipment. Audio-Visual communications cabling shall be supported by approved j-hooks, cable slings, ladder / basket tray and/or conduit as outlined in this document.
- 1.8.2 Supply all items to be built in ample time for rapid progression of the work. Schedule and provide manpower and materials to proceed with work as required to satisfy the construction schedule.

### **1.9 Existing Services and Equipment**

- 1.9.1 All changes and connections to existing services shall be made only in a manner and at a time approved by the Technology Systems Consultant and/or the Owner so as to avoid any interruption of such services during normal working hours. If necessary, changes and connections to existing services shall be made outside of normal business hours at no extra cost to the Owner.

### **1.10 Metric Conversions**

- 1.10.1 Particular attention shall be paid with regard to Imperial versus S.I. metric conversions. This applies to all services including, but not limited to, equipment, material, and site services in both new and existing installations.
- 1.10.2 Conform to Canadian Metric Practice Guide CSA-CAN3-2234-1-89.

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**1.11 Monthly Draws**

1.11.1 Monthly progress draws shall be submitted to the General Contractor for approval by the Technology Systems Consultant.

**1.12 Pricing of Changes**

1.12.1 Where a Contemplated Change Notice (CCN) has been issued and identifies potential changes to the scope of work and those changes have been price-identified in the Tender Form under the Alternate, Separate, Identified and/or Unit Pricing structure, the Audio-Visual Communications Contractor shall price all changes in accordance with the pricing provided in the Tender Form at the time of tender. All prices shall be provided in a broken-down format, identifying the pricing reference (i.e. The line item on the Tender Form).

1.12.2 Where a CCN has been issued and identifies potential changes to the scope of work and those changes have NOT been price-identified in the Tender Form under the Alternate, Separate, Identified and/or Unit Pricing structure, the Audio-Visual Communications Contractor shall provide a complete breakdown of all material, equipment and labour cost associated with each submission in the following format.

All material used in the change(s) shall be identified by:

Quantity  
Price Per Unit  
Material Cost  
Hours per Unit  
Total Hours

Summary shall include:

Total Material Value  
HST  
Technician rate (as per Tender Form)  
Forman rate  
Overhead  
Markup (profit)

Contemplated Change Notices shall include at no extra cost:

Administration  
Record Drawings  
Clean up  
Co-ordination  
Engineering and Drafting  
Estimating  
Guarantee  
Hydro Inspection



Material Delivery  
Material Expediting  
Mileage  
Parking  
Project Management  
Re-Assign Manpower  
Safety  
Schedule Extension  
Supervision  
Tool Charges  
Wastage  
Warranty

Foreman Charges: Foreman Charges shall not exceed 10% of the labour component of the price.

Overhead and Profit: All overhead fees and profit shall be fixed at 5% and 10% unless agreed to by the owner / consultant prior to installation.

## **2 PRODUCT**

### **2.1 General**

- 2.1.1 All equipment and products supplied shall be new and free of all manufacturer defects and delivery or installation damage.
- 2.1.2 All equipment and products supplied shall meet all manufacturer listed characteristics as identified in the latest manufacturer catalogue.
- 2.1.3 All products shall meet all applicable codes and standards and bare the UL/ULC label, be CSA approved and meet FCC/CRTC Regulations.
- 2.1.4 All products shall be provided in accordance with local, provincial, and national fire ratings for the installation on this project.

### **2.2 Warranty**

- 2.2.1 Upon completion of the project the Audio-Visual Communications Contractor shall deliver to the Technology Systems Consultant for the Owner a copy of the manufacturer's warranty information or certificate. This information shall accompany the final documentation described further in these specifications.
- 2.2.2 Subcontractors shall not be acceptable to provide warranty unless pre-approved by the Technology Systems Consultant and the Owner at time of tender. Subcontractors shall not be approved after tender is awarded.
- 2.2.3 The Audio-Visual Communications Contractor shall provide a written 2-year warranty inclusive of all parts and labour. The Audio-Visual Communications Contractor shall also state and agree in writing to providing response for any warranty request within 24 hours during this warranty period.

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### **2.3 Substitutions**

- 2.3.1 Substitution of any product shall be prior approved in writing by only the Technology Systems Consultant.
- 2.3.2 The procedure for substitution approval will include the written submission by the Audio-Visual Communications Contractor including the following:
  - .1 Original specified product
  - .2 Proposed product being substituted
  - .3 Reason for substitution
  - .4 Shop drawings indicating all technical specifications
  - .5 Financial advantage
  - .6 Schedule delivery date
  - .7 Written approval from certifying system manufacturer
- 2.3.3 Based on the review of the information requested above, the Owner and/or Technology Systems Consultant reserve the right to reject any proposed substitution without delay or cost to the project or the Owner.

### **2.4 Material Handling**

- 2.4.1 The Audio-Visual Communications Contractor is responsible for the following:
  - .1 Delivery of all materials to site and transportation to the workplace in accordance with all safety regulations and procedures.
  - .2 Coordinate and schedule all hoisting with Building Management and the General Contractor.
  - .3 Provide and be responsible for lockable storage for all tools and material required to complete the installation through the duration of the project.
  - .4 Remove all tools and excess materials within 2 business days once the project is complete.
- 2.4.2 The Owner and its representatives shall in no way be held liable for any missing material, equipment or tools required to complete the installation.

## **3 EXECUTION**

### **3.1 General**

- 3.1.1 The Audio-Visual Communications Contractor shall supply all materials, labour, tools, and equipment to provide a complete warranted installation as outlined in the contract documents and suitable to the approval of the Owner, Technology Systems Consultant and inspection bodies having jurisdiction.
- 3.1.2 The Audio-Visual Communications Contractor shall be responsible for installing and providing pulling strings, ropes, and fishing walls wherever conduit is not installed, or conduit is installed without these provisions.

- 3.1.3 Provide continuity of all existing services while completing the specified installation. Losses due to interruption of services will be the responsibility of the Audio-Visual Communications Contractor.
- 3.1.4 Arrange for all shutdowns (1) week prior in writing with the Project Manager and those in control of services shall be disrupted. All overtime costs, fees, security, and other requirements shall be the full responsibility of the Audio-Visual Communications Contractor.
- 3.1.5 Should services be interrupted accidentally the Audio-Visual Communications Contractor shall provide material and labour to re-establish services immediately and shall continue without stoppage until all services have been re-established. All material and labour costs including overtime shall be borne solely by the Audio-Visual Communications Contractor. Any material and/or labour costs including overtime associated with other trades and/or the General Contractor to assist in any way the Audio-Visual Communications Contractor in re-establishing services shall be borne solely by the Audio-Visual Communications Contractor.

## **3.2 Site Conditions**

- 3.2.1 The Audio-Visual Communications Contractor is responsible for maintaining a clean work environment and is responsible for the removal of all debris on a daily basis. Debris and removed materials shall be disposed of in conformance with all local by laws and regulations. Failing to comply and after reasonable time and written notice the General Contractor reserves the right to hire cleaners to complete the cleaning and back charge the Audio-Visual Communications Contractor.
- 3.2.2 The Audio-Visual Communications Contractor shall be responsible for the removal and reinstallation of all floor or ceiling tiles, hatch ways or access panels. All items shall be removed and replaced on a daily basis and left in the original condition. Special caution shall be taken to not break, chip or discolour with dirt or fingerprints any such items. The Audio-Visual Communications Contractor will be fully responsible for repair or replacement of all damaged pieces at the discretion of the Project Manager or Owner.
- 3.2.3 The Audio-Visual Communications Contractor is fully responsible for storage of all temporarily removed items for the project.
- 3.2.4 All materials and installation throughout the project will remain the responsibility of the Audio-Visual Communications Contractor until final completion for the project is accepted by the Owner. Damages to any item installed shall be replaced or repaired by the Audio-Visual Communications Contractor to provide a complete final installation at no additional cost to the Owner.
- 3.2.5 At the completion of the project or as and when the Owner requires, restore the original condition of all materials, equipment and surfaces within the work area affected by this installation.

- 3.2.6 All vehicular traffic entering the site shall be coordinated with the General Contractor and no parking or compensation for paid parking will be provided by the Owner.

### **3.3 Cutting, Patching and Repairing**

- 3.3.1 It is the responsibility of the Audio-Visual Communications Contractor to perform all cutting, patching and repair related to the Audio-Visual communications cabling work including any penetrations through walls or floors.

### **3.4 Hoisting Facilities**

- 3.4.1 This Division shall provide its own hoisting facilities regardless of height required to perform work.
- 3.4.2 Hoisting facilities may be provided by the General Contractor, although the General Contractor may at its own discretion not allow the Audio-Visual Communications Contractor to make use of such.

### **3.5 Safety**

- 3.5.1 The Audio-Visual Communications Contractor shall adhere to all safety laws, rules and regulations issued by the authorities having jurisdiction, General Contractor, Project Manager, and the Owner.
- 3.5.2 The Audio-Visual Communications Contractor shall attend all Safety Program meetings requested by the General Contractor.
- 3.5.3 Provide adequate protection in public and work areas to pedestrian and other trade traffic using approved safety barriers, caution tape and signage.
- 3.5.4 At all times maintain clear fire exits, emergency routes and access to emergency equipment including fire hose cabinets, fire extinguishers and standpipe connections.
- 3.5.5 Smoking and combustion of any materials is strictly prohibited on all sites.
- 3.5.6 Provide information to all employees of emergency and fire safety plans for the work site and facility.
- 3.5.7 Provide protection as required by the authorities having jurisdiction to all employees for work performed in typically inaccessible or concealed spaces.
- 3.5.8 If an approved subcontractor is used provide information and ensure all safety specifications herein are met.

### **3.6 Site Adjustments**

- 3.6.1 Locations of all equipment, outlets or devices prior to installation may be revised to within (3) meters without any additional cost or change request.

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- 3.6.2 Portions of the project may be at any time identified in writing to be "On Hold". Work in these areas shall not be started, continued, or completed until further direction is received. No additional cost shall be accepted by the Owner for areas put on hold.

**END OF SECTION**

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## **1 GENERAL**

### **1.1 General**

1.1.1. The following definitions may be used in this document, as well as in any project documents such as but not limited to Addenda, Contemplated Change Notices, Change Orders, and Site Instructions:

Addendum	- Normative document used to provide additional requirements and recommendations to a published document (e.g., standards, contracts). When published, an addendum effectively becomes part of the document that it supports.
Bonding	- The permanent joining of metallic parts to form an electrically conductive path that will ensure electrical continuity and the capacity to conduct safely any current likely to be imposed.
Bonding Conductor (BC)	- A conductor used specifically for the purpose of bonding.
Building Entrance Facility	- The room or space inside a building where telecommunications cables enter and leave the building.
Communications Contractor	- The successful bidder(s) to this Specification responsible for the supply and installation.
Category	- A rating that defines the performance of cabling components and systems. Describes mechanical properties and transmission characteristics of balanced twisted-pair cabling and provides a numbered designation.
Change Notice	- Normative document approved to provide additional requirements and recommendations that describes and authorizes the implementation of an engineering change to the product and its approved configuration documentation.
Owner	- Region of Peel EMS
Technology Systems Consultant	- Ghazdanafar Rizvi SPECTECH

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Contemplated Change Notice	- Normative document to provide additional requirements and recommendations that describes the implementation of an engineering change to the product and its approved configuration documentation for the purposes of pricing. This document does not authorize the implementation of a change to the product and its approved configuration documentation.
Cut Over	- The live date(s) when the Owner will occupy the space as indicated by date and/or phasing.
Grounded Conductor	- A system or circuit conductor that is intentionally grounded.
Grounding System	- A system of hardware and wiring that provides an electrical path from a specified location to an earth ground point.
Modular Copper Patch Panel	- A patch panel that allows each RJ-45 outlet (or port) to be removed individually.
Project	- Supply and installation of a complete Structured Cabling Solution to support Voice, Data and/or Video applications as described in this document.
Provide	- Supply and install.
Workstation	- Systems Furniture Workstation, Office, Meeting Room, Boardroom, Classroom, etc. Any Voice or Data cable originating in a Telecom, LAN, Computer Room or Consolidation Point that is not terminated on a patch panel / IDC Block at the other end.

1.1.2. The following abbreviations may be used in this document:

A	- Ampere
ac	- Alternating current
ACR	- Attenuation to Cross-Talk Ratio
ADC	- Analog to Digital Converter
ADSL	- Asymmetric Digital Subscriber Line
A/E	- Architect or Engineer
AFF	- Above Finished Floor
AHJ	- Authority Having Jurisdiction
ALPETH	- Aluminum Polyethylene

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AME	- Architectural, Mechanical, Electrical
AN	- Access Node
ANSI	- American National Standards Institute
AP	- Access Point
ARPAP	- Resin-coated Aluminum, Polyethylene Aluminum, Polyethylene
ASCII	- American Standard Code for Information Interchange
ASP	- Aluminum Steel Polyethylene
ASTM	- American Society for Testing and Materials
ATD	- Asynchronous Time Division
ATDM	- Asynchronous Time Division Multiplexing
ATM	- Asynchronous Transfer Mode
Attn	- Attenuation
AV	- Audio-Video
AVS	- Audio-Video System
AWG	- American Wire Gauge
BAS	- Building Automation System
BC	- Bonding Conductor
BCD	- Backbone Conduit
BCT	- Bonding Conductor for Telecommunications
BEF	- Building Entrance Facility
BER	- Bit Error Rate
BERT	- Bit Error Rate Test
BFOC	- Bayonet Fibre Optic Connector
BIC	- Building Industry Consultant
BICSI®	- Building Industry Consulting Service International
bit	- Binary Digit
BOM	- Bill Of Material
b/s	- Bit per Second
BWA	- Broadband Wireless Access
CA	- Cable
CACSP	- Coated Aluminum Coated Steel Polyethylene
CAD	- Computer Aided Design
CATV	- Community Antenna Television (Cable Television)
CBN	- Common Bonding Network
CCIA	- Computer Communications Industry Association
CCN	- Contemplated Change Notice
cct	- Circuit
CCTV	- Closed Circuit Television
CD	- Compact Disc
CD	- Change Directive (same as Change Notice and Change Order)
CEC	- Canadian Electrical Code
CEF	- Cable Entrance Facility
cm	- Centimetre
CMP	- Communications Plenum
CMR	- Communications Riser

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CN	-	Change Notice (same as Change Directive and Change Order)
CO	-	Change Order (same as Change Notice and Change Directive)
coax	-	Coaxial Cable
CO-OSP	-	Customer-Owned Outside Equipment
CP	-	Consolidation Point
CPU	-	Central Processing Unit
CPVC	-	Chlorinated Polyvinyl Chloride
CSA	-	Canadian Standards Institute
CSC	-	Construction Specifications Canada
CSI	-	Construction Specifications Institute
CT	-	Cable Tray
Cu	-	Copper
c/w	-	Complete With
dB	-	Decibel
dB/km	-	Decibel per Kilometre
dBm	-	Decibel milliwatt
dBmV	-	Decibel millivolt
demarc	-	Demarcation Point
D-ring	-	Distribution Ring
DSL	-	Digital Subscriber Line
EF	-	Entrance Facility
EIA	-	Electronics Industry Alliance
ELFEXT	-	Equal Level Far-End Crosstalk
e-mail	-	Electronic Mail
EMI	-	Electromagnetic Interference
EMI/RFI	-	Electromagnetic Interference / Radio Frequency Interference
ER	-	Equipment Room
ESD	-	Electrostatic Discharge
e/w	-	Equipped With
FC	-	Fibre Connector
FCC	-	Federal Communications Commission
FDDI	-	Fibre Distributed Data Interface
FEP	-	Fluorinated Ethylene Propylene
FEXT	-	Far-End Crosstalk
FOTP	-	Fibre Optic Test Procedure
ft	-	Foot / Feet
ft2	-	Square Foot / Feet
FTTD	-	Fibre To The Desk
FT 1 / FT 3	-	Fractional T 1 / Fractional T 3
G	-	Giga
Gb	-	Gigabit
GB	-	Gigabyte
Gb/s	-	Gigabit per Second
GC	-	General Contractor
GHz	-	Gigahertz

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HC	-	Horizontal Cross-connect
Hz	-	Hertz
I	-	Current
IC	-	Intermediate Closet
IC	-	Intermediate Cross-connect
ID	-	Identification
ID	-	Inside Diameter
IDC	-	Insulation Displacement Connection
IDC	-	Insulation Displacement Connector
IDC	-	Insulation Displacement Contact
IDF	-	Intermediate Distribution Frame
IEEE®	-	Institute of Electrical and Electronics Engineers, Inc. ®
IG	-	Isolated Ground
in	-	Inch
in2	-	Square Inch
I/O	-	Input / Output (Device)
IOR	-	Index Of Refraction
ISDN	-	Integrated Services Digital Network
ISO	-	International Organization for Standardization
IT	-	Information Technology
kb	-	Kilobit
kB	-	Kilobyte
kg	-	Kilogram
km	-	Kilometre
kV	-	Kilovolt
kVA	-	Kilovoltampere
kW	-	Kilowatt
kWh	-	Kilowatt hour
LAN	-	Local Area Network
laser	-	Light Amplification by Stimulated Emission of Radiation
lb	-	Pound
LED	-	Light Emitting Diode
LO	-	Laser Optimized
LSZH	-	Low Smoke Zero Halogen
m	-	Metre
m2	-	Square Metre
mA	-	Milliampere
MAC	-	Move, Add, or Change
MAN	-	Metropolitan Area Network
Mb	-	Megabit
MB	-	Megabyte
Mb/s	-	Megabit per Second
MB/s	-	Megabyte per Second
MC	-	Main Cross-connect
MDF	-	Main Distribution Frame
MGB	-	Main Grounding Busbar
MHz	-	Megahertz

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mi	-	Mile
MIMS	-	Mineral Insulated Metal Sheathed
min	-	Minute
mm	-	Millimetre
MM	-	Multimode
MMF	-	Multimode Fibre
Misc	-	Miscellaneous
MPP	-	Modular Patch Panel
ms	-	Millisecond
MSDS	-	Material Safety Data Sheet
MUTO	-	Multi-user Telecommunications Outlet
MUTOA	-	Multi-user Telecommunications Outlet Assembly
mW	-	Milliwatt
MW	-	Megawatt
NBCC	-	National Building Code of Canada
NESC	-	National Electrical Safety Code
NEXT	-	Near-end Crosstalk
NIC	-	Network Interface Card
NIR	-	Near-end crosstalk-to-Insertion loss Ratio
NRCC	-	National Research Council of Canada
OD	-	Outside Diameter
OEM	-	Original Equipment Manufacturer
OF	-	Optical Fibre
OSP	-	Outside Plant
PBX	-	Private Branch Exchange
PDU	-	Power Distribution Unit
PP	-	Patch Panel
PSACR	-	Power Sum Attenuation to Crosstalk Ratio
PSELFEXT	-	Power Sum Equal Level Far-End Crosstalk
PSNEXT	-	Power Sum Near-End Crosstalk
PVC	-	Polyvinyl Chloride
QA	-	Quality Assurance
QC	-	Quality Control
QoS	-	Quality of Service
Qty	-	Quantity
RCDD®	-	Registered Communications Distribution Designer
RF	-	Radio Frequency
RFI	-	Radio Frequency Interference
RJ	-	Registered Jack
rms	-	Root Mean Square
RU	-	Rack Unit (1.75")
RX	-	Receive
RX	-	Receiver
SAN	-	Storage Access Network
SC	-	Single Fibre Coupling Optical Fibre Connector
SCC	-	Standards Council of Canada
SCS	-	Structured Cabling Solution

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ScTP	-	Screened Twisted Pair
SFTP	-	Screened Foiled Twisted Pair
SI	-	International System of Units (Le Système International d'Unités)
SLA	-	Service level Agreement
SM	-	Singlemode
SMF	-	Singlemode Fibre
SNMP	-	Simple Network Management Protocol
SNR	-	Signal-to-Noise Ratio
STALPETH	-	Steel Aluminum Polyethylene
STP	-	Shielded Twisted Pair
STP-A	-	Shielded Twisted Pair A
T 1	-	Trunk Level 1
TBB	-	Telecommunications Bonding Backbone
TBBIBC	-	Telecommunications Bonding Backbone Interconnecting Bonding Conductor
TC	-	Telecommunications Closet
TDD	-	Telecommunications Device for the Deaf
TGB	-	Telecommunications Grounding Busbar
TGR	-	Telecommunications Grounding Rod
TIA	-	Telecommunications Industry Association
TMGB	-	Telecommunications Main Grounding Busbar
TP	-	Twisted Pair
TR	-	Telecommunications Room
TS	-	Technical Standard
TSB	-	Telecommunications Systems Bulletin (formerly Technical Systems Bulletin)
TTY	-	Teletypewriter / Text Telephone
TV	-	Television
TX	-	Transmit
TX	-	Transmitter
U	-	(When preceded by a numeral) Rack Unit (equal to 1.75")
UD	-	Underfloor Duct
UL®	-	Underwriters Laboratories Inc.®
ULC	-	Underwriters Laboratories of Canada
UPC	-	Universal Product Code
UPS	-	Uninterruptible Power Supply
UTP	-	Unshielded Twisted Pair
V	-	Volt
VA	-	Volt-Ampere
VCS	-	Voice Communications System
VCSEL	-	Vertical Cavity Surface Emitting Laser
VLAN	-	Virtual Local Area Network
VoIP	-	Voice over Internet Protocol
VPN	-	Virtual Private Network
W	-	Watt
WAN	-	Wide Area Network

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WAP	-	Wireless Application Protocol
Wi-Fi	-	Wireless Fidelity
Wi-Fi	-	Wireless Fidelity
WLAN	-	Wireless Local Area Network
WMAN	-	Wireless Metropolitan Area Network
WS	-	Workstation
WWAN	-	Wireless Wide Area Network
x	-	Mathematical Operation (Multiplication)
X	-	Cross-connect
XC	-	Cross-connect
XLPE	-	Cross-linked Polyethylene
XPE-PVC	-	Expanded Polyethylene Polyvinyl Chloride

## **2 PRODUCT**

**2.1 Not applicable to this Section.**

## **3 EXECUTION**

**3.1 Not applicable to this Section.**

**END OF SECTION**

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**1 GENERAL**

**1.1 General**

1.1.1 The following definitions may be used in this document, as well as in any project documents such as but not limited to Addenda, Contemplated Change Notices, Change Orders, and Site Instructions:

Addendum	- Normative document used to provide additional requirements and recommendations to a published document (e.g., standards, contracts). When published, an addendum effectively becomes part of the document that it supports.
Bonding	- The permanent joining of metallic parts to form an electrically conductive path that will ensure electrical continuity and the capacity to conduct safely any current likely to be imposed.
Bonding Conductor (BC)	- A conductor used specifically for the purpose of bonding.
Building Entrance Facility	- The room or space inside a building where telecommunications cables enter and leave the building.
Audio-Visual Communications Contractor	- The successful bidder(s) to this Specification responsible for the supply and installation.
Category	- A rating that defines the performance of cabling components and systems. Describes mechanical properties and transmission characteristics of balanced twisted-pair cabling and provides a numbered designation.
Change Notice	- Normative document approved to provide additional requirements and recommendations that describes and authorizes the implementation of an engineering change to the product and its approved configuration documentation.
Owner	- Region of Peel EMS
Technology Systems Consultant	- Ghazdanafar Rizvi SPECTECH

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Contemplated Change Notice	- Normative document to provide additional requirements and recommendations that describes the implementation of an engineering change to the product and its approved configuration documentation for the purposes of pricing. This document does not authorize the implementation of a change to the product and its approved configuration documentation.
Cut Over	- The live date(s) when the Owner will occupy the space as indicated by date and/or phasing.
Grounded Conductor	- A system or circuit conductor that is intentionally grounded.
Grounding System	- A system of hardware and wiring that provides an electrical path from a specified location to an earth ground point.
Modular Copper Patch Panel	- A patch panel that allows each RJ-45 outlet (or port) to be removed individually.
Project	- Supply and installation of a complete Structured Cabling Solution to support Voice, Data and/or Video applications as described in this document.
Provide	- Supply and install.
Workstation	- Systems Furniture Workstation, Office, Meeting Room, Boardroom, Classroom, etc. Any Voice or Data cable originating in a Telecom, LAN, Computer Room or Consolidation Point that is not terminated on a patch panel / IDC Block at the other end.

1.1.2 The following abbreviations may be used in this document:

A	- Ampere
ac	- Alternating current
ACR	- Attenuation to Crosstalk Ratio
ADC	- Analog to Digital Converter
ADSL	- Asymmetric Digital Subscriber Line
A/E	- Architect or Engineer
AFF	- Above Finished Floor
AHJ	- Authority Having Jurisdiction
ALPETH	- Aluminum Polyethylene
AME	- Architectural, Mechanical, Electrical
AN	- Access Node

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ANSI	- American National Standards Institute
AP	- Access Point
ARPAP	- Resin-coated Aluminum, Polyethylene Aluminum, Polyethylene
ASCII	- American Standard Code for Information Interchange
ASP	- Aluminum Steel Polyethylene
ASTM	- American Society for Testing and Materials
ATD	- Asynchronous Time Division
ATDM	- Asynchronous Time Division Multiplexing
ATM	- Asynchronous Transfer Mode
Attn	- Attenuation
AV	- Audiovisual
AWG	- American Wire Gauge
BAS	- Building Automation System
BC	- Bonding Conductor
BCD	- Backbone Conduit
BCT	- Bonding Conductor for Telecommunications
BEF	- Building Entrance Facility
BER	- Bit Error Rate
BERT	- Bit Error Rate Test
BFOC	- Bayonet Fibre Optic Connector
BIC	- Building Industry Consultant
BICSI®	- Building Industry Consulting Service International
bit	- Binary Digit
BOM	- Bill Of Material
b/s	- Bit per Second
BWA	- Broadband Wireless Access
CA	- Cable
CACSP	- Coated Aluminum Coated Steel Polyethylene
CAD	- Computer Aided Design
CATV	- Community Antenna Television (Cable Television)
CBN	- Common Bonding Network
CCIA	- Computer Communications Industry Association
CCN	- Contemplated Change Notice
cct	- Circuit
CCTV	- Closed Circuit Television
CD	- Compact Disc
CD	- Change Directive (same as Change Notice and Change Order)
CEC	- Canadian Electrical Code
CEF	- Cable Entrance Facility
cm	- Centimetre
CMP	- Communications Plenum
CMR	- Communications Riser
CN	- Change Notice (same as Change Directive and Change Order)
CO	- Change Order (same as Change Notice and Change Directive)

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coax	-	Coaxial Cable
CO-OSP	-	Customer-Owned Outside Equipment
CP	-	Consolidation Point
CPU	-	Central Processing Unit
CPVC	-	Chlorinated Polyvinyl Chloride
CSA	-	Canadian Standards Institute
CSC	-	Construction Specifications Canada
CSI	-	Construction Specifications Institute
CT	-	Cable Tray
Cu	-	Copper
c/w	-	Complete With
dB	-	Decibel
dB/km	-	Decibel per Kilometre
dBm	-	Decibel milliwatt
dBmV	-	Decibel millivolt
demarc	-	Demarcation Point
D-ring	-	Distribution Ring
DSL	-	Digital Subscriber Line
EF	-	Entrance Facility
EIA	-	Electronics Industry Alliance
ELFEXT	-	Equal Level Far-End Crosstalk
e-mail	-	Electronic Mail
EMI	-	Electromagnetic Interference
EMI/RFI	-	Electromagnetic Interference / Radio Frequency Interference
ER	-	Equipment Room
ESD	-	Electrostatic Discharge
e/w	-	Equipped With
FC	-	Fibre Connector
FCC	-	Federal Communications Commission
FDDI	-	Fibre Distributed Data Interface
FEP	-	Fluorinated Ethylene Propylene
FEXT	-	Far-End Crosstalk
FOTP	-	Fibre Optic Test Procedure
ft	-	Foot / Feet
ft2	-	Square Foot / Feet
FTTD	-	Fibre to the Desk
FT 1 / FT 3	-	Fractional T 1 / Fractional T 3
G	-	Giga
Gb	-	Gigabit
GB	-	Gigabyte
Gb/s	-	Gigabit per Second
GC	-	General Contractor
GHz	-	Gigahertz
HC	-	Horizontal Cross-connect
Hz	-	Hertz
I	-	Current
IC	-	Intermediate Closet
IC	-	Intermediate Cross-connect

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ID	-	Identification
ID	-	Inside Diameter
IDC	-	Insulation Displacement Connection
IDC	-	Insulation Displacement Connector
IDC	-	Insulation Displacement Contact
IDF	-	Intermediate Distribution Frame
IEEE®	-	Institute of Electrical and Electronics Engineers, Inc. ®
IG	-	Isolated Ground
in	-	Inch
in2	-	Square Inch
I/O	-	Input / Output (Device)
IOR	-	Index Of Refraction
ISDN	-	Integrated Services Digital Network
ISO	-	International Organization for Standardization
IT	-	Information Technology
kb	-	Kilobit
kB	-	Kilobyte
kg	-	Kilogram
km	-	Kilometre
kV	-	Kilovolt
kVA	-	Kilovoltampere
kW	-	Kilowatt
kWh	-	Kilowatt hour
LAN	-	Local Area Network
laser	-	Light Amplification by Stimulated Emission of Radiation
lb	-	Pound
LED	-	Light Emitting Diode
LO	-	Laser Optimized
LSZH	-	Low Smoke Zero Halogen
m	-	Metre
m2	-	Square Metre
mA	-	Milliampere
MAC	-	Move, Add, or Change
MAN	-	Metropolitan Area Network
Mb	-	Megabit
MB	-	Megabyte
Mb/s	-	Megabit per Second
MB/s	-	Megabyte per Second
MC	-	Main Cross-connect
MDF	-	Main Distribution Frame
MGB	-	Main Grounding Busbar
MHz	-	Megahertz
mi	-	Mile
MIMS	-	Mineral Insulated Metal Sheathed
min	-	Minute
mm	-	Millimetre
MM	-	Multimode
MMF	-	Multimode Fibre

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Misc	-	Miscellaneous
MPP	-	Modular Patch Panel
ms	-	Millisecond
MSDS	-	Material Safety Data Sheet
MUTO	-	Multi-user Telecommunications Outlet
MUTOA	-	Multi-user Telecommunications Outlet Assembly
mW	-	Milliwatt
MW	-	Megawatt
NBCC	-	National Building Code of Canada
NESC	-	National Electrical Safety Code
NEXT	-	Near-end Crosstalk
NIC	-	Network Interface Card
NIR	-	Near-end crosstalk-to-Insertion loss Ratio
NRCC	-	National Research Council of Canada
OD	-	Outside Diameter
OEM	-	Original Equipment Manufacturer
OF	-	Optical Fibre
OSP	-	Outside Plant
PBX	-	Private Branch Exchange
PDU	-	Power Distribution Unit
PP	-	Patch Panel
PSACR	-	Power Sum Attenuation to Crosstalk Ratio
PSELFEXT	-	Power Sum Equal Level Far-End Crosstalk
PSNEXT	-	Power Sum Near-End Crosstalk
PVC	-	Polyvinyl Chloride
QA	-	Quality Assurance
QC	-	Quality Control
QoS	-	Quality of Service
Qty	-	Quantity
RCDD®	-	Registered Communications Distribution Designer
RF	-	Radio Frequency
RFI	-	Radio Frequency Interference
RJ	-	Registered Jack
rms	-	Root Mean Square
RU	-	Rack Unit (1.75")
RX	-	Receive
RX	-	Receiver
SAN	-	Storage Access Network
SC	-	Single Fibre Coupling Optical Fibre Connector
SCC	-	Standards Council of Canada
SCS	-	Structured Cabling System
ScTP	-	Screened Twisted Pair
SFTP	-	Screened Foiled Twisted Pair
SI	-	International System of Units (Le Système International d'Unités)
SLA	-	Service level Agreement
SM	-	Singlemode
SMF	-	Singlemode Fibre

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SNMP	-	Simple Network Management Protocol
SNR	-	Signal-to-Noise Ratio
STALPETH	-	Steel Aluminum Polyethylene
STP	-	Shielded Twisted Pair
STP-A	-	Shielded Twisted Pair A
T 1	-	Trunk Level 1
TBB	-	Telecommunications Bonding Backbone
TBBIBC	-	Telecommunications Bonding Backbone Interconnecting Bonding Conductor
TC	-	Telecommunications Closet
TDD	-	Telecommunications Device for the Deaf
TGB	-	Telecommunications Grounding Busbar
TGR	-	Telecommunications Grounding Rod
TIA	-	Telecommunications Industry Association
TMGB	-	Telecommunications Main Grounding Busbar
TP	-	Twisted Pair
TR	-	Telecommunications Room
TS	-	Technical Standard
TSB	-	Telecommunications Systems Bulletin (formerly Technical Systems Bulletin)
TTY	-	Teletypewriter / Text Telephone
TV	-	Television
TX	-	Transmit
TX	-	Transmitter
U	-	(When preceded by a numeral) Rack Unit (equal to 1.75")
UD	-	Underfloor Duct
UL <sup>®</sup>	-	Underwriters Laboratories Inc. <sup>®</sup>
ULC	-	Underwriters Laboratories of Canada
UPC	-	Universal Product Code
UPS	-	Uninterruptible Power Supply
UTP	-	Unshielded Twisted Pair
V	-	Volt
VA	-	Volt-Ampere
VCSEL	-	Vertical Cavity Surface Emitting Laser
VLAN	-	Virtual Local Area Network
VoIP	-	Voice over Internet Protocol
VPN	-	Virtual Private Network
W	-	Watt
WAN	-	Wide Area Network
WAP	-	Wireless Application Protocol
WiFi	-	Wireless Fidelity
Wi-Fi	-	Wireless Fidelity
WLAN	-	Wireless Local Area Network
WMAN	-	Wireless Metropolitan Area Network
WS	-	Workstation
WWAN	-	Wireless Wide Area Network
x	-	Mathematical Operation (Multiplication)
X	-	Cross-connect

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XC	-	Cross-connect
XLPE	-	Cross-linked Polyethylene
XPE-PVC	-	Expanded Polyethylene Polyvinyl Chloride

2 **PRODUCT**

2.1 **Not applicable to this Section.**

3 **EXECUTION**

3.1 **Not applicable to this Section.**

END OF SECTION

## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1. Comply with Section 27 00 03 – General Specifications and Requirements for Communications.

### **1.2 General**

- 1.2.1. The Communications Contractor shall adhere to all applicable codes, standards and regulations.
- 1.2.2. All equipment, products and installation methods shall adhere to all Codes and Standards having jurisdiction and as listed in this document.
- 1.2.3. The latest version, including technical bulletins and addenda will be applicable to all codes and standards.
- 1.2.4. If a conflict between codes and standards occur the most stringent code or standard will be applicable.
- 1.2.5. The following list highlights the typical applicable standards. All national and local codes and standards not listed for Products, Buildings, Fire, Health and Safety and Electrical will also apply.
- 1.2.6. All standards' addenda shall be included.
  - ANSI/TIA/EIA 568-B.1 - Commercial Building Telecommunications Cabling Standard: General Requirements
  - ANSI/TIA/EIA 568-B.2 - Commercial Building Telecommunications Cabling Standard: Balanced Twisted Pair Cabling
  - ANSI/TIA/EIA 568-B.3 - Commercial Building Telecommunications Cabling Standard: Optical Fibre Cabling Components Standard
  - ANSI/TIA/EIA 569-A - Commercial Building Standards for Telecommunications Pathways and Spaces. Including Addenda 1-6
  - ANSI/TIA/EIA 598-A - Optical Fibre Cable Color Coding
  - ANSI/TIA/EIA 570 - Residential and Light Commercial Telecommunications Wiring Standard
  - ANSI/TIA/EIA 604 - Fibre Optic Connector Intermateability Standard (Focis3)
  - ANSI/TIA/EIA 606 - Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
  - ANSI/TIA/EIA 607 - Commercial Building Grounding and Bonding Requirements for Telecommunications
  - ANSI/TIA/EIA 758 - Customer Owned Outside Plant Telecommunications Cabling Standard
  - CSA C22.1-98:21 - Canadian Electric Code Part I: Safety Standards for Electrical Installations

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CSA C22.2 No. 0	- Canadian Electric Code Part II: General Requirements (Communications Cables)
CSA C22.2 No. 181.4	- Plugs, Receptacles, and Connectors for Communication Systems
CSA C22.2 No. 214	- Communications Cables
CSA C22.2 No. 0	- Canadian Electric Code Part II: General Requirements (Communications Cables)
CSA C22.2 232 M1998	- Canadian Electric Code Part II: Optical Fibre Cables
CSA T527	- Grounding and Bonding for Telecommunications in Commercial Buildings
CSA T528	- Design Guidelines for Administration of Telecommunications Infrastructure in Commercial Buildings
CSA T529	- Design Guidelines for Telecommunications Wiring Systems in Commercial Buildings
CSA T530	- Building Facilities, Design Guidelines for Telecommunications
BICSI ITSIM	- Information Transport System Installation Manual
CAN/ULC S115	- Standard Method of Fire Tests of Fire stop Systems
CAN/ULC S101	- Standard Method of Fire Endurance Tests of Building Construction and Materials
CAN/ULC S102	- Standard Method of Testing for Surface Burning Characteristics of Building Materials and Assemblies
J-STD-607	- Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
TIA-222	- Structural Standards for Steel Antenna Towers and Antenna Supporting Structures
TIA-942	- Telecommunications Infrastructure Standards for Data Centers
CEC, Part 1	- The Canadian Electrical Code, Part 1
OESC	- Ontario Electrical Safety Code – 28 <sup>th</sup> Edition/2021
O.R. 388/97	- Ontario Fire Code
O.R. 332/12	- Ontario Building Code 2021
IEEE 802.3	- Information Technology – Telecommunications and Information Exchange Between Systems – Local and Metropolitan Area Networks p Specific Requirements Part 3 Carrier Sense Multiple Access with Collision
IEEE 802.11	- Local and Metropolitan Area Networks – Specific Requirements Part 11: Wireless LAN Medium Access Control and Physical Specifications
ANSI/ICEA S-80-576	- Communication Cables
ANSI/ICEA S-83-596	- Fibre Optic Premises Distribution Cable

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ANSI/ICEA S-83-640	- Fibre Optic Outside Plant Communications Cable
ANSI/ICEA Z136.2	- American Standards for the Safe Operation of Optical Fibre Communication Systems Utilizing Laser Diode and LED Sources
ANSI/TIA/EIA 455	- Fibre Optic Test Procedures
ANSI/TIA/EIA 492AAAA	- Detail Specification for 62.5-mm Core Diameter/125-mm Cladding Diameter Class Ia Multimode, Graded-Index Optical Waveguide Fibres
ANSI/TIA/EIA 492AAAB	- Detail Specification for 50.0-mm Core Diameter/125-mm Cladding Diameter Class Ia Multimode, Graded-Index Optical Waveguide Fibres
ANSI/TIA/EIA 492BAAA	- Detail Specification for Class IVa Dispersion-Unshifted Singlemode Optical Waveguide Fibres Used in Communications Systems
ANSI/TIA/EIA 472CAAA	- Detail Specification for All-Dielectric (Construction 1) Fibre Optic Communications Cable for Indoor Plenum Use, Containing Class Ia, 62.5 mm Core Diameter/125 Cladding Diameter Optical Fibre(s)
ANSI/TIA/EIA 472DAAA	- Detail Specification for All-Dielectric Fibre Optic Communications Cable for Outside Plant Use, Containing Class Ia, 62.5 mm Core Diameter/125 mm Cladding Diameter/250 mm Coating Diameter Optical Fibre(s)
ANSI INCITS 263	- Information Technology – Fibre Distributed Data Interface (FDDI) – Token Ring Twisted Pair Physical Layer Medium Dependent (TP-PMD)
CENELEC EN 50173	- Performance Requirements for Generic Cabling Schemes
FIPS PUB 174	- Commercial Building Telecommunications Wiring Standard. Federal Information Publication Standard
ICEA S-90-661	- Individually Unshielded Twisted Pair Indoor Cable for Use in Communications Wiring Systems
IEC 603-7, Part 7	- Detailed Specifications for Connectors, 8-Way, Including Fixed and Free Connectors with Common Mating Schemes
ISO/IEC IS 11801A	- Generic Cabling for Customer Premises
NEMA WC 63	- Performance Standard for Field Testing of Unshielded Twisted-Pair Cabling System
OHSA	- Occupational Health and Safety Act - R.S.O. 1990, c. 0-1

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UL 444 and 13	- Adopted Test and Follow-Up Service Requirements for The Optional Qualification of 100Ω Twisted-Pair
UL 1492	- Standard for Safety Audio-Video Products and Accessories
UL 813	- Standard for Commercial Audio Equipment
UL 983	- Standard for Surveillance Camera Units
UL 1459	- Standard for Telephone Equipment
UL 1950	- Standard for Information Technology Equipment
CEA CEB19	- Recommended Loudspeaker Safety Practices
CEA CPEB6-A R-2004	- Preferred Voltage and Impedances Values for the Interconnection of Audio Products
CEA 426-B R-2011 (ANSI)	- Loudspeaker, Optimum Amplifier Power
NCTA	- National Cable Television Association
NCTA-02/89 rev. 93	- NCTA Recommended Practices for Measurements on Cable Television Systems

## **2 PRODUCT**

### **2.1 Not applicable to this Section.**

## **3 EXECUTION**

### **3.1 Compliance to Codes and Standards**

- 3.1.1. The Communications Contractor shall install all equipment and material in accordance with the standards aforementioned in this section.
- 3.1.2. Quality and workmanship shall be at the highest of professional tradesman levels to be accepted for completion. The Technology Systems Consultant shall have the sole right to reject any work not in accordance with industry standards.
- 3.1.3. All work shall also be performed in accordance with the latest BICSI installation standards.
- 3.1.4. Communications Contractors shall provide installers trained in all applicable codes, standards, regulations, and installation standards.

**END OF SECTION**

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**1 GENERAL**

**1.1 Work Included**

- 1.1.1 Comply with Section 27 00 03 – General Specifications and Requirements for Audio-Visual Communications.

**1.2 General**

- 1.2.1 The Audio-Visual Communications Contractor shall adhere to all applicable codes, standards, and regulations.
- 1.2.2 All equipment, products and installation methods shall adhere to all Codes and Standards having jurisdiction and as listed in this document.
- 1.2.3 The latest version, including technical bulletins and addenda will be applicable to all codes and standards.
- 1.2.4 If a conflict between codes and standards occur the most stringent code or standard will be applicable.
- 1.2.5 The following list highlights the typical applicable standards. All national and local codes and standards not listed for Products, Buildings, Fire, Health and Safety and Electrical will also apply.

ANSI/TIA/EIA 568-B.1	- Commercial Building Telecommunications Cabling Standard: General Requirements
ANSI/TIA/EIA 568-B.2	- Commercial Building Telecommunications Cabling Standard: Balanced Twisted Pair Cabling
ANSI/TIA/EIA 568-B.3	- Commercial Building Telecommunications Cabling Standard: Optical Fibre Cabling Components Standard
ANSI/TIA/EIA 569-A	- Commercial Building Standards for Telecommunications Pathways and Spaces. Including Addenda 1-6
ANSI/TIA/EIA 598-A	- Optical Fibre Cable Color Coding
ANSI/TIA/EIA 570	- Residential and Light Commercial Telecommunications Wiring Standard
ANSI/TIA/EIA 604	- Fibre Optic Connector Intermateability Standard (Focis3)
ANSI/TIA/EIA 606	- Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
ANSI/TIA/EIA 607	- Commercial Building Grounding and Bonding Requirements for Telecommunications
ANSI/TIA/EIA 758	- Customer Owned Outside Plant Telecommunications Cabling Standard
CSA C22.1-98	- Canadian Electric Code Part I: Safety Standards for Electrical Installations
CSA C22.2 No. 181.4	- Plugs, Receptacles, and Connectors for

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	Communication Systems
CSA C22.2 No. 214	- Communications Cables
CSA C22.2 No. 0	- Canadian Electric Code Part II: General Requirements (Communications Cables)
CSA C22.2 232 M1998	- Canadian Electric Code Part II: Optical Fibre Cables
CSA T527	- Grounding and Bonding for Telecommunications in Commercial Buildings
CSA T528	- Design Guidelines for Administration of Telecommunications Infrastructure in Commercial Buildings
CSA T529	- Design Guidelines for Telecommunications Wiring Systems in Commercial Buildings
CSA T530	- Building Facilities, Design Guidelines for Telecommunications
BICSI ITSIM	- Information Transport System Installation Manual
CAN/ULC S115	- Standard Method of Fire Tests of Fire stop Systems
CAN/ULC S101	- Standard Method of Fire Endurance Tests of Building Construction and Materials
CAN/ULC S102	- Standard Method of Testing for Surface Burning Characteristics of Building Materials and Assemblies
J-STD-607	- Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
TIA-222	- Structural Standards for Steel Antenna Towers and Antenna Supporting Structures
TIA-942	- Telecommunications Infrastructure Standards for Data Centers
CEC, Part 1	- The Canadian Electrical Code, Part 1
OESC	- Ontario Electrical Safety Code – 25 <sup>th</sup> Edition/2012
O.R. 388/97	- Ontario Fire Code
O.R. 332/12	- Ontario Building Code 2012
IEEE 802.3	- Information Technology – Telecommunications and Information Exchange Between Systems – Local and Metropolitan Area Networks p Specific Requirements Part 3 Carrier Sense Multiple Access with Collision
IEEE 802.11	- Local and Metropolitan Area Networks – Specific Requirements Part 11: Wireless LAN Medium Access Control and Physical Specifications
ANSI/ICEA S-80-576	- Communication Cables
ANSI/ICEA S-83-596	- Fibre Optic Premises Distribution Cable
ANSI/ICEA S-83-640	- Fibre Optic Outside Plant Communications Cable
ANSI/ICEA Z136.2	- American Standards for the Safe Operation of

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	Optical Fibre Communication Systems Utilizing Laser Diode and LED Sources
ANSI/TIA/EIA 455	- Fibre Optic Test Procedures
ANSI/TIA/EIA 492AAAA	- Detail Specification for 62.5-mm Core Diameter/125-mm Cladding Diameter Class Ia Multimode, Graded-Index Optical Waveguide Fibres
ANSI/TIA/EIA 492AAAB	- Detail Specification for 50.0-mm Core Diameter/125-mm Cladding Diameter Class Ia Multimode, Graded-Index Optical Waveguide Fibres
ANSI/TIA/EIA 492BAAA	- Detail Specification for Class IVa Dispersion-Unshifted Singlemode Optical Waveguide Fibres Used in Communications Systems
ANSI/TIA/EIA 472CAAA	- Detail Specification for All-Dielectric (Construction 1) Fibre Optic Communications Cable for Indoor Plenum Use, Containing Class Ia, 62.5 mm Core Diameter/125 Cladding Diameter Optical Fibre(s)
ANSI/TIA/EIA 472DAAA	- Detail Specification for All-Dielectric Fibre Optic Communications Cable for Outside Plant Use, Containing Class Ia, 62.5 mm Core Diameter/125 mm Cladding Diameter/250 mm Coating Diameter Optical Fibre(s)
ANSI INCITS 263	- Information Technology – Fibre Distributed Data Interface (FDDI) – Token Ring Twisted Pair Physical Layer Medium Dependent (TP-PMD)
CENELEC EN 50173	- Performance Requirements for Generic Cabling Schemes
FIPS PUB 174	- Commercial Building Telecommunications Wiring Standard. Federal Information Publication Standard
ICEA S-90-661	- Individually Unshielded Twisted Pair Indoor Cable for Use in Communications Wiring Systems
IEC 603-7, Part 7	- Detailed Specifications for Connectors, 8-Way, Including Fixed and Free Connectors with Common Mating Schemes
ISO/IEC IS 11801A	- Generic Cabling for Customer Premises
NEMA WC 63	- Performance Standard for Field Testing of Unshielded Twisted-Pair Cabling System
OHSA	- Occupational Health and Safety Act - R.S.O. 1990, c. 0-1
UL 444 and 13	- Adopted Test and Follow-Up Service Requirements For The Optional Qualification of 100Ω Twisted-Pair
UL 1492	- Standard for Safety Audio-Visual Products and Accessories

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UL 813	- Standard for Commercial Audio Equipment
UL 983	- Standard for Surveillance Camera Units
UL 1459	- Standard for Telephone Equipment
UL 1950	- Standard for Information Technology Equipment
CEA-CEB19	- Recommended Loudspeaker Safety Practices
CEA-CPEB6-A R-2004	- Preferred Voltage and Impedances Values for the Interconnection of Audio Products
CEA-426-B R-2005 (ANSI)	- Loudspeaker, Optimum Amplifier Power
NCTA	- National Cable Television Association
NCTA-02/89 rev. 93	- NCTA Recommended Practices for Measurements on Cable Television Systems
ANSI/INFOCOMM 2M-2010	- Standard Guide for Audio Visual Systems

## **2 PRODUCT**

### **2.1 Not applicable to this Section.**

## **3 EXECUTION**

### **3.1 Compliance to Codes and Standards**

- 3.1.1 The Audio-Visual Communications Contractor shall install all equipment and material in accordance with the standards aforementioned in this section.
- 3.1.2 Quality and workmanship shall be at the highest of professional tradesman levels to be accepted for completion. The Technology Systems Consultant shall have the sole right to reject any work not in accordance with industry standards.
- 3.1.3 All work shall also be performed in accordance with the latest InfoComm installation standards.
- 3.1.4 Audio-Visual Communications Contractors shall provide installers trained in all applicable codes, standards, regulations, and installation standards.

**END OF SECTION**

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## **1 GENERAL**

### **1.1 Work Includes**

- 1.1.1. Comply with Section 27 00 03 – General Specifications and Requirements for Communications.

### **1.2 Acceptable Manufacturers – Copper Cabling**

- 1.2.1. All equipment and products supplied shall be new and free of all manufacturer defects and delivery or installation damage.
- 1.2.2. All equipment and products supplied shall meet all manufacturer listed characteristics as identified in the latest manufacturer catalogue.
- 1.2.3. All products shall meet all applicable codes and standards and bare the UL/ULC label, be CSA approved and meet FCC/CRTC Regulations.
- 1.2.4. All products shall be provided in accordance with local, provincial and national fire ratings for the installation on this project.
- 1.2.5. The only acceptable Manufacturers of an end-to-end solution for this project and as further specified in this document will be the following:

- .1 Belden
- .2 Hubbell
- .3 CommScope
- .4 Wirewerks

#### **1.2.6. Certification**

- .1 The Owner requires a complete “Permanent Link” tested and certified installation. Certification shall be provided by the specified and selected product manufacturer directly to the Owner for a period no less than 20 years.
- .2 The Communications Contractor is responsible for providing to the Technology Systems Consultant a copy of the application for certification with 5 days of project award.
- .3 Upon completion of the project the Communications Contractor shall deliver to the Technology Systems Consultant for the Owner a copy of the manufacturer’s warranty information, certificate and or plaque. This information shall accompany the final documentation described further in these specifications.
- .4 The Communications Contractor shall currently be an authorized installer of the manufacturer providing the warranty.

Belden	Certified Systems Vendor
Hubbell	Mission Critical Certified Contractor
CommScope	Certified Installer
Wirewerks	Certified System Vendor

- 1.2.7. Subcontractors shall not be acceptable to provide warranty unless pre-approved by the Technology Systems Consultant and the Owner at time of tender. Subcontractors will not be approved after tender is awarded.
- 1.2.8. The Communications Contractor shall provide a written 2 year warranty inclusive of all parts and labour for the end to end solution. The Communications Contractor shall also state and agree in writing to providing response for any warranty request within 24 hours during this warranty period.

### **1.3 Acceptable Manufacturers – Optical Fibre Cabling**

- 1.3.1. All equipment and products supplied shall be new and free of all manufacturer defects and delivery or installation damage.
- 1.3.2. All equipment and products supplied shall meet all manufacturer listed characteristics as identified in the latest manufacturer catalogue.
- 1.3.3. All products shall meet all applicable codes and standards and bare the UL/ULC label, be CSA approved and meet FCC/CRTC Regulations.
- 1.3.4. All products shall be provided in accordance with local, provincial and national fire ratings for the installation on this project.
- 1.3.5. The only acceptable Manufacturers of an end-to-end solution for this project and as further specified in this document will be the following:
  - .1 Corning
  - .2 Belden
  - .3 Hubbell
  - .4 CommScope
  - .5 Wirewerks
- 1.3.6. Certification
  - .1 The Owner requires a complete “Permanent Link” tested and certified installation. Certification shall be provided by the specified and selected product manufacturer directly to the Owner for a period no less than 20 years.
  - .2 The Communications Contractor is responsible for providing to the Technology Systems Consultant a copy of the application for certification with 5 days of project award.
  - .3 Upon completion of the project the Communications Contractor shall deliver to the Technology Systems Consultant for the Owner a copy of the manufacturer’s warranty information, certificate and or plaque. This information shall accompany the final documentation described further in these specifications.
  - .4 The Communications Contractor shall currently be an authorized installer of the manufacturer providing the warranty.

Corning  
Belden

Network of Preferred Installers (NPI)  
Certified Systems Vendor

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Hubbell	Mission Critical Certified Contractor
CommScope	Certified Installer
Wirewerks	Certified System Vendor

- 1.3.7. Subcontractors shall not be acceptable to provide warranty unless pre-approved by the Technology Systems Consultant and the Owner at time of tender. Subcontractors will not be approved after tender is awarded.
- 1.3.8. The Communications Contractor shall provide a written 2-year warranty inclusive of all parts and labour for the end to end solution. The Communications Contractor shall also state and agree in writing to providing response for any warranty request within 24 hours during this warranty period.

## **2 PRODUCT**

### **2.1 Not applicable to this Section.**

## **3 EXECUTION**

### **3.1 Scope**

- 3.1.1. The project consists of the fit-out of the (3) floors, for Region of Peel EMS, located at 6 Docksteader Rd in the city of Brampton.
- 3.1.2. The specific structured cabling system scope of this project includes but is not limited to:
- .1 Supply of five bound copies of shop drawings for all products prior to placing material order to acquire written approval from the Technology Systems Consultant.
  - .2 Supply and installation of J-hook and cable sling pathways as indicated in this specification.
  - .3 Supply and installation of 4-pair UTP horizontal copper cabling and related accessories to support end-user data applications.
  - .4 Supply and installation of 4-pair UTP horizontal copper cabling and related accessories to support end-user voice applications.
  - .5 Supply and installation of multipair copper cabling and related accessories to support data and/or voice applications over backbone.
  - .6 Supply and installation of optical fibre cabling and related accessories to support data and/or voice applications over backbone.
  - .7 Supply and installation of innerduct for optical fibre cabling.
  - .8 Supply and installation of new open racks, equipment, and accessories.
  - .9 Supply and installation of new AV cabinets, equipment, and accessories.
  - .10 Supply and installation of backboards.
  - .11 Supply and installation of all fire stop materials and/or mechanisms for all penetrations used for communications cabling.



- .12 Complete testing of each cable in a timely fashion and in coordination with other trades and services to ensure a completely tested system prior to activation by the Owner.
- .13 Supply temporary and final record drawings as specified.
- .14 Complete all final documentation requirements including documentation and site reviews to provide manufacturer's certification as per Section 27 00 11.

### **3.2 Phasing**

- 3.2.1. This project shall be completed in (1) one phase. Co-ordination with the Owners staff (including but not limited to the IT staff) and other trades is imperative and shall form part of the scope of this project. This installation will not necessarily be completed over a continuous time period and may be completed over two or more time periods to allow for co-ordination with other groups / trades.

**END OF SECTION**

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**1 GENERAL**

**1.1 Work Included**

- 1.1.1 Comply with Section 27 00 03 – General Specifications and Requirements for Audio-Visual Communications.

**1.2 Acceptable Manufacturers**

- 1.2.1 All equipment and products supplied shall be new and free of all manufacturer defects and delivery or installation damage.
- 1.2.2 All equipment and products supplied shall meet all manufacturer listed characteristics as identified in the latest manufacturer catalogue.
- 1.2.3 All products shall meet all applicable codes and standards and bear the UL/ULC label, be CSA approved and meet FCC/CRTC Regulations.
- 1.2.4 All products shall be provided in accordance with local, provincial, and national fire ratings for the installation on this project.

**1.3 Certification**

- 1.3.1 Upon completion of the project the Audio-Visual Communications Contractor shall deliver to the Technology Systems Consultant for the Owner a copy of the manufacturer's warranty information. This information shall accompany the final documentation described further in these specifications.
- 1.3.2 The Audio-Visual Communications Contractor shall currently be an authorized installer of the manufacturer providing the warranty.

**1.4 Warranty**

- 1.4.1 Subcontractors shall not be acceptable to provide warranty unless pre-approved by the Technology Systems Consultant and the Owner at time of tender. Subcontractors will not be approved after tender is awarded.
- 1.4.2 The Audio-Visual Communications Contractor shall provide a written 2-year warranty inclusive of all parts and labour for the end to end solution. The Audio-Visual Communications Contractor shall also state and agree in writing to providing response for any warranty request within 24 hours during this warranty period.

**2 PRODUCT**

- 2.1 **Not applicable to this Section.**

**3 EXECUTION**

**3.1 Scope**

- 3.1.1 The project consists of the fit-out of the two (3) floors for Region of Peel EMS Dockstader, located at 6 Dockstader Rd, Brampton.

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- 3.1.2 The Audio-Visual Communications Contractor(s) shall be responsible for the complete installation of the following system(s):
- .1 Audio system.
  - .2 Video system.
  - .3 Control Systems
- 3.1.3 The work in these subsystems shall include, supply and installation of cabling on Audio-Visual Communications Contractor installed J- hooks and pathways (some pathways may be shown to be installed by Division 26, refer to drawings and details), equipment racks and/or cabinets, controllers, amplifiers, projectors, screens, speakers, assistive listening devices, grounding and bonding, fire stopping and project documentation.
- 3.1.4 The specific Audio-Visual System scope of this project includes but is not limited to:
- .1 Supply of one (1) PDF format of shop drawings for all products prior to placing material order to acquire written approval from the Technology Systems Consultant.
  - .2 Preparation of connectivity diagrams.
  - .3 Supply and installation of Commercial displays and Interactive displays as specified.
  - .4 Supply and installation of display wall mounts and poles.
  - .5 Supply and installation of electronic control system.
  - .6 Supply and installation of wall and table top touch panels as specified.
  - .7 Supply and installation of digital signal processor.
  - .8 Supply and installation of Projector and projector screen.
  - .9 Supply and installation of AV rack.
  - .10 Supply and installation of wall input plates.
  - .11 Supply and installation of Video conferencing equipment
  - .12 Supply and installation of ceiling and goose neck microphones.
  - .13 Supply and installation of ceiling speakers.
  - .14 Supply and installation of PTZ cameras.
  - .15 Supply and installation of Airmedia.
  - .16 Installation of Owner supplied content player.
  - .17 Supply and installation of AV network.
  - .18 Supply and installation of Control Software on client PC's.
  - .19 Supply and installation of cabling, connectors, and accessories. All cabling, without exception, shall be Plenum (CMP/FT6) rated cabling. Assume all cabling in ceiling spaces require j-hooks.
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- .20 Supply and installation of all fire stop materials and/or mechanisms for all penetrations used for Audio-Visual cabling.
  - .21 Complete installation, testing, verification, and fine tuning of all video components to ensure acceptance by the owner.
  - .22 Complete programming of the Crestron control units and provide client training. Programming requirements shall include client interview(s) as required to determine client programming and functionality requirements. Assume all equipment capabilities are to be used and reflected in the programming for bidding purposes to capture all potential programming costs. No additional costs for programming shall be allowed. A copy of all programming (soft copy) shall be submitted to client for record and safe keeping as part of the record documentation.
  - .23 Complete testing of each piece of equipment and cable in a timely fashion and in coordination with other trades and services to ensure a completely tested system(s) prior to acceptance by the Owner.
  - .24 Supply final record drawings as specified.
  - .25 Complete all final documentation requirements including documentation and site reviews to provide manufacturer's warranty.

### 3.2 **Phasing**

- 3.2.1 This project shall be completed in (1) one phase. Co-ordination with the Owners staff (including but not limited to the IT staff) and other trades is imperative and shall form part of the scope of this project. This installation will not necessarily be completed over a continuous time period and may be completed over two or more time periods to allow for co-ordination with other groups / trades.

**END OF SECTION**

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## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1. Comply with Section 27 00 03 – General Specifications and Requirements for Communications.

### **1.2 Shop Drawings**

- 1.2.1. Provide 5 copies of manufacturer prepared shop drawings identifying complete technical specifications for each product being supplied as part of the end-to-end solution including fire stopping, pathways and other miscellaneous products.
- 1.2.2. Shop drawings shall be stamped and signed “For Review” complete with date submitted.
- 1.2.3. Manufacturers shop drawings showing various model or styles shall be labelled with identification arrows showing which items are being proposed. Arrows shall be reproducible through standard photocopying.
- 1.2.4. Shop drawings shall be approved by the Technology Systems Consultant prior to starting installation and the Communications Contractor will be responsible for the cost of replacing of all installed product not approved.
- 1.2.5. Approved shop drawings shall be included in the Project Manual for this project.

### **1.3 Project Documentation**

- 1.3.1. The Communications Contractor shall provide digitally marked record drawings showing all cable numbers on floor plans, rack elevations, backboard layouts and cable routing at the completion of the project. Drawings shall include all architectural and project changes. Provide within ten (10) days of completion of the project one (1) PDF copy for use by the Technology Systems Consultant.
- 1.3.2. The Communications Contractor shall prepare record drawing(s) using AutoCAD or better. The Communications Contractor shall issue one (1) AutoCAD copy and one (1) PDF copy of record drawings within ten (10) days of project completion. If the Communications Contractor cannot comply with this requirement, Spectech will update all hand drawn record drawings to AutoCAD. The cost for this service shall be based on per diem rates at the time of completion. The Communications Contractor shall be responsible for the costs associated with this work.
- 1.3.3. Prepare a complete test report for each cable identifying a successful test on each cable, complete with the technician’s signature and date. Test reports shall be full test reports in the testing software format and with one page per cable. Provide 1 soft copy on USB of test results with appropriate viewing software to the Technology Systems Consultant within ten (10) days of project completion for approval.

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- 1.3.4. At the completion of the project be prepared to submit 1 copy of a project manual in a digital PDF copy to the Technology Systems Consultants for review and approval. This project manual shall include:
- .1 Contractor's Name, contact information and lead installer/foreman's contact info
  - .2 Letter detailing, total cost of project (including changes), square footage, number of cable drops, project highlights, Architect/Interior Designer and Owner name and contact information.
  - .3 Final bill of materials
  - .4 Approved shop drawings
  - .5 WIMS data sheets on all applicable materials including fire stopping
  - .6 Maintenance and/or operation manuals for all equipment
  - .7 Connectivity database
  - .8 Test results
  - .9 Record drawings
  - .10 Letter of 2 year installation warranty
  - .11 Manufacturer's Certification and warranty documentation
- 1.3.5. Upon written approval from the Technology Systems Consultant prepare (3) additional project manuals for distribution to the Owner.
- 1.3.6. The Communications Contractor shall prepare a separate Data and Voice Connectivity Database in MS Excel spreadsheet format that includes but not limited to the following:
- .1 Data - Horizontal cable number, active equipment port, backbone cable/strand and Owner assigned designation.
  - .2 Voice - Horizontal cable number, backbone pair, Telephone Switch/Node (TN) and Owner assigned designation.
  - .3 Provide (1) soft copy for the Owners use prior to move in.
- 1.3.7. Final documentation not provided within 30 days of project completion and with reasonable notification may result in the commissioning of another agent to prepare such documents. Costs for this work will be deducted from all Holdback amounts available to the Communications Contractor.

#### **1.4 Site Documentation**

- 1.4.1. The Communications Contractor shall be responsible for maintaining a complete set of record marked up drawings on site for the Technology Systems Consultants review at all times. Drawings shall be up to date with all architectural and project changes.
- 1.4.2. Maintain a log of date, time, and reason for any delays in performing the installation. Details shall include names, conditions, and specific reason for delay.

## **2 PRODUCT**

### **2.1 Documentation Requirements**

2.1.1. The following items shall be delivered as scheduled after project award:

Delivery Item	Delivery Schedule	Presentation
Connectivity Diagrams (PDF)	10 days after project award	Email/Electronic PDF
Shop Drawings (PDF)	10 days after project award	Email/Electronic PDF
Monthly Draw Breakdown (PDF)	10 days after project award	Email/Electronic PDF

2.1.2. The following items shall be kept up to date during project construction.

Delivery Item	Delivery Schedule	Presentation
Continuously Updated Drawings	During construction on-site	Electronic PDF

2.1.3. The following items shall be delivered after project completion in a binder:

Delivery Item	Delivery Schedule	Presentation
Contractor's Information	10 Days after Cutover	Electronic PDF
Project Details	10 Days after Cutover	Electronic PDF
Final Bill of Materials	10 Days after Cutover	Electronic PDF
Approved Shop Drawings	10 Days after Cutover	Electronic PDF
WIMS Data Sheets	10 Days after Cutover	Electronic PDF
Maintenance / operation manuals	10 Days after Cutover	Electronic PDF
Record Test Results	10 Days after Cutover	Electronic PDF
Record Drawings (PDF)	10 Days after Cutover	Electronic PDF
Contractor's 2 Year Warranty	10 Days after Cutover	Electronic PDF
Manufacturer Warranty	10 Days after Cutover	Electronic PDF
Programming	10 Days after Cutover	Electronic PDF

- 2.1.4. Should the Owner or General Contractor require hardcopies of any documents listed here as to be provided in an electronic format, the Communications Contractor shall provide as requested at no additional cost.

### **3 EXECUTION**

**3.1 Not applicable to this Section.**

**END OF SECTION**



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**1 GENERAL**

**1.1 Work Included**

- 1.1.1 Comply with Section 27 00 03 – General Specifications and Requirements for Audio-Visual Communications.

**1.2 Connectivity Diagram(s)**

- 1.2.1 Provide connectivity diagram(s), prepared by using AutoCAD, in PDF format prior to installation.

**1.3 Shop Drawings**

- 1.3.1 Provide 1 PDF format of manufacturer prepared shop drawings identifying complete technical specifications for each product being supplied as part of the solution including fire stopping, pathways and other miscellaneous products.
- 1.3.2 Shop drawings shall be stamped and signed “For Review” complete with date submitted.
- 1.3.3 Manufacturers shop drawings showing various model or styles shall be labelled with identification arrows showing which items are being proposed. Arrows shall be reproducible through standard photocopying.
- 1.3.4 Shop drawings shall be approved by the Technology Systems Consultant prior to starting installation and the Audio-Visual Communications Contractor will be responsible for the cost of replacing of all installed product not approved.
- 1.3.5 Approved shop drawings shall be included in the Project Manual for this project.

**1.4 Project Documentation**

- 1.4.1 The Audio-Visual Communications Contractor shall provide hand marked record drawings showing all cable numbers on floor plans, rack elevations, and cable routing at the completion of the project. Drawings shall include all architectural and project changes. Provide within ten (10) days of completion of the project two (2) hard copies for use by the Technology Systems Consultant.
- 1.4.2 At the completion of the project, be prepared to submit one (1) copy of a project manual on a DVD to the Technology Systems Consultants for review and approval. This project manual shall include:
- .1 Contractor’s Name, contact information and lead installer/foreman’s contact info
  - .2 Letter detailing, total cost of project (including changes), square footage, project highlights, Architect/Interior Designer and Owner name and contact information.
  - .3 Final bill of materials
  - .4 Approved shop drawings
  - .5 WIMS data sheets on all applicable materials including fire stopping

- .6 Maintenance and/or operation manuals for all equipment
- .7 Test results
- .8 Record drawings
- .9 Letter of 2 year installation warranty
- .10 Manufacturer's warranty documentation
- 1.4.3 Upon written approval from the Technology Systems Consultant prepare (2) additional project manuals for distribution to the Owner.
- 1.4.4 Final documentation not provided within 30 days of project completion and with reasonable notification may result in the commissioning of another agent to prepare such documents. Costs for this work will be deducted from all Holdback amounts available to the Audio-Visual Communications Contractor.

## 1.5 **Site Documentation**

- 1.5.1 The Audio-Visual Communications Contractor shall be responsible for maintaining a complete set of record marked up drawings on site for the Technology Systems Consultants review at all times. Drawings shall be up to date with all architectural and project changes.
- 1.5.2 Maintain a log of date, time, and reason for any delays in performing the installation. Details shall include names, conditions, and specific reason for delay.

## 2 **PRODUCT**

### 2.1 **Documentation Requirements**

- 2.1.1 The following items shall be delivered as scheduled after project award:

Delivery Item	Delivery Schedule	Presentation
Connectivity Diagrams (PDF)	10 days after project award	Email/ Electronic PDF
Shop Drawings (PDF)	10 days after project award	Email/ Electronic PDF
Monthly Draw Breakdown (PDF)	10 days after project award	Email/ Electronic PDF

- 2.1.2 The following items shall be kept up to date during project construction.

Delivery Item	Delivery Schedule	Presentation
Continuously Updated Drawings	During construction on-site	Electronic PDF

- 2.1.3 The following items shall be delivered after project completion in a binder:

Delivery Item	Delivery Schedule	Presentation
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Contractor's Information	10 Days after Cutover	Electronic PDF
Project Details	10 Days after Cutover	Electronic PDF
Final Bill of Materials	10 Days after Cutover	Electronic PDF
Approved Shop Drawings	10 Days after Cutover	Electronic PDF
WIMS Data Sheets	10 Days after Cutover	Electronic PDF
Maintenance / operation manuals	10 Days after Cutover	Electronic PDF
Record Test Results	10 Days after Cutover	Electronic PDF
Record Drawings	10 Days after Cutover	Electronic PDF
Record Drawings (PDF)	10 Days after Cutover	Electronic PDF
Contractor's 2 Year Warranty	10 Days after Cutover	Electronic PDF
Manufacturer Warranty	10 Days after Cutover	Electronic PDF
Programming	10 Days after Cutover	Electronic PDF

2.1.4 Should the Owner or General Contractor require hardcopies of any documents listed here as to be provided in an electronic format, the Audio-Visual Communications Contractor shall provide as requested at no additional cost.

### **3 EXECUTION**

#### **3.1 Not applicable to this Section.**

**END OF SECTION**

## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1. Comply with Section 27 00 03 – General Specifications and Requirements for Communications.

### **1.2 General**

- 1.2.1. Use only fire stopping products that have been tested for specific fire resistance rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire rating involved for each separate instance.

### **1.3 Materials**

- 1.3.1. Products manufactured by Hilti, Specified Technologies Inc. (STI), or equivalent are acceptable.
- 1.3.2. Obtain fire stop systems for each type of penetration and construction condition indicated from a single manufacturer (i.e. Do not mix manufacturers for the same type of penetration).

### **1.4 Performance Requirements**

- 1.4.1. Fire Stop Systems shall conform to the fire (F), hose (H) and temperature (T) ratings of Codes and shall have a flame spread rating of 25 or less, National Fire Protection Association (NFPA Class "A").
- 1.4.2. Fire Stop Systems acceptable for this project are those that have been tested to the CAN/ULC S115 Standard.
- 1.4.3. Fire Stop Systems shall be CSA approved, non-permanent, dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming or backer materials.
- 1.4.4. Fire stopping shall maintain a minimum one-hour rating, meet applicable Federal, Provincial, Local building codes, and be tested by a SCC and accredited Third Party Testing Agency in accordance with the Standards.
- 1.4.5. In locations containing high moisture, fire stopping shall be compatible with Formalin.
- 1.4.6. Fire rated fittings allowing easy cable additions may be used. All non-permanent caulking or foams shall be replaced with the removal or addition of any cabling before final acceptance by the owner.
- 1.4.7. Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, add-ons and changes will occur.
- 1.4.8. Where non-mechanical products are utilized, provide products that upon curing do no re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water, or other forms of moisture characteristic during or after construction.

- 1.4.9. Where it is not practical to use a mechanical device, openings within floors and walls designed to accommodate communications cabling shall be provided with re-enterable products that do not cure or dry.
- 1.4.10. Openings for cable trays shall be sealed using re-enterable fire stopping pillows.

## **1.5 Quality Assurance**

- 1.5.1. Products/Systems: Provide fire stopping systems that comply with the following requirements:
  - .1 Fire stopping tests are performed by a qualified, testing and inspection agency. A qualified testing and inspection agency is UL, or another agency performing testing and follow-up inspection services for fire stop system acceptable to authorities having jurisdiction.
  - .2 Fire stopping products bear the classification marking of qualified testing and inspection agency.
- 1.5.2. Installer Qualifications: Experience in performing work of this section who is qualified by the fire stopping manufacturer as having been provided the necessary training to install fire stop products in accordance with specified requirements.

## **1.6 Delivery, Storage and Handling**

- 1.6.1. Manufacturer's original, unopened, undamaged containers, identification labels intact identifying product and manufacturer, date of manufacture; lot number; shelf life, if applicable; qualified testing and inspection agency's classification marking; and mixing instruction for multicomponent products.
- 1.6.2. Handle and store products according to manufacturer's recommendations published in technical materials. Leave products wrapped or otherwise protected and under clean and dry storage conditions until required for installation.
- 1.6.3. Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

## **1.7 Project Conditions**

- 1.7.1. Do not install fire stopping products when ambient or substrate temperatures are outside limitations recommended by manufacturer.
- 1.7.2. Do not install fire stopping products when substrates are wet due to rain, frost, condensation, or other causes.
- 1.7.3. Maintain minimum temperature before, during, and for a minimum 3 days after installation of materials.
- 1.7.4. Do not use materials that contain flammable solvents.
- 1.7.5. Coordinate construction of openings and penetrating items to ensure that through-penetration fire stop systems are installed according to specified requirements.

- 1.7.6. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration fire stop systems.
- 1.7.7. Schedule installation of fire stopping after completion of penetrating item installation but prior to covering or concealing of openings.
- 1.7.8. Supply and install temporary fire stopping at the end of every work shift or when location of work is changing from one work area to another. This shall be done to maintain the penetration's fire rating in areas where no work is being done.

## **2 PRODUCT**

### **2.1 Fire Stop Grommets & Discs**

- 2.1.1. STI SpecSeal Brand molded two-piece grommet having a foam fire and smoke sealing membrane that conforms to the outside diameter of the individual cable.
- 2.1.2. Shall be used only for penetrations of only 1 (one) or 2 (two) individual 4-pair UTP or F/STP cables.

Specified Product:

	Part No.	# Of Cables	Hole Diameter
Hilti	CFS-D	1	1" (25mm)
Specified Technologies Inc. (STI)	RFG1	1	9/16" (14mm)
Specified Technologies Inc. (STI)	RFG2	2	1" (25mm)

### **2.2 Fire Stop Sealants**

- 2.2.1. STI SpecSeal® Brand single component latex formulations that upon cure do not re-emulsify during exposure to moisture.

Specified Product:

Hilti	CP 606 FS-ONE MAX Sealant
Specified Technologies Inc. (STI)	SpecSeal® Series SSS Sealant
Specified Technologies Inc. (STI)	SpecSeal® Series LCI Sealant

### **2.3 Fire Stop Putty**

- 2.3.1. STI SpecSeal® Brand intumescent, non-hardening, water resistant putties containing no solvents, inorganic fibres or silicone compounds.

Specified Product:

Hilti	CP 617 Firestop Putty Pads
Hilti	CP 618 Firestop Putty Stick
Specified Technologies Inc. (STI)	SpecSeal® Series SSP Putty

## **2.4 Fire Rated Cable Pathways**

- 2.4.1. STI EZ-PATH™ Brand device modules comprised of steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill.

Specified STI Products:

EZ-Path Multi-Gang Wall Bracket	EZP544W
EZ-Path (No Options)	EZD44
Single EZ-Path Kit	EZDP44

Only where wall thickness exceeds 10" use the following.

(adjust quantity of EZ-Path units and accessories to suit cable quantity):

Single EZ-PATH Kit	EZDP33FWS
Two Gang EZ-PATH Kit	EZDP233GK
Three Gang EZ-PATH Kit	EZDP333GK
Four Gang EZ-PATH Kit	EZDP433GK
Radius Control Module	RCM33
Extension Module	EZD33E

Specified Hilti Products:

Firestop Gang Plate	CFS-SL GP
Single Speed Sleeve Kit	CFS-SL SK

Only where wall thickness exceeds 10" use the following

(adjust quantity of Sleeve units and accessories to suit cable quantity):

Single Speed Sleeve Kit	CP 653
Two Gang Speed Sleeve Kit	CFS-SL GP, CFS-SL GP CAP, and Speed Sleeves
Three Gang Speed Sleeve Kit	CFS-SL GP and Speed Sleeves
Four Gang Speed Sleeve Kit	CFS-SL GP and Speed Sleeves
Extended Speed Sleeve	CFS-SL GA L

## **3 EXECUTION**

### **3.1 Examination**

- 3.1.1. Before beginning installation, verify that substrate conditions previously installed under other sections are acceptable for installation of fire stopping in accordance with manufacturer's installation instructions and technical information.
- 3.1.2. Surfaces shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellents, and any other substances that may inhibit optimum adhesion.
- 3.1.3. Provide masking and temporary covering to protect adjacent surfaces.
- 3.1.4. Do not proceed until unsatisfactory conditions have been corrected.

**3.2     Installation**

- 3.2.1.     Install through-penetration fire stop systems in accordance with Performance Criteria and in accordance with the conditions of testing and classification as specified in the published design.
- 3.2.2.     Comply with manufacturer's instructions for installation of fire stopping products.

**3.3     Field Quality Control**

- 3.3.1.     Keep areas of work accessible until inspection by authorities having jurisdiction.
- 3.3.2.     Where deficiencies are found, repair fire stopping products so they comply with requirements.

**3.4     Non-Monitored Penetrations**

- 3.4.1.     Where fire watch is not in effect, or the Communications Contractor has not been able to confirm whether fire watch is in effect, all fire penetrations, whether all cables have been pulled or not, removed or not, shall be fire stopped at the end of every workday prior to the Communications Contractor leaving the site. At no time shall a penetration be un-attended or without fire stopping material in areas where work is not in progress.

**END OF SECTION**



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**1 GENERAL**

**1.1 Work Included**

- 1.1.1 Comply with Section 27 00 03 – General Specifications and Requirements for Audio-Visual Communications.

**1.2 General**

- 1.2.1 Use only fire stopping products that have been tested for specific fire resistance rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire rating involved for each separate instance.

**1.3 Materials**

- 1.3.1 Products manufactured by Hilti, Specified Technologies Inc. (STI), or equivalent are acceptable.
- 1.3.2 Obtain fire stop systems for each type of penetration and construction condition indicated from a single manufacturer (i.e. Do not mix manufacturers for the same type of penetration).

**1.4 Definitions**

- 1.4.1 Fire stopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies.
- 1.4.2 Smoke and Acoustical Sealing: Material or combination of materials used to maintain an effective barrier against the spread of smoke and hot gases, and to restore the STC rating in through penetrations in non-fire rated wall and floor assemblies.

**1.5 Performance Requirements**

- 1.5.1 Fire Stop Systems shall conform to the fire (F), hose (H) and temperature (T) ratings of Codes and shall have a flame spread rating of 25 or less, National Fire Protection Association (NFPA Class "A").
- 1.5.2 Fire Stop Systems acceptable for this project are those that have been tested to the CAN/ULC S115 Standard.
- 1.5.3 Fire Stop Systems shall be CSA approved, non-permanent, dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming or backer materials.
- 1.5.4 Fire stopping shall maintain a minimum one-hour rating, meet applicable Federal, Provincial, Local building codes, and be tested by a SCC and accredited Third Party Testing Agency in accordance with the Standards.
- 1.5.5 In locations containing high moisture, fire stopping shall be compatible with Formalin.

- 1.5.6 Fire rated fittings allowing easy cable additions may be used. All non-permanent caulking or foams shall be replaced with the removal or addition of any cabling before final acceptance by the owner.
- 1.5.7 Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, add-ons and changes will occur.
- 1.5.8 Where non-mechanical products are utilized, provide products that upon curing do no re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during or after construction.
- 1.5.9 Where it is not practical to use a mechanical device, openings within floors and walls designed to accommodate communications cabling shall be provided with re-enterable products that do not cure or dry.
- 1.5.10 Openings for cable trays shall be sealed using re-enterable fire stopping pillows.

**1.6 Quality Assurance**

- 1.6.1 Products/Systems: Provide fire stopping systems that comply with the following requirements:
  - .1 Fire stopping tests are performed by a qualified, testing and inspection agency. A qualified testing and inspection agency is UL, or another agency performing testing and follow-up inspection services for fire stop system acceptable to authorities having jurisdiction.
  - .2 Fire stopping products bear the classification marking of qualified testing and inspection agency.
- 1.6.2 Installer Qualifications: Experience in performing work of this section who is qualified by the fire stopping manufacturer as having been provided the necessary training to install fire stop products in accordance with specified requirements.

**1.7 Delivery, Storage and Handling**

- 1.7.1 Manufacturer's original, unopened, undamaged containers, identification labels intact identifying product and manufacturer, date of manufacture; lot number; shelf life, if applicable; qualified testing and inspection agency's classification marking; and mixing instruction for multicomponent products.
- 1.7.2 Handle and store products according to manufacturer's recommendations published in technical materials. Leave products wrapped or otherwise protected and under clean and dry storage conditions until required for installation.
- 1.7.3 Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

**1.8 Project Conditions**

- 1.8.1 Do not install fire stopping products when ambient or substrate temperatures are outside limitations recommended by manufacturer.

- 1.8.2 Do not install fire stopping products when substrates are wet due to rain, frost, condensation, or other causes.
- 1.8.3 Maintain minimum temperature before, during, and for a minimum 3 days after installation of materials.
- 1.8.4 Do not use materials that contain flammable solvents.
- 1.8.5 Coordinate construction of openings and penetrating items to ensure that through-penetration fire stop systems are installed according to specified requirements.
- 1.8.6 Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration fire stop systems.
- 1.8.7 Schedule installation of fire stopping after completion of penetrating item installation but prior to covering or concealing of openings.
- 1.8.8 Supply and install temporary fire stopping at the end of every work shift or when location of work is changing from one work area to another. This shall be done to maintain the penetration's fire rating in areas where no work is being done.

## **2 PRODUCT**

### **2.1 Fire Stop Grommets & Discs**

- 2.1.1 Shall be used only for penetrations of individual 4-pair UTP or F/STP cables.

Specified Product:

	Part No.	# Of Cables	Hole Diameter
Hilti	CFS-D	1	1" (25mm)
Specified Technologies Inc. (STI)	RFG1	1	9/16" (14mm)
Specified Technologies Inc. (STI)	RFG2	2	1" (25mm)

### **2.2 Fire Stop Sealants**

- 2.2.1 Single component latex formulations that upon cure do not re-emulsify during exposure to moisture.

Specified Product:

Hilti	CP 606 FS-ONE MAX Sealant
Specified Technologies Inc. (STI)	SpecSeal® Series SSS Sealant
Specified Technologies Inc. (STI)	SpecSeal® Series LCI Sealant

### **2.3 Fire Stop Putty**

- 2.3.1 Intumescent, non-hardening, water resistant putties containing no solvents, inorganic fibres or silicone compounds.

Specified Product:

Hilti	CP 617 Firestop Putty Pads
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Hilti	CP 618 Firestop Putty Stick
Specified Technologies Inc. (STI)	SpecSeal® Series SSP Putty

## 2.4 **Fire Rated Cable Pathways**

2.4.1 Device modules comprised of steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill.

Specified STI Products:	
EZ-Path Multi-Gang Wall Bracket	EZP544W
EZ-Path (No Options)	EZD44
Single EZ-Path Kit	EZDP44

Only where wall thickness exceeds 10" use the following  
(Adjust quantity of EZ-Path units and accessories to suit cable quantity):

Single EZ-PATH Kit	EZDP33FWS
Two Gang EZ-PATH Kit	EZDP233GK
Three Gang EZ-PATH Kit	EZDP333GK
Four Gang EZ-PATH Kit	EZDP433GK
Radius Control Module	RCM33
Extension Module	EZD33E

Specified Hilti Products:	
Firestop Gang Plate	CFS-SL GP
Single Speed Sleeve Kit	CFS-SL SK

Only where wall thickness exceeds 10" use the following  
(Adjust quantity of Sleeve units and accessories to suit cable quantity):

Single Speed Sleeve Kit	CP 653
Two Gang Speed Sleeve Kit	CFS-SL GP, CFS-SL GP CAP, and Speed Sleeves
Three Gang Speed Sleeve Kit	CFS-SL GP and Speed Sleeves
Four Gang Speed Sleeve Kit	CFS-SL GP and Speed Sleeves
Extended Speed Sleeve	CFS-SL GA L

## 3 **EXECUTION**

### 3.1 **Examination**

3.1.1 Before beginning installation, verify that substrate conditions previously installed under other sections are acceptable for installation of fire stopping in accordance with manufacturer's installation instructions and technical information.

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- 3.1.2 Surfaces shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellents, and any other substances that may inhibit optimum adhesion.
  - 3.1.3 Provide masking and temporary covering to protect adjacent surfaces.
  - 3.1.4 Do not proceed until unsatisfactory conditions have been corrected.
  - 3.2 **Installation**
    - 3.2.1 Install through-penetration fire stop systems in accordance with Performance Criteria and in accordance with the conditions of testing and classification as specified in the published design.
    - 3.2.2 Comply with manufacturer's instructions for installation of fire stopping products.
  - 3.3 **Field Quality Control**
    - 3.3.1 Keep areas of work accessible until inspection by authorities having jurisdiction.
    - 3.3.2 Where deficiencies are found, repair fire stopping products, so they comply with requirements.
  - 3.4 **Non-Monitored Penetrations**
    - 3.4.1 Where fire watch is not in effect, or the Audio-Visual Communications Contractor has not been able to confirm whether fire watch is in effect, all fire penetrations, whether all cables have been pulled or not, removed or not, shall be fire stopped at the end of every workday prior to the Audio-Visual Communications Contractor leaving the site. At no time shall a penetration be un-attended or without fire stopping material in areas where work is not in progress.

**END OF SECTION**

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## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1 Comply with Section 27 00 03 – General Specifications and Requirements for Communications.

### **1.2 General**

- 1.2.1 All cables and related terminations, support and grounding hardware shall be furnished, installed, wired, tested, labelled, and documented by the Communications Contractor as detailed in this section.
- 1.2.2 Product specifications, general design considerations and installation guidelines are provided in this section.
- 1.2.3 The Communications Contractor shall meet or exceed all requirements for the cable system described in this section.
- 1.2.4 Local electrical codes shall be adhered to.
- 1.2.5 Local building codes shall be adhered to.
- 1.2.6 All communications components including, entrance lugs, entrance terminal frames, racks, cabinets, cable tray, ladder racks, metallic pathways, enclosures, and other components noted on drawings shall be bonded to an independent grounding system and in accordance with local codes and standards, TIA/EIA J-STD-607-A, ANSI/TIA-942 and IEEE Std.1100 and these specifications.
- 1.2.7 Labelling shall conform to TIA/EIA-606.
- 1.2.8 Grounding system shall include a local copper Telecommunications Grounding Busbar (by Division 26) in each entrance facility and equipment room bonded to a Telecommunications Grounding Backbone (by Division 26).
- 1.2.9 The TBB shall be bonded directly to the Telecommunications Main Grounding Busbar (by Division 26). The TMGB shall be bonded directly to the building entrance grounding system and meet all local codes and standards as noted above.
- 1.2.10 The grounding system shall be visually verifiable and adequately sized to handle expected currents safely.
- 1.2.11 All grounding conductors and busbars shall be made of copper.
- 1.2.12 The grounding system shall be intentional, visually verifiable, adequately sized to handle expected currents safely, and direct these currents away from network equipment. As such, grounding shall be purposeful in its design and installation.
- 1.2.13 Lugs, HTAPs, grounding strips, and busbars shall be UL Listed, and CSA certified and made of premium quality tin-plated electrolytic copper that provides low electrical resistance while inhibiting corrosion. Antioxidant shall be used when making bonding connections in the field.

### **1.3 Lugs**

- 1.3.1 Wherever possible, two-hole lugs shall be used. All lugs shall be irreversible compression. Lugs with inspection windows shall be used in all non-corrosive environments so that connections may be inspected for full conductor insertion (battery rooms are an exception where windowless lugs may be used).
- 1.3.2 Die index numbers shall be embossed on all compression connections to allow crimp inspection.

### **1.4 Cable Assemblies**

- 1.4.1 Cable assemblies shall be UL Listed and CSA Certified. Cables shall be a distinctive green or green/yellow in color, and all jackets shall be UL, VW-1 flame rated.

### **1.5 Telecommunications Grounding Busbar**

- 1.5.1 The Telecommunications Grounding Busbar (TGB) shall be supplied and installed by Division 26.

### **1.6 Telecommunications Bonding Backbone Requirements**

- 1.6.1 The Telecommunications Grounding Busbar within each telecommunications space shall be bonded to the building ground riser with a Telecommunications Bonding Backbone. The TGB and the TBB shall be supplied and installed by Division 26.
- 1.6.2 The gauge of the TBB shall be determined based on TIA/EIA J-STD-607-A. The table below is shown for reference.

TBB Length in Linear meters (feet)	TBB Size (AWG)
Less than 4 (13)	6
4-6 (14-20)	4
6-8 (21-26)	3
8-10 (27-33)	2
10-13 (34-41)	1
13-16 (42-52)	1/0
16-20 (53-66)	2/0
Greater than 20 (66)	3/0

## **2 PRODUCT**

### **2.1 Common Bonding Network**

- 2.1.1 The Common Bonding Conductor within each Entrance Facility, Data Centre, Computer Room, Telecommunications Room, LAN Room, etc. shall be a green or green/yellow jacketed #2 copper conductor. The installation route shall be as shown on drawings.
- 2.1.2 The Common Bonding Conductor shall be routed in as straight a path as possible.

## **2.2 Grounding Clamps**

2.2.1 Where a grounding conductor is routed through a metal conduit, the Communications Contractor shall use a #6 AWG copper conductor with green or green/yellow jacket to bond the conduit to the grounding conductor routed through the metal conduit. Series GPL grounding clamps shall be used to bond to the conduit and series HTWC HTAP with clear cover shall be used to bond to the grounding conductor.

## **2.3 Communications Grounding and Bonding Conductor Label Kit**

2.3.1 Telecommunications Grounding and Bonding Conductor Label Kits shall be supplied and installed by the Communications Contractor at every rack and cabinet as well as one for every Telecommunications Grounding Busbar.

Specified Product:

Harger GRNTAG607PK10

Panduit LTYK

## **2.4 Code Conductor, Two-Hole, Long Barrel With Window Lug**

2.4.1 Where lugs are required for bonding, the Communications Contractor shall supply and install Code Conductor, Two-Hole, and Long Barrel with Window Lugs.

2.4.2 Code Conductor, Two-Hole, Long Barrel with Window Lugs shall be supplied and installed by the Communications Contractor as required.

2.4.3 Lugs shall be tin plated, irreversible compression, have NEMA hole sizes and spacing and shall meet NEBS Level 3.

## **2.5 Code/Flex Conductor HTAP**

2.5.1 Code/Flex Conductor HTAPs shall be supplied and installed by the Communications Contractor as required.

## **2.6 Clear Covers for HTCT HTAP**

2.6.1 Clear Covers for HTCT HTAPs shall be supplied and installed by the Communications Contractor (each HTAP requires one clear cover).

## **2.7 Grounding Clamp, U-Bolt, Bronze**

2.7.1 Each conduit entering/leaving a telecommunications space/room shall be bonded to the grounding system using a Series GPL Bronze U-Bolt Grounding Clamp.

## **2.8 Ladder Tray / Basket Tray Grounding**

2.8.1 Bonding network jumpers shall be supplied and installed by the Communications Contractor to bond the tray to the grounding system.

## **2.9 Antioxidant**

2.9.1 Antioxidant shall be used by the Communications Contractor when making bonding connections.



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## **2.10 Bonding Screws**

- 2.10.1 Bonding screws shall have serrations on the bottom of screw to remove paint from patch panel to bond patch panel to rack or cabinet rails.
- 2.10.2 Bonding screws shall be thread-forming to remove paint from threaded rack or cabinet rail holes to bond patch panel to rack or cabinet rails.
- 2.10.3 The Communications Contractor shall supply and install four (4) screws for every patch panel (copper and optical fibre) as well as for every Owner supplied switch (assume 48 port switches).

Specified Product:

Panduit	RGTBSG-C	#12-24 screws
Panduit	RGTBS1032G-C	#10-32 screws
Panduit	RGTBSM6G-C	M6 screws
Panduit	RGTBSM5G-C	M5 screws

## **2.11 Bonding Cage Nut**

### **2.11.1**

Specified Product:

Panduit CNB4K

## **2.12 Bond Clamp**

Specified Product:

Belden	X9905753	For 0.75" or larger cables
Belden	X9905754	For 0.75" or smaller cables
Belden	AX100226	Six-Position Ground Bracket

## **2.13 Rack Grounding**

### **2.13.1 Paint Piercing Washers**

- 2.13.1.1.1.1 Series RGW paint piercing washers shall accommodate 3/8" stud size and shall have an outside diameter of 0.875".
- 2.13.1.1.1.1.2 Series RGW paint piercing washer kits shall come complete with 0.16 oz. (5cc) of antioxidant.
- 2.13.1.1.1.1.3 Series RGW paint piercing washers shall be supplied and installed by the Communications Contractor where rack elements bolt together.
- 2.13.1.1.1.1.4 Series RGW paint piercing washers shall be supplied and installed by the Communications Contractor where vertical cable managers are manufactured of metal.
- 2.13.1.1.1.1.5 Two paint piercing washers shall be supplied and installed by the Communications Contractor for every nut/bolt set.

Specified Product:

Panduit	RGW-24-1Y	Pack of 24
Panduit	RGW-100-1Y	Pack of 100

### **2.13.2 Rack Grounding Strip**

- .1 Series RGS grounding strip shall be 78.65" long, 0.67" wide, 0.05" thick, have EIA Universal mounting hole pattern and shall be made of high conductivity, low resistance wrought copper and tin plated.
- .2 Series RGS grounding strip kits shall come complete with 0.16 oz. (5cc) of antioxidant and thread-forming screws.
- .3 One series RGS rack grounding strip shall be supplied by the Communications Contractor for every two post rack. The rack grounding strip shall be mounted to the rear of the side rail of each rack.

Specified Product:

Harger RGBVKIT145872A

Panduit RGS134-1Y

2.13.3 Common Bonding Network Jumper

- .1 The Common Bonding Network Jumper shall be made of #6 AWG green or green/yellow jacketed copper conductor no less than 96" long with one end factory terminated to lug.
- .2 The Common Bonding Network Jumper kits shall come complete with 0.16 oz. (5cc) of antioxidant and thread-forming screws.
- .3 One Common Bonding Network Jumper shall be supplied and installed for every rack. Do not bond racks serially.

Specified Product:

Harger RGJ67G1082AKIT

Panduit RGREJ696Y

- .4 Where a Common Bonding Network has not been specified the Communications Contractor shall supply and install a Code Conductor Two Hole Long Barrel with Window Lug to bond the Common Bonding Network Jumper directly to the Telecommunications Grounding Busbar.

Specified Product:

Harger GECLB62A

Panduit LCC6-  
14JAW-L

- .5 Where a Common Bonding Network has been specified the Communications Contractor shall supply and install a Code/Flex Conductor HTAP or C-TAP Kit to bond the Common Bonding Network Jumper to the Common Bonding Network.

Specified Product:

Harger CT2248

Panduit HTWC250-2-  
1

2.13.4 Electrostatic Discharge Port

- .1 The Electrostatic Discharge Port shall accommodate a standard ESD wrist strap 4mm plug.

- .2 The Electrostatic Discharge Port kits shall come complete with an ESD protection sticker, 0.16 oz. (5cc) of antioxidant and thread-forming screws.
- .3 The Communications Contractor shall supply and install two Electrostatic Discharge Ports for every rack. One ESD port shall be mounted directly to the rack grounding strip on the back of the rack at approximately 48" AFF, and the other shall be mounted directly to the vertical mounting rail of the rack in the front at approximately 48" AFF.

Specified Product:

Panduit RGEDS2-1 Kit c/w #12-24 and M6 screws

Panduit RGEDS2A-1 Kit c/w #10-32 and M5 screws

## **2.14 Cabinet Grounding**

### **2.14.1 Cabinet Grounding Strip Kit**

- .1 Series RGS grounding strips shall have EIA Universal mounting hole pattern and shall be made of high conductivity, low resistance wrought copper and tin plated.
- .2 Series RGS grounding strip kits shall come complete with four (4) grounding strips, 0.16 oz. (5cc) of antioxidant and bonding studs.
- .3 One series RGS rack grounding strip kit with four (4) grounding strips shall be supplied by the Communications Contractor for every cabinet. Each grounding strip shall be mounted to each cabinet equipment rail.

Specified Product:

Panduit RGS134-1Y for #12-24, M6, #10-32 or M5 mounting hole rails

Panduit RGS134B-1 for cage-nut rails (pack of 1 strip)

Panduit RGS134B-10-1 For cage-nut rails (pack of 10 strips)

### **2.14.2 Grounding Busbar Kit**

- .1 The Grounding Busbar shall be made of high conductivity, low resistance wrought copper and tin plated.
- .2 One Cabinet Grounding Busbar kit shall be supplied and installed by the Communications Contractor for every cabinet.

Specified Product:

Panduit RGRB19U 20 holes

Panduit RGRB19Y 14 holes

Panduit RGRB19CN 20 holes for cage-nut

### **2.14.3 Front to Back Rail Jumper Kit**

- .1 The Front to Back Rail Jumper Kit shall be made of #6 AWG green or green/yellow jacketed copper conductors to bond the rear cabinet rails to the front cabinet rails.

.2 The Front to Back Rail Jumper Kit shall come complete with thread-forming screws or bonding studs.

.3 One Panduit series CGJ Front to Back Rail Jumper Kit shall be supplied and installed by the Communications Contractor for each cabinet.

Specified Product:

Panduit CGJ640U for #12-24 or M6 holes and a 42" deep cabinet

Panduit CGJ640UA for #10-32 or M5 holes and a 42" deep cabinet

Panduit CGJ640UB for cage-nut rails and a 42" deep cabinet

#### 2.14.4 Common Bonding Network Jumper

.1 The Common Bonding Network Jumper shall be made of #6 AWG green or green/yellow jacketed copper conductor 96" long with one end factory terminated to lug.

.2 The Common Bonding Network Jumper kits shall come complete with 0.16 oz. (5cc) of antioxidant and thread-forming screws.

.3 One Common Bonding Network Jumper shall be supplied and installed for every cabinet.

Specified Product:

Harger RGJ67G1082AKIT

Panduit RGREJ696Y

.4 Where a Common Bonding Network has not been specified the Communications Contractor shall supply and install a Code Conductor Two Hole Long Barrel with Window Lug to bond the Common Bonding Network Jumper directly to the Telecommunications Grounding Busbar.

Specified Product:

Harger GECLB62A

Panduit LCC6-  
14JAW-L

.5 Where a Common Bonding Network has been specified the Communications Contractor shall supply and install a Code/Flex Conductor HTAP Kit to bond the Common Bonding Network Jumper to the Common Bonding Network.

Specified Product:

Harger CT2248

Panduit HTWC250-2-  
1

#### 2.14.5 Electrostatic Discharge Port

.1 The Electrostatic Discharge Port shall accommodate a standard ESD wrist strap 4mm plug.

.2 The Electrostatic Discharge Port kits shall come complete with an ESD protection sticker, 0.16 oz. (5cc) of antioxidant and thread-forming screws or bonding studs.

- .3 The Communications Contractor shall supply and install two Electrostatic Discharge Ports for every cabinet. One ESD port shall be mounted directly to the cabinet grounding strip on the back of the cabinet at approximately 48" AFF, and the other shall be mounted directly to the cabinet grounding strip on the front of the cabinet at approximately 48" AFF. ESD ports may be mounted on top of patch panels or horizontal cable managers.

Specified Product:

Panduit	RGESD2-1	Kit c/w #12-24 and M6 screws
Panduit	RGESD2A-1	Kit c/w #10-32 and M5 screws
Panduit	RGESD2B-1	Kit c/w bonding studs

### **3 EXECUTION**

#### **3.1 General**

- 3.1.1 Structured grounding kits shall be TIA-942 compliant, listed for their purpose with a nationally recognized testing laboratory, and RoHS compliant.
- 3.1.2 Grounding strip shall comply with EIA universal mounting hole spacing and mount to standard 19-inch and 23-inch racks and cabinets.
- 3.1.3 All components shall be bonded to the rails with paint piercing hardware.
- 3.1.4 Electrostatic discharge (ESD) ports shall be mounted to the front and back of the rack(s) and/or cabinet(s).
- 3.1.5 Equipment shall be bonded to the grounding strip with a discrete jumper and two-hole long barrel compression lugs.
- 3.1.6 There shall be a #6 AWG copper code discrete jumper that terminates on the mesh common bonding network (MCBN) with a compression HTAP and attaches to the grounding strip using a two-hole, long barrel compression lug. The compression lugs shall meet NEBS Level 3 Criteria and have inspection windows.
- 3.1.7 All jumpers shall have green or green-and-yellow VW-1 rated insulation.
- 3.1.8 Where rack sections bolt together, paint piercing grounding washers shall be used on both sides, under the head of the bolt and between the nut and the rack.
- 3.1.9 The Communications Contractor shall ensure a complete grounding system is installed for the project. If any portion of the system to be installed by Division 26 is incomplete it shall be the responsibility of the Communications Contractor to advise the Technology Systems Consultant.

**END OF SECTION**

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**1 GENERAL**

**1.1 Work Included**

- 1.1.1 Comply with Section 27 00 03 – General Specifications and Requirements for Audio-Visual Communications.

**1.2 General**

- 1.2.1 All cables and related terminations, support and grounding hardware shall be furnished, installed, wired, tested, labelled, and documented by the Audio-Visual Communications Contractor as detailed in this section.
- 1.2.2 Product specifications, general design considerations and installation guidelines are provided in this section.
- 1.2.3 The Audio-Visual Communications Contractor shall meet or exceed all requirements for the cable system described in this section.
- 1.2.4 Local electrical codes shall be adhered to.
- 1.2.5 Local building codes shall be adhered to.
- 1.2.6 All Audio-Visual Communications components including, entrance lugs, entrance terminal frames, racks, cabinets, cable tray, ladder racks, metallic pathways, enclosures, and other components noted on drawings shall be bonded to an independent grounding system and in accordance with local codes and standards, TIA/EIA J-STD-607-A, ANSI/TIA-942 and IEEE Std.1100 and these specifications.
- 1.2.7 Labelling shall conform to TIA/EIA-606.
- 1.2.8 Grounding system shall include a local copper Telecommunications Grounding Busbar (by Division 26) in each entrance facility and equipment room bonded to a Telecommunications Grounding Backbone (by Division 26).
- 1.2.9 The TBB shall be bonded directly to the Telecommunications Main Grounding Busbar (by Division 26). The TMGB shall be bonded directly to the building entrance grounding system and meet all local codes and standards as noted above.
- 1.2.10 The grounding system shall be visually verifiable and adequately sized to handle expected currents safely.
- 1.2.11 All grounding conductors and busbars shall be made of copper.
- 1.2.12 The grounding system shall be intentional, visually verifiable, adequately sized to handle expected currents safely, and direct these currents away from network equipment. As such, grounding shall be purposeful in its design and installation.
- 1.2.13 Lugs, HTAPs, grounding strips, and busbars shall be UL Listed, and CSA certified and made of premium quality tin-plated electrolytic copper that provides low electrical resistance while inhibiting corrosion. Antioxidant shall be used when making bonding connections in the field.

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1.3 **Lugs**

- 1.3.1 Wherever possible, two-hole lugs shall be used. All lugs shall be irreversible compression. Lugs with inspection windows shall be used in all non-corrosive environments so that connections may be inspected for full conductor insertion (battery rooms are an exception where windowless lugs may be used).
- 1.3.2 Die index numbers shall be embossed on all compression connections to allow crimp inspection.

1.4 **Cable Assemblies**

- 1.4.1 Cable assemblies shall be UL Listed and CSA Certified. Cables shall be a distinctive green or green/yellow in color, and all jackets shall be UL, VW-1 flame rated.

2 **PRODUCT**

2.1 **Common Bonding Network**

- 2.1.1 The Common Bonding Conductor within each Entrance Facility, Data Centre, Computer Room, Telecommunications Room, LAN Room, etc. shall be a green or green/yellow jacketed #2 copper conductor. The installation route shall be as shown on drawings.

2.2 **Grounding Clamps**

- 2.2.1 Where a grounding conductor is routed through a metal conduit, the Audio-Visual Communications Contractor shall use a #6 AWG copper conductor with green or green/yellow jacket to bond the conduit to the grounding conductor routed through the metal conduit. Series GPL grounding clamps shall be used to bond to the conduit and series HTWC HTAP with clear cover shall be used to bond to the grounding conductor.

2.3 **Communications Grounding and Bonding Conductor Label Kit**

- 2.3.1 Telecommunications Grounding and Bonding Conductor Label Kits shall be supplied and installed by the Audio-Visual Communications Contractor at every rack and cabinet as well as one for every Telecommunications Grounding Busbar.

Specified Product:

Harger GRNTAG607PK10

Panduit LTYK

2.4 **Code Conductor, Two-Hole, Long Barrel with Window Lug**

- 2.4.1 Where lugs are required for bonding, the Audio-Visual Communications Contractor shall supply and install Code Conductor, Two-Hole, and Long Barrel with Window Lugs.
- 2.4.2 Code Conductor, Two-Hole, Long Barrel with Window Lugs shall be supplied and installed by the Audio-Visual Communications Contractor as required.

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- 2.4.3 Lugs shall be tin plated, irreversible compression, have NEMA hole sizes and spacing and shall meet NEBS Level 3.
- 2.5 **Grounding Clamp, U-Bolt, Bronze**
- 2.5.1 Each conduit entering/leaving a telecommunications space/room shall be bonded to the grounding system using a Series GPL Bronze U-Bolt Grounding Clamp.
- 2.6 **Antioxidant**
- 2.6.1 Antioxidant shall be used by the Audio-Visual Communications Contractor when making bonding connections.
- 2.7 **Bonding Screws**
- 2.7.1 Bonding screws shall have serrations on the bottom of screw to remove paint from patch panel to bond patch panel to rack or cabinet rails.
- 2.7.2 Bonding screws shall be thread-forming to remove paint from threaded rack or cabinet rail holes to bond patch panel to rack or cabinet rails.
- 2.7.3 The Audio-Visual Communications Contractor shall supply and install four (4) screws for every patch panel (copper and optical fibre) as well as for every Owner supplied switch (assume 48 port switches).
- Specified Product:
- |         |              |               |
|---------|--------------|---------------|
| Panduit | RGTBSG-C     | #12-24 screws |
| Panduit | RGTBS1032G-C | #10-32 screws |
| Panduit | RGTBSM6G-C   | M6 screws     |
| Panduit | RGTBSM5G-C   | M5 screws     |
- 2.8 **Bonding Cage Nut**
- 2.8.1
- Specified Product:
- Panduit CNB4K
- 2.8.2 Electrostatic Discharge Port
- .1 The Electrostatic Discharge Port shall accommodate a standard ESD wrist strap 4mm plug.
  - .2 The Electrostatic Discharge Port kits shall come complete with an ESD protection sticker, 0.16 oz. (5cc) of antioxidant and thread-forming screws.
  - .3 The Audio-Visual Communications Contractor shall supply and install two Electrostatic Discharge Ports for every rack. One ESD port shall be mounted directly to the rack grounding strip on the back of the rack at approximately 48" AFF, and the other shall be mounted directly to the vertical mounting rail of the rack in the front at approximately 48" AFF.
-



Specified Product:

Panduit RGEDS2-1 Kit c/w #12-24 and M6 screws

Panduit RGEDS2A-1 Kit c/w #10-32 and M5 screws

## 2.9 **Cabinet Grounding**

### 2.9.1 Cabinet Grounding Strip Kit

- .1 Series RGS grounding strips shall have EIA Universal mounting hole pattern and shall be made of high conductivity, low resistance wrought copper and tin plated.
- .2 Series RGS grounding strip kits shall come complete with four (4) grounding strips, 0.16 oz. (5cc) of antioxidant and bonding studs.
- .2 One series RGS rack grounding strip kit with four (4) grounding strips shall be supplied by the Audio-Visual Communications Contractor for every cabinet. Each grounding strip shall be mounted to each cabinet equipment rail.

Specified Product:

Panduit RGS134-1Y for #12-24, M6, #10-32 or M5 mounting hole rails

Panduit RGS134B-1 for cage-nut rails (pack of 1 strip)

Panduit RGS134B-10-1 For cage-nut rails (pack of 10 strips)

### 2.9.2 Grounding Busbar Kit

- .1 The Grounding Busbar shall be made of high conductivity, low resistance wrought copper and tin plated.
- .3 One Cabinet Grounding Busbar kit shall be supplied and installed by the Audio-Visual Communications Contractor for every cabinet.

Specified Product:

Panduit RGRB19U 20 holes

Panduit RGRB19Y 14 holes

Panduit RGRB19CN 20 holes for cage-nut

### 2.9.3 Front to Back Rail Jumper Kit

- .1 The Front to Back Rail Jumper Kit shall be made of #6 AWG green or green/yellow jacketed copper conductors to bond the rear cabinet rails to the front cabinet rails.
- .4 The Front to Back Rail Jumper Kit shall come complete with thread-forming screws or bonding studs.
- .5 One Panduit series CGJ Front to Back Rail Jumper Kit shall be supplied and installed by the Audio-Visual Communications Contractor for each cabinet.

Specified Product:

Panduit CGJ620U for #12-24 or M6 holes and a 24" deep cabinet

Panduit CGJ630U for #12-24 or M6 holes and a 36" deep cabinet

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Panduit	CGJ640U	for #12-24 or M6 holes and a 42" deep cabinet
Panduit	CGJ620UA	for #10-32 or M5 holes and a 24" deep cabinet
Panduit	CGJ630UA	for #10-32 or M5 holes and a 36" deep cabinet
Panduit	CGJ640UA	for #10-32 or M5 holes and a 42" deep cabinet
Panduit	CGJ620UB	for cage-nut rails and a 24" deep cabinet
Panduit	CGJ630UB	for cage-nut rails and a 36" deep cabinet
Panduit	CGJ640UB	for cage-nut rails and a 42" deep cabinet

#### 2.9.4 Common Bonding Network Jumper

- .1 The Common Bonding Network Jumper shall be made of #6 AWG green or green/yellow jacketed copper conductor 96" long with one end factory terminated to lug.
- .6 The Common Bonding Network Jumper kits shall come complete with 0.16 oz. (5cc) of antioxidant and thread-forming screws.
- .7 One Common Bonding Network Jumper shall be supplied and installed for every cabinet.

##### Specified Product:

Harger RGJ67G1082AKIT

Panduit RGREJ696Y

- .8 Where a Common Bonding Network has not been specified the Audio-Visual Communications Contractor shall supply and install a Code Conductor Two Hole Long Barrel with Window Lug to bond the Common Bonding Network Jumper directly to the Telecommunications Grounding Busbar.

##### Specified Product:

Harger GECLB62A

Panduit LCC6-  
14JAW-L

- .9 Where a Common Bonding Network has been specified the Audio-Visual Communications Contractor shall supply and install a Code/Flex Conductor HTAP Kit to bond the Common Bonding Network Jumper to the Common Bonding Network.

##### Specified Product:

Harger CT2248

Panduit HTWC250-2-  
1

#### 2.9.5 Electrostatic Discharge Port

- .1 The Electrostatic Discharge Port shall accommodate a standard ESD wrist strap 4mm plug.
- .10 The Electrostatic Discharge Port kits shall come complete with an ESD protection sticker, 0.16 oz. (5cc) of antioxidant and thread-forming screws or bonding studs.
- .11 The Audio-Visual Communications Contractor shall supply and install two Electrostatic Discharge Ports for every cabinet. One ESD port shall be

mounted directly to the cabinet grounding strip on the back of the cabinet at approximately 48" AFF, and the other shall be mounted directly to the cabinet grounding strip on the front of the cabinet at approximately 48" AFF. ESD ports may be mounted on top of patch panels or horizontal cable managers.

Specified Product:

Panduit	RGESD2-1	Kit c/w #12-24 and M6 screws
Panduit	RGESD2A-1	Kit c/w #10-32 and M5 screws
Panduit	RGESD2B-1	Kit c/w bonding studs

### **3 EXECUTION**

#### **3.1 General**

- 3.1.1 Structured grounding kits shall be TIA-942 compliant, listed for their purpose with a nationally recognized testing laboratory, and RoHS compliant.
- 3.1.2 Grounding strip shall comply with EIA universal mounting hole spacing and mount to standard 19-inch and 23-inch racks and cabinets.
- 3.1.3 All components shall be bonded to the rails with paint piercing hardware.
- 3.1.4 Electrostatic discharge (ESD) ports shall be mounted to the front and back of the rack(s) and/or cabinet(s).
- 3.1.5 Equipment shall be bonded to the grounding strip with a discrete jumper and two-hole long barrel compression lugs.
- 3.1.6 All jumpers shall have green or green-and-yellow VW-1 rated insulation.
- 3.1.7 Where rack sections bolt together, paint piercing grounding washers shall be used on both sides, under the head of the bolt and between the nut and the rack.
- 3.1.8 The Audio-Visual Communications Contractor shall ensure a complete grounding system is installed for the project. If any portion of the system to be installed by Division 26 is incomplete it shall be the responsibility of the Audio-Visual Communications Contractor to advise the Technology Systems Consultant.

**END OF SECTION**

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## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1 Comply with Section 27 00 03 – General Specifications and Requirements for Audio-Visual Communications.

### **1.2 General**

- 1.2.1 The Audio-Visual Communications Contractor shall be responsible for measuring and confirming cable pathways prior to installation of any cabling to ensure no cabling will exceed the specified distance limitations. Where the distance limitations are exceeded, the Audio-Visual Communications Contractor shall inform the Technology Systems Consultant prior to installation of cabling. No compensation for removal of cabling will be accepted if not adhered to.

### **1.3 Indoor Cable Distribution**

- 1.3.1 The Audio-Visual Communications Contractor shall install and distribute cabling using riser sleeves, conduit, communications cable tray, floor ducts systems and/or surface raceways as indicated on drawings and as supplied and installed by Division 26.
- 1.3.2 All cabling extending beyond conduit and /or cable tray pathways shall be supported using J-hooks and/or Cable Slings up to the point of termination complete with “Velcro” Ty-raps supplied and installed by the Audio-Visual Communications Contractor, in accordance with these specifications.
- 1.3.3 Innerduct shall be supplied and installed by the Audio-Visual Communications Contractor where required to protect Audio-Visual cabling. Innerduct shall be as further described in this specification.

## **2 PRODUCT**

### **2.1 J-Hooks**

- 2.1.1 J-hooks shall be made of metal and/or plastic and shall be Plenum rated.
- 2.1.2 J-hooks shall be supplied and installed with all necessary fastening suitable for the building structure being used to support the cabling and as per the manufacturer’s installation requirements or guidelines.
- 2.1.3 J-hooks shall be manufactured by Erico or Panduit and sized to suit.

#### **Specified Product:**

Erico	CAT12
Erico	CAT21
Erico	CAT32
Erico	CAT64
Panduit	JP75
Panduit	JP131
Panduit	JP2
Panduit	JP4

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Notes: Product Codes shown above indicate only Series numbers and are not application specific.

## **2.2 Cable Slings**

- 2.2.1 Cable slings shall be supplied and installed as indicated on drawings and as required to support larger bundles of cabling.
- 2.2.2 Cable slings shall be supplied with all necessary fastening suitable for the building structure being used to support the cabling and as per the manufacturer's installation requirements or guidelines.
- 2.2.3 Cable slings shall be manufactured by Erico and sized to suit installation or as noted on drawings.

Specified Product:  
Erico CAT425

Notes: Product Code shown above indicates only Series number and is not application specific.

## **2.3 Velcro Wraps**

- 2.3.1 Velcro wraps shall be supplied and installed to support and neatly bundle all cabling.
- 2.3.2 No nylon or plastic Ty-wraps will be permitted on this project and will be removed and replaced at the expense of the Audio-Visual Communications Contractor.
- 2.3.3 Velcro wraps shall be black in colour.

Specified Product:  
Panduit HLS/HLM-15R0

# **3 EXECUTION**

## **3.1 General**

- 3.1.1 All pathways shall be installed to run parallel to building lines at all times.
- 3.1.2 Pathways shall be installed in coordination with other trades in order to minimize interferences and obstructions. The Audio-Visual Communications Contractor shall be responsible for relocating installed pathways at no cost to the Owner.
- 3.1.3 All cable supports shall be installed to the permanent structure of the building and be limited to areas that will not damage the structural stability such as tensioned beams and slabs. It is the responsibility of the Audio-Visual Communications Contractor to submit information to the structural engineer for review and approval prior to installation.
- 3.1.4 Anchors for J-hooks and/or Cable Slings shall not be drilled into post tensioned beams under any circumstances. All anchors shall be drilled into slab.
- 3.1.5 Pneumatic hammers shall not be used unless the Audio-Visual Communications Contractor has written authorization from the building owner/landlord.

- 3.1.6 The Audio-Visual Communications Contractor shall minimize the removal/disturbance of fire spray insulation while installing cable supports and/or accessories.

### 3.2 **Audio-Visual Indoor Cable Distribution**

- 3.2.1 The Audio-Visual Communications Contractor shall install cables in a manner that shall ensure that the Audio-Visual System(s) is free of noise (both video and audio).
- 3.2.2 The Audio-Visual Communications Contractor shall ensure that all proper installation practices are followed to prevent electromagnetic, electrostatic and radio frequency noise in the Audio-Visual System(s).
- 3.2.3 Separation of the audio system(s) and related cables from sources of noise shall be based on the following table of distances or manufacturer recommendations, whichever is more stringent.

	208V cct	Lighting cct	Heat Source	Plumbing
Intercom	30 cm	30 cm	30 cm	15 cm
Line	60 cm	60 cm	30 cm	15 cm
Loudspeaker	30 cm	30 cm	30 cm	15 cm
Microphone	60 cm	60 cm	30 cm	15 cm
Control Network				

- 3.2.4 Separation of the video system(s) and related cables from sources of noise shall be based on the following table of distances or manufacturer recommendations, whichever is more stringent.

	208V cct	Lighting cct	Heat Source	Plumbing
Component	15 cm	60 cm	30 cm	15 cm
Composite	15 cm	60 cm	30 cm	15 cm
RGB	15 cm	60 cm	30 cm	15 cm

### 3.3 **J-Hooks**

- 3.3.1 Suspended ceiling and T-Bar hangers shall not be acceptable in any situation.
- 3.3.2 J-Hooks shall be installed every 3' to 4' to support cabling (ensure that the distance between j-hooks is not consistent; do not place j-hooks exactly the same distance apart repeatedly).
- 3.3.3 All cabling shall be installed to have no more than 3" sag between J-hooks. All cabling shall be fastened using Velcro Wraps only. The Audio-Visual Communications Contractor will be responsible for all costs associated with removing other fasteners and install the specified product.
- 3.3.4 If the quantity of cables exceeds 80% of the manufacturer's capacity rating install the next larger size or substitute with cable slings at no additional cost to the Owner.

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- 3.3.5 J-hooks shall be installed in coordination with other building services and without interruption to the Owner or surrounding Owners within the building.
- 3.4 **Cable Slings**
- 3.4.1 Cable slings shall be installed as noted on drawings and when cabling exceeds the capacity of J-hooks.
- 3.4.2 Cable slings shall be installed every 3' to 4' to support cabling (ensure that the distance between cable slings is not consistent; do not place cable slings exactly the same distance apart repeatedly).
- 3.4.3 All cabling shall be installed to have no more than 3" sag between cable slings.
- 3.4.4 Cable slings shall be sized to not exceed 80% of the manufacturers published capacities.
- 3.5 **Velcro Wraps**
- 3.5.1 Velcro Wraps shall be installed at every J-hook, between every pair of J-hooks or within 2' of a J-hook to neatly bundle cabling.
- 3.5.2 Velcro Wraps shall be installed every 3' to neatly bundle cabling installed in cable tray.
- 3.5.3 Velcro Wraps shall be installed every 6" to neatly bundle cabling at all locations on racks, cabinets, patch panels and IDC mounts.
- 3.6 **Fire Stopping**
- 3.6.1 For all fire stopping requirements refer to Section 27 00 13 – Fire Stopping for Communications.
- 3.7 **Grounding**
- 3.7.1 For all grounding and bonding requirements refer to Section 27 05 26 – Grounding and Bonding for Communications Systems.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1 Comply with Section 27 00 03 – General Specifications and Requirements for Communications.

### **1.2 General**

- 1.2.1 The Communications Contractor shall be responsible for measuring and confirming cable pathways prior to installation of any cabling to ensure no cabling will exceed the specified distance limitations. Where the distance limitations are exceeded, the Communications Contractor shall inform the Technology Systems Consultant prior to installation of cabling. No compensation for removal of cabling will be accepted if not adhered to.
- 1.2.2 The Communications Contractor shall be responsible for installing and providing pulling strings, ropes and fishing walls wherever conduit is not installed or conduit is installed without these provisions.

### **1.3 Indoor Cable Distribution**

- 1.3.1 Ensure ANSI/EIA/TIA-568-B installation practices are followed for all indoor cable distribution.
- 1.3.2 The Communications Contractor shall install and distribute cabling using riser sleeves, conduit, communications cable tray, floor ducts systems and/or surface raceways as indicated on drawings and as supplied and installed by Division 26.
- 1.3.3 All cabling extending beyond conduit and /or cable tray pathways shall be supported using J-hooks and/or Cable Slings up to the point of termination complete with “Velcro” Ty-raps supplied and installed by the Communications Contractor, in accordance with these specifications.
- 1.3.4 Innerduct shall be supplied and installed by the Communications Contractor for all fibre optic cabling not indicated shall be installed in conduit and at locations fibre optic cabling leaves a conduit. Innerduct shall be as further described in this specification.

## **2 PRODUCT**

### **2.1 J-Hooks**

- 2.1.1 J-hooks shall be made of metal and/or plastic and shall be Plenum rated.
- 2.1.2 J-hooks shall be supplied and installed with all necessary fastening suitable for the building structure being used to support the cabling and as per the manufacturer’s installation requirements or guidelines.
- 2.1.3 J-hooks shall be manufactured by Erico or Panduit and sized to suit.

Specified Product:

Erico CAT12

Erico CAT21



Erico	CAT32
Erico	CAT64
Panduit	JP75
Panduit	JP131
Panduit	JP2
Panduit	JP4

Notes: Product Codes shown above indicate only Series numbers and are not application specific.

## **2.2 Cable Slings**

- 2.2.1 Cable slings shall be supplied and installed as indicated on drawings and as required to support larger bundles of cabling.
- 2.2.2 Cable slings shall be supplied with all necessary fastening suitable for the building structure being used to support the cabling and as per the manufacturer's installation requirements or guidelines.
- 2.2.3 Cable slings shall be manufactured by Erico and sized to suit installation or as noted on drawings.

Specified Product:  
Erico CAT425

Notes: Product Code shown above indicates only Series number and is not application specific.

## **2.3 Vertical Backbone Support**

- 2.3.1 Vertical backbone supports shall be supplied and installed as indicated on drawings and as required to support vertically installed backbone.
- 2.3.2 Vertical backbone supports shall be supplied with all necessary fastening suitable for the building structure being used to support the cabling and as per the manufacturer's installation requirements or guidelines.
- 2.3.3 Vertical backbone supports shall be manufactured by Erico and sized to suit installation or as noted on drawings.

Specified Product:  
Erico CAT600

Notes: Product Code shown above indicates only Series number and is not application specific.

## **2.4 Heavy Duty Split-Lace Kellum Grip With U Eye**

- 2.4.1 Split-lace cable grips with u eye shall be double weave with uniform gripping power and shall be CSA approved.
- 2.4.2 Tin-coated bronze split-lace cable grips shall be non-magnetic to minimize hysteresis and resultant heat build up.

Specified Product:

		Cable Dia. Range Inches (cm)	Approx. Breaking Strength Lbs (N)
Hubbell / Bryant	SHS075U	0.75-0.99 (1.90- 2.51)	2820 (12543)
Hubbell / Bryant	SHS100U	1.00-1.24 (2.54- 3.15)	4280 (19037)
Hubbell / Bryant	SHS125U	1.25-1.49 (3.17- 3.78)	4280 (19037)
Hubbell / Bryant	SHS150U	1.50-1.74 (3.81- 4.42)	4280 (19037)

- 2.4.3 Stainless steel grips shall be 302/304 and shall be designed for harsh environment where superior corrosion resistance and strength are required.

Specified Product:

		Cable Dia. Range Inches (cm)	Approx. Breaking Strength Lbs (N)
Hubbell / Bryant	SHS075US	0.75-0.99 (1.90- 2.51)	4250 (18904)
Hubbell / Bryant	SHS100US	1.00-1.24 (2.54- 3.15)	7300 (32470)
Hubbell / Bryant	SHS125US	1.25-1.49 (3.17- 3.78)	7300 (32470)
Hubbell / Bryant	SHS150US	1.50-1.74 (3.81- 4.42)	11150 (49595)

## 2.5 **Heavy Duty Split Lace Kellum Grip With Double U Eye**

- 2.5.1 Split-lace cable grips with double u eye shall be double weave with uniform gripping power and shall be CSA approved.
- 2.5.2 Tin-coated bronze split-lace cable grips shall be non-magnetic to minimize hysteresis and resultant heat build up.

Specified Product:

		Cable Dia. Range Inches (cm)	Approx. Breaking Strength Lbs (N)
Hubbell / Bryant	SHS075	0.75-0.99 (1.90-2.51)	2820 (12543)
Hubbell / Bryant	SHS100	1.00-1.24 (2.54-3.15)	4280 (19037)
Hubbell / Bryant	SHS125	1.25-1.49 (3.17-3.78)	4280 (19037)
Hubbell / Bryant	SHS150	1.50-1.99 (3.81-5.05)	4280 (19037)
Hubbell / Bryant	SHS200	2.00-2.49 (5.08-6.32)	8050 (35806)
Hubbell / Bryant	SHS250	2.50-2.99 (6.35-7.59)	8050 (35806)

Hubbell / Bryant	SHS300	3.00-3.49 (7.62-8.86)	10060 (44747)
Hubbell / Bryant	SHS350	3.50-3.99 (8.89-10.13)	12070 (53687)
Hubbell / Bryant	SHS400	4.00-4.49 (10.16- 11.40)	12070 (53687)
Hubbell / Bryant	SHS450	4.50-4.99 (11.43- 12.67)	12070 (53687)
Hubbell / Bryant	SHS500	5.00-5.99 (12.70- 15.21)	14080 (62628)

2.5.3 Stainless steel grips shall be 302/304 and shall be designed for harsh environment where superior corrosion resistance and strength are required.

Specified Product:

		Cable Dia. Range Inches (cm)	Approx. Breaking Strength Lbs (N)
Hubbell / Bryant	SHS200DES	2.00-2.49 (5.08-6.32)	20105 (89627)
Hubbell / Bryant	SHS250DES	2.50-2.99 (6.35-7.59)	20105 (89627)
Hubbell / Bryant	SHS300DES	3.00-3.49 (7.62-8.86)	25200 (112090)
Hubbell / Bryant	SHS350DES	3.50-3.99 (8.89-10.13)	30200 (134330)
Hubbell / Bryant	SHS400DES	4.00-4.49 (10.16- 11.40)	30200 (134330)

## 2.6 Velcro Wraps

2.6.1 Velcro wraps shall be supplied and installed to support and neatly bundle all cabling.

2.6.2 No nylon or plastic wraps will be permitted on this project and will be removed and replaced at the expense of the Communications Contractor.

2.6.3 Velcro Wraps shall be black in colour.

Specified Product:

		Width	Tensile Strength
Panduit	HLM-15R0	0.330"	18
Panduit	HLS-15R0	0.750"	50
Panduit	HLS-75R0	0.750"	50
Panduit	TTS-20R0	0.750"	40
Panduit	TTS-35R3-0	0.750"	40

## 2.7 Innerduct

2.7.1 Innerduct shall be supplied non-plenum (FT4) or plenum (FT6) rated to suit the installation.

2.7.2 All FT6 or CMP rated cabling shall be installed within equally rated innerduct.

- 2.7.3 All innerduct shall include pre-lubricated pull tape.
- 2.7.4 Optical fibre cabling may be installed without innerduct where either of the following is true:
- .1 The optical fibre cable is armoured.
  - .2 The conduit where the optical fibre cable(s) will be installed is equal to or less than 1.5" trade size and is dedicated to optical fibre cabling.
- 2.7.5 Innerduct shall be coloured for use with different cabling as follows:
- |                  |                |
|------------------|----------------|
| Multimode Fibre  | Orange         |
| Singlemode Fibre | Yellow         |
| Copper           | White or Clear |
- 2.7.6 Innerduct shall be sized to suit or as noted on drawings.
- Specified Product:
- |         |             |            |
|---------|-------------|------------|
| Carlton | CF4X1C-500  | for Plenum |
| Carlton | DF4X1C-500R | for Riser  |

## **2.8 Split Wrap**

- 2.8.1 Split wrap shall be supplied to dress cabling from wall feed to furniture feed locations.
- 2.8.2 Split wrap shall be sized to suit each location.
- 2.8.3 Split wrap shall be coloured to match the power whip supplied with the furniture.

Specified Product:

	Part Number	Tool Required
Panduit	PW50F-T20	PWT50
Panduit	PW75F-C20	PWT75
Panduit	PW100F-C20	PWT100
Panduit	PW150F-L20	PWT150

## **2.9 Overhead Wire Basket Tray**

- 2.9.1 Provide wire basket of types and sizes indicated with all required splicing and mounting hardware.
- 2.9.2 Wire basket crosswire to be constructed with shaped wire to provide flat surface for cable support, avoiding pressure points or cable strain. Round wire construction shall not be allowed.
- 2.9.3 Wire basket shall be made of high strength steel wires and formed into a standard 2 inch by 4 inch wire mesh pattern with intersecting wires welded together. All mesh sections must have at least one bottom longitudinal wire along entire length of straight section.

- 2.9.4 Wire diameter shall be 0.195" (5mm) minimum on all mesh sections up to 16 linear inches. Wire diameter linewire shall be 0.234" (6mm) minimum on all mesh sections in excess of 16 linear inches.
- 2.9.5 All straight section longitudinal wires shall be constructed with a continuous top wire safety edge. Safety edge must be the WBT "Canadian-Weld" on all tray sizes.
- 2.9.6 All fittings shall be field formed, from straight sections, in accordance with manufacturer's instructions.
- 2.9.7 All Tray sections and splicing assemblies shall be UL/C-UL Classified as an Equipment Ground Conductor (EGC).
- 2.9.8 The cable tray shall be installed complete with splice bars, "uni-strut" trapeze supports, threaded rod, ceiling anchors and all manufacturer recommended installation components following manufacturer's installation instructions and recommendations.
- 2.9.9 All cable counts shall be verified by Communications Contractor to size the cable tray appropriately for a maximum of 50% fill. The cable tray shall be increased in size if over 50% filled.

Specified Product:

Description	Part No.
WBT Tray	WBT(4") X (24") X (10') (Hot Dipped Galvanized
WBT Cable drop control ("waterfall")	VERTICAL DOWN
WBT Bend radius control corner	CABLE GUIDE
WBT Attachment to fill fitting gap	FITTING ATTACHMENT 2
WBT Attachment to fill fitting gap	FITTING ATTACHMENT 4/6
WBT Attaches tray directly to rack	RACK ATTACHMENT
WBT Used to splice tray sections	SPLICE KIT
WBT Used to splice tray sections	WASHER SUPPORT
WBT Used to splice tray sections	BAR SPLICE
WBT Used to splice fittings	CORNER SPLICE
WBT Ceiling support for 24" tray	CEILING SUPT 24

### **3 EXECUTION**

#### **3.1 General**

- 3.1.1 All pathways shall be installed to run parallel to building lines at all times.
- 3.1.2 Pathways shall be installed in coordination with other trades in order to minimize interferences and obstructions. The Communications Contractor shall be responsible for relocating installed pathways at no cost to the Owner.
- 3.1.3 All cable supports shall be installed to the permanent structure of the building and be limited to areas that will not damage the structural stability such as tensioned beams and slabs. It is the responsibility of the Communications Contractor to submit information to the structural engineer for review and approval prior to installation.

- 3.1.4 Anchors for J-hooks and/or Cable Slings shall not be drilled into post tensioned beams under any circumstances. All anchors shall be drilled into slab.
- 3.1.5 Pneumatic hammers shall not be used unless the Communications Contractor has written authorization from the building owner/landlord.
- 3.1.6 The Communications Contractor shall minimize the removal/disturbance of fire spray insulation while installing cable supports and/or accessories.

### **3.2 Data and / or Voice Indoor Cable Distribution**

- 3.2.1 All pathways and cabling installation shall maintain clearances from all electrical and heat sources as outlined below.

Fluorescent Fixtures	15 cm
Electrical distribution cabling and conduits less than 1KVA	1.0 m
Electrical distribution cabling and conduits greater than 1KVA	3.0 m
Transformers and Motors	1.2 m
HVAC system including ducts	30 cm
Mechanical piping	15 cm

- 3.2.2 Prepare all conduits and pathways prior to installation of cabling. This shall include bushing or reaming all conduit openings, pulling of wire brush and mandrel to clean out ducts and identifying any potential cause of damage to cabling during installation. Report all items to the Technology Systems Consultant immediately.
- 3.2.3 When installing cables in stacked duct banks install cabling in lower ducts leaving upper ducts for future installations.

### **3.3 J-Hooks**

- 3.3.1 Suspended ceiling and T-Bar hangers shall not be acceptable in any situation.
- 3.3.2 J-Hooks shall be installed every 3' to 4' to support cabling (ensure that the distance between j-hooks is not consistent; do not place j-hooks exactly the same distance apart repeatedly).
- 3.3.3 All cabling shall be installed to have no more than 3" sag between J-hooks. All cabling shall be fastened using Velcro Ty-Wraps only. The Communications Contractor will be responsible for all costs associated with removing other fasteners and install the specified product.
- 3.3.4 If the quantity of cables exceeds 80% of the manufacturer's capacity rating install the next larger size or substitute with cable slings at no additional cost to the Owner.
- 3.3.5 J-hooks shall be installed in coordination with other building services and without interruption to the Owner or surrounding Owners within the building.

### **3.4 Cable Slings**

- 3.4.1 Cable slings shall be installed as noted on drawings and when cabling exceeds the capacity of J-hooks.

- 3.4.2 Cable slings shall be installed every 3' to 4' to support cabling (ensure that the distance between cable slings is not consistent; do not place cable slings exactly the same distance apart repeatedly).
- 3.4.3 All cabling shall be installed to have no more than 3" sag between cable slings.
- 3.4.4 Cable slings shall be sized to not exceed 80% of the manufacturers published capacities.

### **3.5 Velcro Wraps**

- 3.5.1 Velcro Wraps shall be installed at every J-hook, between every pair of J-hooks or within 2' of a J-hook to neatly bundle cabling.
- 3.5.2 Velcro Wraps shall be installed every 3' to neatly bundle cabling installed in cable tray.
- 3.5.3 Velcro Wraps shall be installed every 6" to neatly bundle cabling at all locations on racks, cabinets, patch panels and IDC mounts.

### **3.6 Inner Duct**

- 3.6.1 Innerduct shall be installed and supported to meet all local codes and standards.
- 3.6.2 Innerduct shall be installed to meet the minimum bend radius for cable installation.

### **3.7 Split Wrap**

- 3.7.1 Split wrap shall be installed to neat bundle cabling from outlet location to system furniture connection point.
- 3.7.2 Split wrap installation should be in a manner to minimize the amount of exposed spiral wrap.
- 3.7.3 Secure split wrap neatly when applicable.

### **3.8 Fire Stopping**

- 3.8.1 For all fire stopping requirements refer to Section 27 00 13 – Fire Stopping for Communications.

### **3.9 Grounding**

- 3.9.1 For all grounding and bonding requirements refer to Section 27 05 26.10 – Grounding and Bonding for Communications.

**END OF SECTION**

XXX-YYY-SS-ZZ      where: XXX = Room (Origin)  
                              YYY = Room (Destination)  
                              SS = Number of Strands  
                              ZZ = Strand designation





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Hubbell /	1.00-1.24 (2.54-	4280 (19037)
Bryant	3.15)	
Hubbell /	1.25-1.49 (3.17-	4280 (19037)
Bryant	3.78)	
Hubbell /	1.50-1.74 (3.81-	4280 (19037)
Bryant	4.42)	

## **2.2 IDC Mount Designation Strip Label**

2.2.1 IDC mounts shall be labelled using designation strips and labels specifically manufactured for the IDC mount being installed. Labels shall be colour coded as follows:

Orange	Incoming Circuits (Demarcation Point)
Green	Owner Connection to Incoming Circuits (Owner side of Demarcation Point)
White / Silver	Equipment Connections
Purple	First Level Backbone Cabling
Gray	Second Level Backbone Cabling
Blue	Horizontal Cabling
Brown	Interbuilding Backbone (Main XC to remote Intermediate XC)
Yellow	Auxiliary Circuits, Alarms, Maintenance, Security, and other Misc. Circuits
Red	Key Telephone Systems

## **2.3 Racks and Cabinets**

2.3.1 Racks and Cabinets shall be labelled using lamacoid plates.

2.3.2 Lamacoid plates shall be black background with white letters.

2.3.3 Lamacoid plate letters shall be 1" high.

2.3.4 Lamacoid plates shall be no more than 2" high.

2.3.5 Length of lamacoid plates shall be as required to accommodate number of characters.

# **3 EXECUTION**

## **3.1 General**

3.1.1 All labels shall be printed on a laser printer. No handwritten labels shall be accepted.

## **3.2 Cable Labels**

3.2.1 Cable labels shall be installed on clean and dry cable and mounted within 100mm or 4" of each end of each cable.

3.2.2 Labels on all faceplates, patch panels and IDC mounts shall be mounted on a clean dry surface and aligned accurately.

**3.3 Patch Cord Labels**

- 3.3.1 Patch cord labels shall be installed on clean and dry patch cords and mounted within 50mm or 2" of each end of each patch cord.

**3.4 Rack and Cabinet Labelling**

- 3.4.1 Rack and cabinet labelling shall be installed on clean and dry racks and cabinets and mounted on the top rail of each rack and each cabinet, at the front and at the rear.
- 3.4.2 Lamacoid plates shall be mounted to each rack and cabinet with screws. The Communications Contractor shall drill racks and cabinets prior to any cabling or equipment is mounted.
- 3.4.3 Adhesive shall not be accepted as a method of securing lamacoid plates to racks and cabinets.

**END OF SECTION**

**1 GENERAL**

**1.1 Work Included**

- 1.1.1 Comply with Section 27 00 03 – General Specifications and Requirements for Audio-Visual Communications.

**1.2 Cable Labelling**

- 1.2.1 All cabling runs shall be labelled in two (2) locations (at each end of the cable).
- 1.2.2 All cabling terminated in faceplate jacks or patch panels shall be labelled in four (4) locations (each end of cable and each faceplate/patch panel).

**2 PRODUCT**

**2.1 Cable Labelling**

- 2.1.1 All products shall meet UL 969 standards and be rated for indoor or outdoor use as applicable to the installation.
- 2.1.2 Cable labels shall be self laminating, vinyl with white printing area and sized to allow label to wrap around 2.5 times minimum. Labels also shall be sized to suit the labelling requirement maintaining a minimum 10pt. font size.

**3 EXECUTION**

**3.1 General**

- 3.1.1 All labels shall be laser printed. No handwritten labels shall be accepted.

**3.2 Cable Labels**

- 3.2.1 Cable labels shall be installed on clean and dry cable and mounted within 100mm or 4" of each end of each cable.
- 3.2.2 Labels on all faceplates, patch panels and IDC mounts shall be mounted on a clean dry surface and aligned accurately.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Work Included**

1.1.1 Comply with Section 27 00 03 – General Specifications and Requirements for Audio-Visual Communications.

### **1.2 General**

1.2.1 For General information refer to applicable sections in this document.

## **2 PRODUCT**

### **2.1 AV-401 and AV-402 – [Meeting Room 111 and 110]**

#### **2.1.1 Input**

Specified Product.

Qty.	Manufacturer	Part No.	Description
1	Huddly	L1	Conference Camera
1	Shure	MXA920	Ceiling Microphone

#### **2.1.2 Outputs**

Specified Product.

Qty.	Manufacturer	Part No.	Description
1	NEC	M751	75" Commercial display
2	Shure	MXN5W-C	Ceiling mounted network loudspeaker

#### **2.1.3 Control**

Specified Product.

Qty.	Manufacturer	Part No.	Description
1	Crestron	UC-CX100-T-W	UC Engine Teams kit
1	Crestron	FT2-1200-PTL	Table Top
1	Crestron	FT2A-CBLR1T-HD	HDMI Cable retractor
1	Crestron	FT2A-PWR-US-2	AC Power Outlet Module
1	Crestron	FT2A-CBLR-1T-4K-USBC-HD	USB-C Cable retractor
1	Crestron	FT2A-CHGR-USBA/C	USB Type C & A Charging ports

#### **2.1.4 Hardware**

Specified Product.

Qty.	Manufacturer	Part No.	Description
1	Chief	AS3LDP7	Display Mount
1	Chief	AS3A102	UC Bracket Accessory

#### **2.1.5 Function**

Provide Video conference functionality through the Crestron teams kit.  
These functionalities include:

- .1 Room to be controlled by Crestron tabletop with custom programming.
- .2 Ability to connect BYOD device to display wirelessly and via cable cubby on the table.
- .3 Ability to have live video conference calling using UC assembly in conjunction with ceiling microphone and speakers with web-based conferencing platforms such as Teams, Zoom, etc.
- .4 Ability to share content on display wirelessly.
- .5 Ability to track speaker on the table using the conference camera.

## 2.2 **AV-403 – [ Workstations 112]**

### 2.2.1 Inputs

Specified Product.

Qty.	Manufacturer	Part No.	Description
2	Generic		Region of Peel TV (By Owner)
1			TV Receiver (By Others)
3	Crestron	DM-TX-200-C-2G	Wall plate Input

### 2.2.2 Outputs

Specified Product.

Qty.	Manufacturer	Part No.	Description
2	NEC	M551	55" Commercial Display
3	NEC	M751	75" Commercial Display
3	Crestron	SAROS SB-200-P-B	Sound Bar

### 2.2.3 Control

Specified Product.

Qty.	Manufacturer	Part No.	Description
3	Crestron	TSW-1070-W-S	10" Wall Mount touch screen
3	Crestron	DM-RMC-4KZ-100-C	DM Receiver
1	Crestron	DMF-CI-8	DM Card Chassis
6	Crestron	DM-NVX-351C	DM Encoder
3	Crestron	DM-NVX-350	Decoder
1	Crestron	HD-WP-4K-401-C	Video Processor
1	Crestron	CEN-SW-POE-16	16 Port POE Switch

### 2.2.4 Hardware

Specified Product.

Qty.	Manufacturer	Part No.	Description
------	--------------	----------	-------------

5	Chief	LSM1U	Display Mount
1	Middle Atlantic	MFR-1627GC	16RU Mobile Furniture rack
1	APC	AP9562	1U PDU

#### 2.2.5 Function

- .1 Ability to share content on the displays via TV Receiver, Region of Peel TV and HDMI wall input.
- .2 Ability to chose the video source of the content and destination display using Crestron wall mount touch panel.

### 2.3 **AV-404 – [Parade room 113]**

#### 2.3.1 Inputs

Specified Product.

Qty.	Manufacturer	Part No.	Description
1	Generic		TV Receiver
3	Brightsign		Digital Signage Player
1	Extron	WPB 109	Wall plate Input
1	Extron	WPD 100 AV	AV Wall plate input

#### 2.3.2 Outputs

Specified Product.

Qty.	Manufacturer	Part No.	Description
1	Surface	Surface Hub-85	85" Interactive Display c/w Cart
2	NEC	M551	55" Commercial Display

#### 2.3.3 Control

Specified Product.

Qty.	Manufacturer	Part No.	Description
1	Crestron	TSW-1070-W-S	10" Wall Mount touch screen
1	Crestron	HD-MD6X2-4K-E	HDMI Switcher

#### 2.3.4 Hardware

Specified Product.

Qty.	Manufacturer	Part No.	Description
2	Chief	LSM1U	Display Mount
2	Chief		Pole mount

#### 2.3.5 Function

- .1 Ability to present and collaborate using your own device's (BYOD). Connect BYOD to display using HDMI input.
- .2 Provide videowall information and control with access to programing content through any browser with appropriate credentials.

.3 Room to be controlled by Crestron wall mount touch panel.

#### 2.4 **AV-405 – [Cafeteria 114]**

##### 2.4.1 Inputs

Specified Product.

Qty.	Manufacturer	Part No.	Description
1	BrightSign		Digital Signage Player
1	Extron	WPB 109	Wall plate Input
1	Extron	WPD 100 AV	AV Wall plate input
1			TV Receiver (By Others)

##### 2.4.2 Outputs

Specified Product.

Qty.	Manufacturer	Part No.	Description
2	NEC	M651	65" Commercial Display
2	Crestron	SAROS SB-200-P-B	Sound Bar

##### 2.4.3 Control

Specified Product.

Qty.	Manufacturer	Part No.	Description
1	Crestron	TSW-1070-W-S	10" Wall Mount touch screen

##### 2.4.4 Hardware

Specified Product.

Qty.	Manufacturer	Part No.	Description
2	Chief	LSM1U	Display Mount

##### 2.4.5 Function

.1 Provide videowall information and control with access to programing content through any browser with appropriate credentials.

.4 Room to be controlled by Crestron wall mount touch panel.

#### 2.5 **AV-406 – [Expanded Training I 210]**

##### 2.5.1 Inputs

Specified Product.

Qty.	Manufacturer	Part No.	Description
1	Shure	MXA920	Ceiling Microphone
1	Crestron	IV-CAM-P20-B	PTZ Camera
1	Extron	WPB 109	Wall plate Input
1	Extron	WPD 100 AV	AV Wall plate input
1	Crestron	FT2-202-ELEC	Table Top



1 Crestron AM-3200 WF Airmedia

#### 2.5.2 Outputs

Specified Product.

Qty.	Manufacturer	Part No.	Description
1	Epson	Powerlite 810E	Ultra Shot Throw Projector
1	Da-Lite		120" Motorized Projector Screen
2	Shure	MXN5W-C	Ceiling mounted network loudspeaker

#### 2.5.3 Control

Specified Product.

Qty.	Manufacturer	Part No.	Description
1	Crestron	UC-CX-100-T	UC Engine Teams kit
1	Crestron	DMF-CI-8	DM Card Chasis
2	Crestron	DM-NVX-D30C	Decoder
1	Crestron	DM-NVX-360	Encoder
3	Crestron	DM-NVX-E30C	Encoder
2	Crestron	DM-NVX-360	Decoder
1	Crestron	C4PN	Control Processor
1	Crestron	GLS-PART-CN	Room Sensor
1	Crestron	IV-SAM-VXS-1B	Automate VX System
1	Inogeni		SDI to USB Converter

#### 2.5.4 Hardware

Specified Product.

Qty.	Manufacturer	Part No.	Description
1	Middle Atlantic	MFR-1627GC	16RU Mobile Furniture rack
1	APC	AP9562	1U PDU

#### 2.5.5 Function

- .1 Ability to present, call and collaborate using your own device's (BYOD). Connect BYOD to display wirelessly and input sound to the loudspeakers as required.
- .5 Provide video conference support to room through PTZ camera.
- .6 Ability to have audio input via ceiling microphones.
- .7 Room to be controlled by Crestron wall mount touch panel.

### 2.6 **AV-407 – [Expanded Training II 211]**

#### 2.6.1 Inputs

Specified Product.

Qty.	Manufacturer	Part No.	Description
1	Shure	MXA920	Ceiling Microphone

1	Crestron	IV-CAM-P20-B	PTZ Camera
1	Extron	WPB 109	Wall plate Input
1	Extron	WPD 100 AV	AV Wall plate input
1	Shure	MXA920	Ceiling Microphone

#### 2.6.2 Outputs

Specified Product.

Qty.	Manufacturer	Part No.	Description
1	NEC	M981	98" Commercial Display
2	Shure	MXN5W-C	Ceiling mounted network loudspeaker

#### 2.6.3 Control

Specified Product.

Qty.	Manufacturer	Part No.	Description
1	Crestron	UC-CX-100-T	UC Engine Teams kit
1	Crestron	DMF-CI-8	DM Card Chasis
2	Crestron	DM-NVX-D30C	Decoder
1	Crestron	DM-NVX-360	Encoder
3	Crestron	DM-NVX-E30C	Encoder
2	Crestron	DM-NVX-360	Decoder
1	Crestron	C4PN	Control Processor
1	Crestron	GLS-PART-CN	Room Sensor
1	Crestron	IV-SAM-VXS-1B	Automate VX System
1	Inogeni		SDI to USB Converter

#### 2.6.4 Hardware

Specified Product.

Qty.	Manufacturer	Part No.	Description
1	Chief	XPA1UB	Mobile Display Cart

#### 2.6.5 Function

- .1 Ability to present, call and collaborate using your own device's (BYOD). Connect BYOD to display wirelessly and input sound to the loudspeakers as required.
- .8 Provide video conference support to room through PTZ camera.
- .9 Ability to have audio input via ceiling microphone.
- .10 Room to be controlled by Crestron wall mount touch panel.

### 2.7 **AV-408 – [Expanded Training III 212]**

#### 2.7.1 Inputs

Specified Product.

Qty.	Manufacturer	Part No.	Description
1	Shure	MXA920	Ceiling Microphone

1	Crestron	IV-CAM-P20-B	PTZ Camera
1	Extron	WPB 109	Wall plate Input
1	Extron	WPD 100 AV	AV Wall plate input
1	Shure	MXA920	Ceiling Microphone

#### 2.7.2 Outputs

Specified Product.

Qty.	Manufacturer	Part No.	Description
1	NEC	M981	98" Commercial Display
2	Shure	MXN5W-C	Ceiling mounted network loudspeaker

#### 2.7.3 Control

Specified Product.

Qty.	Manufacturer	Part No.	Description
1	Crestron	UC-CX-100-T	UC Engine Teams kit
1	Crestron	DMF-CI-8	DM Card Chasis
1	Crestron	DM-NVX-360	Encoder
3	Crestron	DM-NVX-E30C	Encoder
2	Crestron	DM-NVX-360	Decoder
1	Crestron	C4PN	Control Processor
1	Crestron	GLS-PART-CN	Room Sensor
1	Crestron	IV-SAM-VXS-1B	Automate VX System
1	Inogeni		SDI to USB Converter

#### 2.7.4 Hardware

Specified Product.

Qty.	Manufacturer	Part No.	Description
1	Chief	XPA1UB	Mobile Display Cart

#### 2.7.5 Function

- .1 Ability to present, call and collaborate using your own device's (BYOD). Connect BYOD to display wirelessly and input sound to the loudspeakers as required.
- .11 Provide video conference support to room through PTZ camera.
- .12 Ability to have audio input via ceiling microphone.
- .13 Room to be controlled by Crestron wall mount touch panel.

### 2.8 **AV-409 – [Servery 213]**

#### 2.8.1 Inputs

Specified Product.

Qty.	Manufacturer	Part No.	Description
1	BrightSign		Digital Signage Player
1	Extron	WPB 109	Wall plate Input

1	Extron	WPD 100 AV	AV Wall plate input
1			TV Receiver (By Others)

2.8.2 Outputs  
Specified Product.

Qty.	Manufacturer	Part No.	Description
2	NEC	M651	65" Commercial Display
2	Crestron	SAROS SB-200-P-B	Sound Bar

2.8.3 Control  
Specified Product.

Qty.	Manufacturer	Part No.	Description
1	Crestron	TSW-1070-W-S	10" Wall Mount touch screen

2.8.4 Hardware  
Specified Product.

Qty.	Manufacturer	Part No.	Description
2	Chief	LSM1U	Display Mount

2.8.5 Function

- .1 Provide videowall information and control with access to programing content through any browser with appropriate credentials.
- .14 Room to be controlled by Crestron wall mount touch panel.

## 2.9 **AV-410 – [Fitness 693]**

2.9.1 Inputs  
Specified Product.

Qty.	Manufacturer	Part No.	Description
1			TV Receiver (By Others)

2.9.2 Outputs  
Specified Product.

Qty.	Manufacturer	Part No.	Description
1	NEC	M651	65" Commercial Display
2	TOA		Wall Speakers

2.9.3 Control  
Specified Product.

Qty.	Manufacturer	Part No.	Description
1	Crestron	TSW-1070-W-S	10" Wall Mount touch screen

1 Crestron AMPX-300 Amplifier

2.9.4 Hardware

Specified Product.

Qty.	Manufacturer	Part No.	Description
1	Chief	LSM1U	Display Mount

2.9.5 Function

.1 Provide videowall information and control with access to programing content through any browser with appropriate credentials.

.15 Room to be controlled by Crestron wall mount touch panel.

**2.10 AV-411,414,416 and 417 – [Lobby 104, VEPA Room, Male and Female Locker]**

2.10.1 Inputs

Specified Product.

Qty.	Manufacturer	Part No.	Description
1	BrightSign		Digital Signage Player

2.10.2 Outputs

Specified Product.

Qty.	Manufacturer	Part No.	Description
1	NEC	M551	55" Commercial LED Display

2.10.3 Hardware

Specified Product.

Qty.	Manufacturer	Part No.	Description
1	Chief	LSM1U	Display Mount

2.10.4 Function

.1 Provide videowall information and control with access to programing content through any browser with appropriate credentials.

**2.11 AV-412 and AV-413 – [Corridor B 120]**

2.11.1 Inputs

Specified Product.

Qty.	Manufacturer	Part No.	Description
3	BrightSign		Digital Signage Player

2.11.2 Outputs

Specified Product.

Qty.	Manufacturer	Part No.	Description
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3	NEC	M551	55" Commercial LED Display
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2.11.3 Hardware

Specified Product.

Qty.	Manufacturer	Part No.	Description
3	Chief	LSM1U	Display Mount

2.11.4 Function

- .1 Provide videowall information and control with access to programing content through any browser with appropriate credentials.

### 3 **EXECUTION**

- 3.1 **The Audio-Visual Communications Contractor shall refer to other sections of these specifications.**

END OF SECTION

## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1. Comply with Section 27 00 03 – General Specifications and Requirements for Communications.

### **1.2 General**

- 1.2.1. The Communications Contractor shall commission the cabling infrastructure by completing detailed testing described further in this section and successfully completing requirements to ascertain a manufacturer's warranty of not less than 20 years for the complete copper and fibre solution.
- 1.2.2. The Communications Contractor shall be responsible for completing a "Permanent Link" test for 100% of all horizontal and backbone cabling installed for use as part of this project.
- 1.2.3. The Communications Contractor shall repair and/or replace all components at no additional cost to the Owner for all failed test results.
- 1.2.4. All copper test results will be based on the balanced twisted-pair test requirements as defined in:

ANSI/TIA/EIA-568-B.1  
ANSI/TIA/EIA-568-B.2

- 1.2.5. All fibre cabling testing will be based on the following testing standards:

ANSI/TIA/EIA-568-B.1  
ANSI/TIA/EIA-568-B.3  
TIA/EIA TSB-140  
ANSI/TIA/EIA-526-14-A OFSTP 14A—Optical Power Loss Measurements of  
Installer Multimode Fibre Cable Plant  
ANSI/TIA/EIA-526-7 OFSTP 7—Measurement of Optical Power Loss of  
Installed Single-Mode Fibre Cable Plant

### **1.3 Copper Test Parameters**

- 1.3.1. The following test parameters will be used and measured for all (4) pairs in every copper cable based on Category of cable:

Wire Map  
Length  
Insertion Loss  
Near End Cross Talk (NEXT)  
Power Sum Near End Cross Talk (PSNEXT)  
Equal Level Far End Cross Talk (ELFEXT)  
Power Sum Equal Level Far End Crosstalk (PSELFEXT)  
Return Loss  
Propagation Delay  
Delay Skew

1.3.2. Category 3 cabling only shall be tested for:

Wire map (continuity)  
Length  
Shorts  
Grounds

1.3.3. Test multi-pair cables in single, two or four pair configurations based on applicable use.

1.3.4. The nominal velocity propagation (NVP) shall be set for each specific manufacturer and cable specification.

1.3.5. The following test parameters will be used and measured for all Coaxial cabling:

DC loop resistance  
Impedance  
Length  
TDR  
Attenuation  
Noise

1.3.6. The tests shall be performed by comparing the measured value with the specified test limits based on the applicable category standards.

1.3.7. A Pass result shall only be accepted with a "Pass" result from an approved tester. "Pass\*" shall not be accepted and shall be deemed as a "Fail".

1.3.8. Test results from 1MHz through 100MHz or 250MHz as applicable shall all exceed the test limits in order for the cable to be considered to have passed.

#### **1.4 Optical Fibre Test Parameters**

1.4.1. Fibre test parameters shall meet ANSI/TIA/EIA Standard 568-B for field testing of fibre optic links. The link attenuation shall be calculated by the following formulas specified in ANSI/TIA/EIA 568-B:

Link Attenuation = Cable Attenuation + Connector Insertion Loss + Splice Insertion Loss

Cable Attenuation (dB) = Attenuation Coefficient (dB/km) x Length (km)

Connector Attenuation (dB) = Number of connector pairs x connector loss (dB)  
[Maximum allowable connector loss is 0.75 dB]

Splice Attenuation (dB) = Number of splices (S) x splice loss (dB)  
[Maximum allowable splice loss is 0.3 dB]

1.4.2. Acceptable Attenuation Coefficients are listed below:

Type	Wavelength (nm)	Coefficient (dB/km)
Multimode 62.5/125 µm	850	3.5
	1300	1.5



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Multimode 50/125 µm	850	3.5
	1300	1.5
Singlemode (Inside Plant)	1310	1.0
	1550	1.0
Singlemode (Outside Plant)	1310	0.5
	1550	0.5

Notes: Active devices or passive devices other than cable, connectors, and splices are not included in Link Attenuation tests.

- 1.4.3. Link attenuation test limits are based on the use of the One Reference Jumper Method specified by ANSI/TIA/EIA-526-14A, Method B and ANSI/TIA/EIA- 526-7, Method A.1 and TSB 140.
- 1.4.4. The acceptable link attenuation for a multimode horizontal optical fibre cabling solution is based on the maximum 90 m (295ft) testing distance. The horizontal optical fibre cabling link segments need to be tested at only one (1) wavelength. The horizontal link should be tested at 850 nm or 1300 nm in one direction in accordance with ANSI/EIA/TIA-526-14A, Method B, and One Reference Jumper and TSB 140. The horizontal link may be tested using a fixed upper limit for attenuation of 2.0 dB. This value is based on the loss of two (2) connector pairs, one (1) pair at the telecommunications outlet/connector and one (1) pair at the horizontal cross-connect, plus 90 m (295 ft) of optical fibre cable.
- 1.4.5. Multimode Backbone Link shall be tested in both directions at both operating wavelengths. Tests shall be performed at 850 nm and 1300 nm in accordance with ANSI/EIA/TIA-526 14A and TSB 140. The link attenuation equation shall be used to determine limit acceptable values, because backbone length and the potential number of splices vary depending upon site conditions.
- 1.4.6. Singlemode Backbone Links shall be tested at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA-526-7, Method A.1, One Reference Jumper and TSB 140. All Singlemode links shall be certified with test tools using laser light sources at 1310 nm and 1550nm.
- 1.4.7. Complete a test each strand of fibre with an Optical Time Domain Reflectometer (OTDR) for length and attenuation. Performance test shall be below the total return loss budget for the cable connectors/balun. Provide comprehensive OTDR testing for all fibre runs. Include a hard copy chart recording with the test documentation.
- 1.4.8. Fibre Optic Cable test result data shall contain the following information in an electronic database for each strand tested:
  - .1 The identification of the link/fibre in accordance with the identification and labelling method specified for the project.

- .2 Insertion loss measured at each wavelength specified including the test limit calculated for the each wavelength and the margin.
- .3 Link length for each optical fibre based on the formulas in this document.

## **1.5 Test Documentation**

- 1.5.1. Test results shall be prepared in one page format and include:
  - .1 Cable Identity
  - .4 Date and Time of Test
  - .5 Technicians Signature
  - .6 Make and Model of Tester Hardware and Software Version
  - .7 Copy of Tester Calibration Certificate
- 1.5.2. Sample and layout of test results shall be approved by Technology Systems Consultant prior to final submission.
- 1.5.3. Test results shall be supplied in electronic format matching tester used to conduct testing. Files to be MS Windows based and inclusive of viewing software if required.

## **1.6 Warranty**

- 1.6.1. The Communications Contractor shall arrange for a not less than 20 year Manufacturer Warranty for a complete end to end solution for copper and fibre cabling.
- 1.6.2. In addition to the Manufactures Warranty the Communications Contractor shall provide a written unconditional parts and labour (1) warranty from the date of "Substantial Completion". On projects not requiring official filling of Substantial Completion the warranty start date will be based on written acceptance of the project by the Owner.
- 1.6.3. The Communications Contractor shall provide proof of application for the manufacturer's warranty within 5 days of project award.
- 1.6.4. The Communications Contractor shall provide a Plaque and/or framed Warranty Certificate issued directly from the Manufacturer at the completion of the project.

## **2 PRODUCT**

### **2.1 General**

- 2.1.1. Testing equipment shall provide testing based on the following standards:
  - .1 Level IIe field test instruments are required for measurements up to category 5e and Class D cabling.
  - .2 Level III field test instruments are required for measurements up to category 6 and Class E cabling.

- 2.1.2. Testers shall be calibrated prior to use on the project and proof of such calibration shall be available to the Technology Systems Consultant if requested.
- 2.1.3. Tester shall be equipped with manufacturer approved and provided test cords. Field assemblies for testing will not be acceptable.
- 2.1.4. The same tester type shall be used throughout the duration of the project.
- 2.1.5. Technicians shall be specifically trained and approved to use the tester used in this project. Proof of training may be requested.

## **2.2 Acceptable Field Testers**

### **2.2.1. Copper**

Fluke DSX Series

### **2.2.2. Optical Fibre**

- .1 For multimode fibre, field test equipment shall meet ANSI/TIA/EIA-525-14-A. Consult also ANSI/TIA/EIA-455-50B and ANSI/TIA/EIA-568-B.1, clause 11 for further clarification.
- .8 For singlemode fibre, field test equipment shall meet ANSI/TIA/EIA-526-7.

Fluke MultiFiber® series  
Fluke DSX Series  
OTDR

## **3 EXECUTION**

### **3.1 General**

- 3.1.1. The Technology Systems Consultant reserves the right to witness test any or all of the cabling as required. The Communications Contractor will provide (3) days notice prior to starting testing in any particular phase of the project.
- 3.1.2. The Technology Systems Consultant may request verification testing of up to 10% of the cabling installation. A fee of \$150 per cable will be back-charged to the Communications Contractor and deducted from the final payment for failed test results.
- 3.1.3. The Communications Contractor shall arrange and include all time required to tour site with manufacturer in order to warranty the cabling solution. This includes for additional visits if required.
- 3.1.4. The Communications Contractor shall provide (24) hour service for responding to warranty items. Initial response time to the Owner shall be no more than (1) hour. All repairs to shall be completed within (24) hours.

- 
- 3.1.5. The Communications Contractor shall provide (2) technicians for cut over support for each phase of the project as noted below. This work may be required after hours or on a weekend and shall be included in the tender amount.

Phase 1 (8) hours of regular time

- 3.1.6. During this time the Owner may request additional testing, moves, adds or changes to the installation.

**END OF SECTION**

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**1 GENERAL**

**1.1 Work Included**

- 1.1.1 Comply with Section 27 00 03 – General Specifications and Requirements for Audio-Visual Communications.

**1.2 General**

- 1.2.1 The Audio-Visual Communications Contractor shall commission the Audio-Visual System(s) by completing detailed testing described further in this section, any testing required by the manufacturer(s) and successfully completing requirements to ascertain a manufacturer's warranty.
- 1.2.2 The Audio-Visual Communications Contractor shall repair and/or replace all components at no additional cost to the Owner for all failed tests.
- 1.2.3 The Audio-Visual Communications Contractor shall ensure that all equipment is bench tested prior to installation.
- 1.2.4 Upon completion of work as described in these specifications and drawings the Audio-Visual Communications Contractor shall submit a written requested to the Technology Systems Consultant for a site inspection. Should the Audio-Visual System(s) not be complete and ready for testing, the Audio-Visual Communications Contractor shall be required to pay for subsequent site inspection(s).
- 1.2.5 The Audio-Visual Communications Contractor shall provide all necessary personnel to operate and test the Audio-Visual System(s) and all shall be qualified to test and adjust all equipment.
- 1.2.6 The Audio-Visual Communications Contractor shall repair or replace any equipment that fails to operate or meet performance requirements.

**1.3 Warranty**

- 1.3.1 In addition to the Manufactures Warranty the Audio-Visual Communications Contractor shall provide a written unconditional parts and labour (1) warranty from the date of "Substantial Completion". On projects not requiring official filling of Substantial Completion the warranty start date shall be based on written acceptance of the Audio-Visual System(s) by the Owner.
- 1.3.2 The Audio-Visual Communications Contractor shall provide proof of application for the manufacturer's warranty within 5 days of project award, where such application is required.

**1.4 Service Contract**

- 1.4.1 The Audio-Visual Communications Contractor shall offer the Owner a service contract for a period of one, three and five years to start following expiration of warranty period.

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**2    PRODUCT**

**2.1    Testers**

- 2.1.1 Provide any test equipment required to ensure that all tests provide confirmation of conformance to technical specifications.

**3    EXECUTION**

**3.1    General**

- 3.1.1 The Audio-Visual Communications Contractor shall provide (48) hour service for responding to warranty items. Initial response time to the Owner shall be no more than (1) hour. All repairs to shall be completed within (48) hours.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1. Comply with Section 27 00 03 – General Specifications and Requirements for Communications.

### **1.2 Lightning and Surge Protection**

- 1.1.2. All Indoor/Outdoor copper or armoured cables shall be protected using Building Entrance Terminals.

## **2 PRODUCT**

### **2.1 Lightning and Surge Protectors**

- 1.1.3. Building Entrance Terminals shall use industry standard 5 pin protection modules.
- 1.1.4. Plastic components shall meet or exceed specifications set for in UL 497.
- 1.1.5. Surge protection modules shall be 5 pin, 3 element gas type protection modules. Over voltage on either side shall cause the entire tube to ionize to provide a simultaneous path to ground for both sides of the circuit.
- 1.1.6. Ground pin shall be tin. Tip and Ring pins shall be gold alloy.
- 1.1.7. The nominal DC breakdown shall be 300V @ 100V/μsec.
- 1.1.8. The minimum surge life shall be as follows:

Surge	Minimum Operations
10A, 10 x 1000 μsec	Unlimited
100A, 10 x 1000 μsec	> 300
1 Arms, 1 sec	> 60
10 Arms, 1 sec	> 20

- 1.1.9. The Capacitance shall be 1 Vrms@ 1 KHz, 50VDC < 100pf and the hold current shall be 200mA minimum.
- 1.1.10. Fail safe operation shall be:
- |         |          |
|---------|----------|
| Current | Time     |
| @ 1.0A  | < 50 sec |
| @ 5.0A  | < 15 sec |
| @ 20A   | < 10 sec |
| @ 60A   | < 3 sec  |
- 1.1.11. The Building Entrance Terminals shall include solid state surge protection modules.

Specified Product:		
Circa	2200B-100	Building Entrance Terminals
Circa	CT3B1S	Solid State Surge Protection Modules

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Belden AX100826 Bix 4-pair  
Belden AX100827 110 4-pair

**2.2 Grounding Lug Kits**

1.1.12. Refer to Section 27 05 26 – Grounding and Bonding for Communications.

**3 EXECUTION**

**3.1 Lightening and Surge Protectors**

1.1.13. All pairs of the Indoor/Outdoor copper cable shall be installed with Building Entrance Terminals and surge protection modules at both ends. Building Entrance Terminals shall be installed within 50' of the copper cabling entering into a building.

**3.2 Lightening Protection Backboards**

1.1.14. Use backboard(s) for mounting of all cables that enter/exit the building as well as all building entrance terminals, lightening protection modules and all related equipment.

1.1.15. Refer to drawings for location of lightening protection backboard(s).

1.1.16. For backboard construction requirements refer to Section 27 11 16 – Communications Cabinets, Racks, Frames and Enclosures.

**3.3 Grounding and Bonding**

1.1.17. Bond building entrance terminals to Telecommunications Grounding Busbar (provided by Division 26).

1.1.18. For all grounding and bonding requirements refer to Section 27 05 26 – Grounding and Bonding for Communications.

**END OF SECTION**



## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1. Comply with Section 27 00 03 – General Specifications and Requirements for Communications.

### **1.2 General**

- 1.1.2. All Communications equipment rooms shall be kept clean and free of debris at all times including during construction.

### **1.3 Location of Equipment**

- 1.1.3. Cabinets, racks, brackets, backboards and devices may be relocated prior to installation from the location shown on contract documents a distance of up to 3.05 m (10'-0") without adjustment to the contract price.

### **1.4 Telecommunications Rooms (TR)**

- 1.1.4. Plywood backboards shall be provided as detailed on the drawings.
- 1.1.5. All racks, cabinets, and/or brackets shown on drawings shall be provided by the Communications Contractor unless otherwise noted.
- 1.1.6. Cable tray and pathways within the TR shall be provided by Division 26 unless otherwise noted.
- 1.1.7. The Communications Contractor shall supply and install cabling waterfalls for all locations cabling drops from the cable tray into racks, cabinets and backboards.

## **2 PRODUCT**

### **2.1 Telecommunications Racks**

- 1.1.8. Telecommunications racks supplied and installed for this project shall be floor mounted, free standing and black.
- 1.1.9. The racks shall provide 44U of rack mounting space and shall be double tapped (front and back of rail) with mounting holes as per EIA-310-C.
- 1.1.10. Refer to drawings for quantity of telecommunications racks. Provide additional mounting screws as required, to secure all patch panels, shelves and Owner equipment mounted on racks.

Specified Product:

	RU	Part Number	Type
Belden	45	XDR8419	2-Post Distribution Rack
Hammond	45	RB-2PA	2-Post Open Frame Rack
Panduit	45	R2P6S	2-Post Rack

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## 2.2 **Telecommunications Rack Components**

### 1.1.11. Vertical Cable Managers

- .1 Vertical cable managers shall be installed to run the full height of the rack.
- .2 The vertical cable manager shall have hinged front doors and back and side knockouts or fingers for transition of patch cords. Knockouts and fingers shall be able to be removed without cutting and provide bend radius protection.
- .3 The manager shall include slack management spools that can be repositioned as required. Install the quantity of cable managers as shown on drawings.
- .4 Where racks are ganged, supply and install one 8" wide vertical cable manager at the end of each row, and supply and install one 12" wide vertical cable manager between racks.

#### Specified Product:

	Width	Part Number
Belden	8"	BHVVH008
Hammond	8"	FRCM44U812
Panduit	8"	PRVF8 c/w PRD8

### 1.1.12. Horizontal Cable Managers

- .1 Horizontal cable managers shall be compatible with standard 19" racks.
- .2 Each horizontal cable manager shall be located as shown on drawings.

#### Specified Product:

HCM 1	Systimax	HCM2U	Located as shown
	Ortronics	OR-MM6HMF2RU	Located as shown
	Panduit	NCMHAEF2	Located as shown
	Belden	BHH192U	Located as shown

## 2.3 **Audio-Visual Cabinets**

- 1.1.13. Cabinets shall be supplied and installed complete with all accessories to provide a complete cabinet as indicated below.
- 1.1.14. Cabinets shall be floor mounted, freestanding and have the ability to be ganged together.
- 1.1.15. Cabinets shall have a capacity of 44U, with mounting holes as per EIA-310-C.
- 1.1.16. Cabinets shall have (6) knockouts on top and be able to accept fans or chimney extensions.
- 1.1.17. Shelving shall be able to bear 200 lbs. in a retracted or extended position.
- 1.1.18. Each server cabinet shall be black, 30" x 42" and include the following components:

#### Specified Product:

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Description	Middle Atlantic	y
30" x 42" Cabinet	BGR-4532-AV	1
Front – Mesh Door	-	1
Rear – Mesh Door	-	1
Solid Side Panels	-	2
Vertical Manager	-	2
19" Mounts with Cage Nuts	-	4
Keyboard	CTRS-R3-19-B	1
Roll-out Shelf (Heavy Duty)	SS-VTR-CVR5	2
Set of (2) Fixed and (2) Swivel	-	1
Castors		
10-32 Cage Nuts		50

## 2.4 **Plywood Backboards**

- 1.1.19. All backboards supplied and installed for this project shall be constructed of  $\frac{3}{4}$ " thick, fire rated, 4' wide x 8' high, one side good plywood as noted on drawings.
- 1.1.20. Unless otherwise noted, plywood sheets shall be placed vertically.
- 1.1.21. All backboards shall be painted with two (2) coats of fire retardant non-conductive white paint. "Fire Rating" stamp shall be left visible (unpainted) to allow for confirmation of rating.
- 1.1.22. Communications Contractor shall supply and install all backboards as noted on Communications Drawings including for use by others.
- 1.1.23. Offset backboards:
  - .1 Shall be mounted to 2"x6" studs.
  - .2 All cables shall be fed from behind the backboard unless otherwise noted.
  - .3 Install offset backboards where required as shown on drawings.
- 1.1.24. Surface mounted (flush) backboards:
  - .1 Shall be used for wall mount brackets, wall mount double swing-out cabinets, wall mount racks, telephone equipment, service provider equipment, lightening protection, horizontal cables, riser cables, IDC punch down blocks, CATV equipment, and/or any other use as identified in the scope of work for this project.
  - .2 Install surface mounted (flush) backboards where required as shown on drawings.

## 2.5 **Cable Drop Control ("waterfalls")**

- 1.1.25. Cable drop control fittings shall be manufactured by the cable tray manufacturer. For further information, refer to Section 27 05 28 – Pathways for Communications.

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### **3 EXECUTION**

#### **3.1 General**

- 1.1.26. The Communications Contractor shall provide a complete installation and be responsible for coordination within all telecommunications rooms. Installations and locations of all equipment shall be as noted on drawings. The Communications Contractor shall confirm final layout before proceeding and be responsible to install equipment and fittings.
- 1.1.27. Any cutting or patching required for installation of any telecommunications component will be the responsibility of the Communications Contractor.

#### **3.2 Racks and Cabinets**

- 1.1.28. Install racks and cabinets in positions shown and gang as required with manufactured recommended products. All racks and cabinets shall be level and clean of all dust and debris.
- 1.1.29. The Communications Contractor shall anchor all racks to the floor, raised floor or wall in the location indicated.
- 1.1.30. All racks shall be installed without any applied or screened labelling containing any name or information other than the original manufacturer's identification.
- 1.1.31. Install all accessories with mechanical fasteners, including power bars permanently to racks to provide a complete solution.

#### **3.3 Grounding and Bonding**

- 1.1.32. For all grounding and bonding requirements refer to Section 27 05 26 – Grounding and Bonding for Communications.

**END OF SECTION**

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## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1. Comply with Section 27 00 03 – General Specifications and Requirements for Communications.

### **1.2 IDC Termination**

- 1.1.2. Insulation displacement connectors (IDC) shall have an insulation resistance of no less than 100 mega Ohms between clips.
- 1.1.3. Insulation displacement connectors (IDC) shall have a durability of no less than 200 insertions / withdrawals of any combination of wire gauge.
- 1.1.4. Insulation displacement connectors (IDC) shall be FCC Part 68, subpart F compliant.

## **2 PRODUCT**

### **2.1 IDC Termination Blocks**

- 1.1.5. All horizontal voice cables shall be terminated on the backboard (as shown on drawings) unless otherwise specified in this document.
- 1.1.6. All cables shall be terminated on IDC connectors complete with associated hardware such as mounts, cable/cross-connect wire managers, etc.
- 1.1.7. The IDC connectors shall accept 22 to 26 AWG solid copper conductors.
- 1.1.8. The IDC mounts shall accept cables from behind the connector.

Specified Product:

	Description	Part No.
Belden	BIX Mount (50 pair) - QMBIX10C	A0284798
Belden	BIX Distribution Connector (4 pair marking) - QCBIX1A4	A0393146
Belden	BIX Modular Jack Connector (6 port, PS5, T568A/B Coded)	AX100798
Belden	Distribution Ring	A0270168
Belden	Designation Strip (50/pack)	A0270169
Belden	19" Rack Bracket Kit	A0352331

- 1.1.9. Cable management in the form of distribution rings or approved similar shall be provided between columns and rows of IDC mounts to support cross connect management in a manner recommended by the manufacturer.

### **2.2 Modular Copper Patch Panels – 48 Port**

- 1.1.10. All horizontal UTP cabling shall be terminated on 2U, 48 port modular patch panels.

- 1.1.11. All copper patch panels shall be black.
- 1.1.12. All modular patch panels shall be populated with UTP modules as required. Module category and colour shall meet requirements set out in Section 27 15 43 - Communications Faceplates and Connectors.

Specified Product:		Comments:
Belden	AX103115	Keystone
Hubbell	HPJ48	Keystone
Commscope	CPP-UDDM-KJ-2U-48	Keystone
Wirewerks	WW-000041	Keystone

### 2.3 **Optical Fibre Patch Panels**

- 1.1.13. Fibre Optic cabling shall be terminated in patch panels.
- 1.1.14. Patch panels shall be black in colour and supplied as indicated on drawings.
- 1.1.15. Blank strips shall be provided for all unused openings.

Specified Product:		Comments:
Belden	AX105563	1U
Corning	PCH-01U	1U
Hubbell	FCR1U3SP	1U
Commscope	FL2-12RPNL-B	1U
e		
Wirewerks	PPW1U1	1U

## 3 **EXECUTION**

### 3.1 **Termination Requirements**

- 1.1.16. All cabling shall be terminated using EIA/TIA 568A configuration.

### 3.2 **Grounding and Bonding**

- 1.1.17. For all grounding and bonding requirements refer to Section 27 05 26 – Grounding and Bonding for Communications.

### 3.3 **Patch Panels**

- 1.1.18. Install patch panels on racks and cabinets with a minimum of four (4) bonding screws.
- 1.1.19. Provide a final installation that is clean of all fingerprints and dirt complete with identification labelling as per these specifications.

**END OF SECTION**

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## 1 **GENERAL**

### 1.1 **Work Included**

- 1.1.1. Comply with Section 27 00 03 – General Specifications and Requirements for Communications.

### 1.2 **General**

- 1.1.2. The power cord must be a minimum 6 feet in length to reach up to the ladder tray or down to the floor where it will plug into a receptacle (supplied by Division 26).
- 1.1.3. The power bar(s) shall be UL/ULC listed and shall meet UL/ULC 1363 and 1449 requirements.

## 2 **PRODUCT**

### 2.1 **Vertical Power Bars**

- 1.1.4. Each active equipment rack shall come complete with two vertical power bars.
- 1.1.5. The power bar(s) shall be UL/ULC listed and shall meet UL/ULC 1363 and 1449 requirements.

Specified  
Product:

Comments:

APC AP8830 Metered Rack PDU w 24 NEMA 5-20R outlets.  
10-foot power cord w NEMA 5-20P connector.

APC AP8832 Metered Rack PDU w 24 NEMA 5-20R outlets.  
10-foot power cord w NEMA L5-30P connector.

### 2.2 **Uninterruptible Power Supplies**

- 1.1.6. The uninterruptible Power Supplies shall be CSA/UL/ULC listed.

Specified Product:

Comments:

APC SRT2200RMXLA-NC Rack mount, 2U, Network Card w Rail Kit.  
2200VA, 6 NEMA 5-20R, 1 NEMA L5-20R outlets.  
6-foot power cord w NEMA 5-20P connector.

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APC	SRT3000RMXLA-NC	Rack mount, 2U, Network Card w Rail Kit. 3000VA, 8 NEMA 5-20R, 1 NEMA L5-30R outlets. 8-foot power cord w NEMA L5-30P connector.
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### **3 EXECUTION**

#### **3.1 General**

1.1.7. Mount power bars to rear vertical cable managers of rack(s).

**END OF SECTION**



## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1. Comply with Section 27 00 03 – General Specifications and Requirements for Communications.

### **1.2 General**

- 1.1.2. Backbone cabling shall be installed in pathways indicated on drawings and as per Section 27 05 28 of this specification.
- 1.1.3. All cables penetrating the exterior building enclosure shall conform to Section 01 83 16.
- 1.1.4. All cables shall be neatly bundled and installed as per the manufacturer's guidelines or the standards in these specifications; whichever is more stringent.
- 1.1.5. The Communications Contractor shall be responsible for a complete backbone cabling installation including but not limited to termination jacks, IDC mounts, cabling, Velcro wraps, patch panels and labelling.
- 1.1.6. Provide grounding and protection for all backbone cables as specified in section 27 05 26 of this specification.

## **2 PRODUCT**

### **2.1 Backbone 4 Pair UTP Cabling**

- 1.1.7. All backbone cabling shall be UTP, 4 pair, with solid copper conductors, compliant with EIA/TIA cable category as identified below.
- 1.1.8. The cable shall be CSA certified and stamped with CMP or CMR rating accordingly.
- 1.1.9. Cable shall have continuous sequential length markers clearly and permanently printed over the entire length of the cable.
- 1.1.10. All UTP cables shall meet requirements identified below.

Specified Product:

	Cat.	Rating	Colour	Series <sup>1</sup>	Termination
Belden	6A	CMP/FT6	White		Patch Panel
Hubbell	6A	CMP/FT6	White		Patch Panel
Commscope	6A	CMP/FT6	White		Patch Panel
Wirewerks	6A	CMP/FT6	White		Patch Panel

Notes: <sup>1</sup> Series or Product Codes shown are not colour specific.

## 2.2 **Multipair Backbone Cable**

- 1.1.11. All backbone cabling shall be UTP, with solid copper conductors, compliant with EIA/TIA cable category as identified below.
- 1.1.12. The cable shall be CSA certified and stamped with CMP or CMR rating accordingly.
- 1.1.13. Cable shall have continuous sequential length markers clearly and permanently printed over the entire length of the cable.
- 1.1.14. Cable shall be constructed with 25pr units complete with binding cords and overall jacket splitting cord.
- 1.1.15. All UTP cables shall meet requirements identified below.

Specified Product:

	Cat.	Rating	Pairs	Colour	Series <sup>1</sup>	Termination
Belden	5e	CMR/FT4	25	White		Patch Panel
Hubbell	5e	CMR/FT4	25	White		Patch Panel
Commscope	5e	CMR/FT4	25	White	PUR5525xx-UI	Patch Panel
Wirewerks	5e	CMR/FT4	25	White		Patch Panel

Notes: <sup>1</sup> Series or Product Codes shown are not colour specific.

## 3 **EXECUTION**

### 3.1 **General**

- 1.1.16. Comply with manufacturer's recommended bundling practices for installation. Ensure that excess pressure is not placed on the cable at any point that may result in the compression or deformation of the cable jacket and internal pair/conductor geometry.
- 1.1.17. Cables shall not be scrapped, dented or otherwise damaged before, during or after installation. All damaged cabling shall be replaced at no extra cost to the Owner.
- 1.1.18. Ensure that all cables are of sufficient length to allow for slack, vertical runs, wastage, connectorization and future moves.
- 1.1.19. All pairs of all copper cables shall be terminated.

### 3.2 **Multipair Copper Backbone Cable**

- 1.1.20. Multipair copper cabling shall be installed in a continuous run and no splices shall be permitted.
- 1.1.21. The Telecommunicates Contractor will be responsible to protect the cabling during installation and will be responsible for replacing the cable if found to have dents or scraps which may have an effect on the cable performance, reliability and life span.

- 1.1.22. Separate backbone cables in neatly combed bundles based on type service being provided for identification purposes. Secure all cables with Velcro wraps only.
- 1.1.23. When a potential for cable damage existing during installation provide a non-corrosive cable lubricant to allow ease of installation.
- 1.1.24. Armoured or metallic sheath cables shall be grounded with an approved bonding clamp to the local grounding busbar with a minimum #6 AWG green ground wire and installed as per section 27 05 26 of this specification.
- 1.1.25. Multipair cabling installed in common pathways with other types of cabling shall be bundled separately and installed in a manner not damage other cabling during installation or over the life of the installation.

**3.3 Cable Routing**

- 1.1.26. Make all necessary adjustments to cable route(s) / pathway(s) to accommodate architectural, structural, mechanical and/or electrical conditions.
- 1.1.27. All pathways shall be parallel to building lines. If it is necessary to route cables otherwise to accommodate cable length written permission shall be obtained from the Technology Systems Consultant prior to installation.
- 1.1.28. Any deviation from cable routing shown on drawings (where shown) shall be approved in writing by the Technology Systems Consultant prior to installation and shall be documented on record drawings.

**3.4 Bend Radius**

- 1.1.29. Do not kink or exceed the cable minimum bend radius for all cabling. For all copper cabling maintain a minimum of (4) times cable diameter as bend radii if the manufacturer specifies no bend radius.

**3.5 Cable Lubricant**

- 1.1.30. Where there is the potential for excess stress on a cable(s) when pulling through conduit systems, apply a non-corrosive quick drying lubricant to the cable to facilitate pulling.
- 1.1.31. Completely remove all cable lubricant from cable jacket as cable exits the conduit system prior to termination and labelling.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1. Comply with Section 27 00 03 – General Specifications and Requirements for Communications.

### **1.2 General**

- 1.1.2. Backbone cabling shall be installed in pathways indicated on drawings and as per Section 27 05 28 of this specification.
- 1.1.3. All cables penetrating the exterior building enclosure shall conform to Section 01 83 16.
- 1.1.4. All cables shall be neatly bundled and installed as per the manufacturer's guidelines or the standards in these specifications; whichever is more stringent.
- 1.1.5. The Communications Contractor shall be responsible for a complete backbone cabling installation including and not limited to, termination jacks, adaptor plates, cabling, velcro wraps, patch panels and labelling.
- 1.1.6. All Fibre Optic cabling shall be installed in dedicated conduit and/or innerduct.
- 1.1.7. Provide grounding and protection for all optical fibre armoured cables as specified in section 27 05 26 of this specification.

## **2 PRODUCT**

### **2.1 Multimode Distribution Series Optical Fibre Cable**

- 1.1.8. Optical fibre backbone cabling shall be distribution series indoor OFNP Plenum rated multimode optical fibre.
- 1.1.9. The cable(s) shall be CSA approved and stamped accordingly.
- 1.1.10. Distribution series optical fibre cabling shall have 900-micron tight buffered fibre individually placed in a 2mm coded sub-unit with aramid strength members.
- 1.1.11. Distribution series optical fibre cabling shall be fully dielectric with no metallic components in the cable.

Specified Product:

	Type	Rating	Strands	Colour	Series
Corning	OM3 50/125µm	OFNP	12	Aqua	
Belden	OM3 50/125µm	OFNP	12	Aqua	
Hubbell	OM3 50/125µm	OFNP	12	Aqua	
Commscope	OM3 50/125µm	OFNP	12	Aqua	
Wirewerks	OM3 50/125µm	OFNP	12	Aqua	

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### **3 EXECUTION**

#### **3.1 Fibre Optic Backbone Cabling**

- 1.1.12. Fibre optic cabling shall be installed in conduit and/or innerduct and as per manufacturer's instructions.
- 1.1.13. Fibre optic cabling in racks and cabinets shall be neatly dressed using Velcro ty-wraps.
- 1.1.14. All cables shall be continuous with no splices other than those that may be identified on drawings.
- 1.1.15. Provide a minimum of 3.0 m (10'-0") of slack at the patch panel end of each fibre optic cable. Neatly coil slack in cabinet and fasten with Velcro wraps.
- 1.1.16. All strands of fibre optic cabling shall be terminated.
- 1.1.17. Clean all cabling of pulling lubricants prior to termination and labelling.
- 1.1.18. Carefully relocate existing fibre optic cabling into new racks without removing connectors. Provide complete testing of all existing fibre connections as per these specifications.

#### **3.2 Bend Radius**

- 1.1.19. Do not kink or exceed the cable minimum bend radius for all cabling. Maintain a minimum of ten (10) times the cable diameter or 30 mm (1.2") whichever is larger for a bend radius.

#### **3.3 Cable Lubricant**

- 1.1.20. Where there is the potential for excess stress on a cable(s) when pulling through conduit systems, apply a non-corrosive quick drying lubricant to the cable to facilitate pulling.
- 1.1.21. Completely remove all cable lubricant from cable jacket as cable exits the conduit system prior to termination and labelling.

**END OF SECTION**

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## 1 **GENERAL**

### 1.1 **Work Included**

- 1.1.1 Comply with Section 27 00 03 – General Specifications and Requirements for Audio-Visual Communications.

### 1.2 **General**

- 1.2.1 Audio-Visual cabling shall be installed in pathways indicated on drawings (where indicated) and as per Section 27 05 28 of this specification.
- 1.2.2 All cables shall be neatly bundled and installed as per the manufacturer's guidelines or the standards in these specifications; whichever is more stringent.
- 1.2.3 Ensure that all cables are sufficiently long to allow for slack, vertical runs, wastage, connectorization and future moves.

## 2 **PRODUCT**

### 2.1 **Video Cable**

- 2.1.1 The cable shall be CSA certified and stamped with FT6 rating accordingly.
- 2.1.2 One (or more) of the following shall be used depending on signal carrying requirements. The Audio-Visual Communications Contractor shall determine based on equipment and connectors used.

Specified Product:

	Part No.	Rating	Cond.
Belden	1280P	FT6	6
Belden	1279P	FT6	5
Belden	1278P	FT6	4
Belden	1277P	FT6	3

### 2.2 **Microphone Cabling**

- 2.2.1 The cable shall be CSA certified and stamped with FT6 rating accordingly.

Specified Product:

	Part No.	Rating
Belden	TBD	FT6

### 2.3 **Computer Audio Cable**

- 2.3.1 The cable shall be CSA certified and stamped with FT6 rating accordingly.

Specified Product:

	Part No.	Rating	Cond.
Belden	83553	FT6	3

### 2.4 **Cresnet Control Cable**

- 2.4.1 The cable shall be CSA certified and stamped with FT6 rating accordingly.

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Specified Product:

	Part No.	Rating	AWG	Pairs	Strands
Crestron	Cresnet-P	FT6	22, 18	2	7, 16
Belden	1502P	FT6	22, 18	2	7, 16

## 2.5 **Speaker Cable**

2.5.1 The cable shall be CSA certified and stamped with FT6 rating accordingly.

Specified Product:

	Part No.	Rating	AWG	Cond.	Strands
Belden	6300FC	FT6	18	2	7

## 2.6 **UTP Cable**

2.6.1 Refer to Section 27 15 13 (Communications Copper Horizontal Cabling) for details.

## 2.7 **HDMI Cable**

2.7.1 The cable shall be CSA certified and stamped with FT6 rating accordingly.

## 2.8 **Antennae Cable**

2.8.1 The cable shall be CSA certified and stamped with FT6 rating accordingly.

## 2.9 **Optical Fibre Cable**

2.9.1 The cable shall be CSA certified and stamped with FT6 rating accordingly.

# 3 **EXECUTION**

## 3.1 **General**

- 3.1.1 UTP cabling shall be terminated as per manufacturer's guidelines and remove only enough cable jacket to perform termination.
- 3.1.2 Comply with manufacturer's recommended bundling practices for installation. Ensure that excess pressure is not placed on the cable at any point that may result in the compression or deformation of the cable jacket and internal pair/conductor geometry.
- 3.1.3 Cables shall not be scrapped, dented or otherwise damaged before, during or after installation. All damaged cabling shall be replaced at no extra cost to the Owner.
- 3.1.4 Ensure that all cables are of sufficient length to allow for slack, vertical runs, wastage, connectorization and future moves.
- 3.1.5 All cables shall be continues between terminated ends. No splices or connections shall be permitted at any point between terminated ends.
- 3.1.6 The Audio-Visual Communications Contractor shall seal cable ends to prevent moisture from entering cable while being pulled through conduit. Assume moisture is present within all conduits.

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**3.2 Cable Routing**

- 3.2.1 Make all necessary adjustments to cable route(s) / pathway(s) to accommodate architectural, structural, mechanical and/or electrical conditions.
- 3.2.2 All pathways shall be parallel to building lines. If it is necessary to route cables otherwise to accommodate cable length written permission shall be obtained from the Technology Consultant prior to installation.
- 3.2.3 Any deviation from cable routing shown on drawings (where shown) shall be approved in writing by the Technology Consultant prior to installation and shall be documented on record drawings.
- 3.2.4 Cables shall not be installed within non-metallic cable pathways such as PVC conduit.

**3.3 Bend Radius**

- 3.3.1 Do not kink or exceed the cable minimum bend radius for all cabling. For all copper cabling maintain a minimum of (4) times cable diameter as bend radii if the manufacturer specifies no bend radius.
- 3.3.2 Where there is the potential for excess stress on a cable(s) when pulling through conduit systems, apply a non-corrosive quick drying lubricant to the cable to facilitate pulling. Completely remove all cable lubricant from cable jacket as cable exits the conduit system prior to termination and labelling.

**3.4 Cable Distance Limitations**

- 3.4.1 The Audio-Visual Communications Contractor shall verify distance limitations of all cables and adjust AWG, cable type, and/or equipment to suite application.

**END OF SECTION**



## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1. Comply with Section 27 00 03 – General Specifications and Requirements for Communications.

### **1.2 General**

- 1.1.2. All cables penetrating the exterior building enclosure shall conform to Section 01 83 16.
- 1.1.3. Horizontal cabling shall be installed in pathways indicated on drawings and as per Section 27 05 28 of this specification.
- 1.1.4. All cables shall be neatly bundled and installed as per the manufacturer's guidelines or the standards in these specifications; whichever is more stringent.
- 1.1.5. Ensure that all cables are sufficiently long to allow for slack, vertical runs, wastage, connectorization and future moves.
- 1.1.6. The maximum horizontal run length shall not exceed 90-meters. If the 90 meter constraint cannot be met, the Communications Contractor shall notify the Technology Systems Consultant immediately (prior to installation).

## **2 PRODUCT**

### **2.1 Horizontal Unshielded Twisted Pair (UTP) Copper Cabling**

- 1.1.7. All horizontal cabling shall be UTP, 4 pair, minimum 22 AWG, solid copper conductor, compliant with EIA/TIA cable category as identified below.
- 1.1.8. The cable shall be CSA certified and stamped with CMP or CMR rating accordingly.
- 1.1.9. All UTP cables shall meet requirements identified below.

Specified Product:

	Cat.	Rating	Colour	Series <sup>1</sup>	System	Termination
Belden	6	CMR/FT4	Blue	2412	Data	Patch Panel
Hubbell	6	CMR/FT4	Blue	C6RRW	Data	Patch Panel
Commscope	6	CMR/FT4	Blue	CS34R WHT C6	Data	Patch Panel
Wirewerks	6	CMR/FT4	Blue	6040-2RWH-R305	Data	Patch Panel
Belden	6	CMR/FT4	Yellow	2412	Camera	Patch Panel
Hubbell	6	CMR/FT4	Yellow	C6RRW	Camera	Patch Panel
Commscope	6	CMR/FT4	Yellow	CS34R WHT C6	Camera	Patch Panel
Wirewerks	6	CMR/FT4	Yellow	6040-2RWH-R305	Camera	Patch Panel
Belden	6	CMR/FT4	White	2412	WAP	Patch Panel

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Hubbell	6	CMR/FT4	White	C6RRW	WAP	Patch Panel
Commscope	6	CMR/FT4	White	CS34R WHT C6	WAP	Patch Panel
Wirewerks	6	CMR/FT4	White	6040-2RWH- R305	WAP	Patch Panel
Belden	6	CMR/FT4	Red	2412	Phones	Patch Panel
Hubbell	6	CMR/FT4	Red	C6RRW	Phones	Patch Panel
Commscope	6	CMR/FT4	Red	CS34R WHT C6	Phones	Patch Panel
Wirewerks	6	CMR/FT4	Red	6040-2RWH- R305	Phones	Patch Panel

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Notes: <sup>1</sup> Series or Product Codes shown are not colour specific.

### **3 EXECUTION**

#### **3.1 Horizontal UTP Cabling**

- 1.1.10. UTP cabling shall be terminated as per manufacturer's guidelines and remove only enough cable jacket to perform termination.
- 1.1.11. Untwist pairs a maximum of 13 mm (1/2") for all categories of cables.
- 1.1.12. Provide a minimum of 3.0 m (10'-0") of slack at both ends of each cable. Neatly coil slack and attach to ladder tray or provide independent support in ceiling. Slack for workstation outlets shall be located above outlet in ceiling space.
- 1.1.13. UTP cabling shall be neatly bundled using only Velcro wraps. Bundle cables separately for identification purposes when applicable.
- 1.1.14. Comply with manufacturer's recommended bundling practices for installation. Ensure that excess pressure is not placed on the cable at any point that may result in the compression or deformation of the cable jacket and internal pair/conductor geometry.
- 1.1.15. Cables shall not be scrapped, dented or otherwise damaged before, during or after installation. All damaged cabling shall be replaced at no extra cost to the Owner.
- 1.1.16. Ensure that all cables are of sufficient length to allow for slack, vertical runs, wastage, connectorization and future moves.

#### **3.2 Cable Routing**

- 1.1.17. Make all necessary adjustments to cable route(s) / pathway(s) to accommodate architectural, structural, mechanical and/or electrical conditions.
  - 1.1.18. All pathways shall be parallel to building lines. If it is necessary to route cables otherwise to accommodate cable length written permission shall be obtained from the Technology Systems Consultant prior to installation.
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- 1.1.19. Any deviation from cable routing shown on drawings (where shown) shall be approved in writing by the Technology Systems Consultant prior to installation and shall be documented on record drawings.

**3.3 Bend Radius**

- 1.1.20. Do not kink or exceed the cable minimum bend radius for all cabling. For all copper cabling maintain a minimum of (4) times cable diameter as bend radii if the manufacturer specifies no bend radius.
- 1.1.21. Where there is the potential for excess stress on a cable(s) when pulling through conduit systems, apply a non-corrosive quick drying lubricant to the cable to facilitate pulling.
- 1.1.22. Completely remove all cable lubricant from cable jacket as cable exits the conduit system prior to termination and labelling.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1. Comply with Section 27 00 03 – General Specifications and Requirements for Communications.

### **1.2 Outlet Locations**

- 1.1.2. Horizontal cable outlets may be relocated prior to installation from the location shown on the drawings to a maximum distance of 3.05m (10'-0") without adjustment to the contract price.

## **2 PRODUCT**

### **2.1 Keystone Style UTP Termination Modules (Outlet)**

- 1.1.3. All keystone style UTP termination modules shall have the following minimum performance characteristics:

Modular jack current rating	1.5 Amperes maximum
Modular jack durability	1,000 mating cycles
Modular jack contact pressure	100 grams minimum per contact
Dielectric voltage strength	1,000 V RMS at 60Hz for 1 minute
Insulation resistance	200 MΩ minimum
Contact resistance	1 MΩ per contact
IDC termination connectors resistance	100 MΩ between clips

- 1.1.4. The contact material of the termination module shall be phosphor bronze with 50 micro-inches of gold over nickel.

- 1.1.5. Keystone style UTP termination modules shall be of the same category as the UTP cabling to ensure that manufacturer end to end warranties can be attained.

- 1.1.6. UTP cables shall be terminated with keystone style modules as listed below:

**Specified Product:**

	Cat.	Colour	Part No.	System
Belden	6	Blue	AX101326	Data/Voice
Hubbell	6	Blue	HXJ6B	Data/Voice
Commscope	6	Blue	NA	Data/Voice
Wirewerks	6	Blue	KW- CC645BBL	Data/Voice

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2.2 **Optical Fibre Connectors**

- 1.1.7. Optical fibre terminations shall be made for field termination and shall be of the same manufacturer and style to suit the cabling installed.
- 1.1.8. Fibre terminations shall be made with a ceramic ferrule and cable boot.
- 1.1.9. Optical fibre cables shall be terminated with connectors as listed below:

Specified Product:

	Fibre	Type	Part No.
Corning	MM	LC	95-050-99-X
Belden	MM	LC	AX105202-S1
Hubbell	MM	LC	FCLCMM
Commscope	MM	LC	MFC-LCR
Wirewerks	MM	LC	FTALCMM

2.3 **Optical Fibre Adapter Strips**

- 1.1.10. Optical fibre adapter strips shall be of the same manufacturer and style to suit the cabling installed.
- 1.1.11. Optical fibre patch panels shall be installed complete with optical fibre adapter strips as listed below:

Specified Product:

	Fibre	Type	Part No.
Corning	MM	LC	CCH-CPXX-A8
Belden	MM	LC	
Hubbell	MM	LC	FSPLCDM3
Commscope	MM	LC	
Wirewerks	MM	LC	ASWL

2.4 **Workstation Faceplates and Adapters**

- 1.1.12. Workstation outlets shall be supplied and installed for all terminations at the workstation end and as further specified below to suit the application.
- 1.1.13. The Communications Contractor shall confirm colour of outlets prior to placing order.
- 1.1.14. Workstation outlets shall be manufactured by the end to end solution manufacturer when available.
- 1.1.15. Modular Furniture Faceplates
- .1 Modular furniture faceplates shall be installed in all furniture outlets that have a modular furniture knockout shall consist of a minimum of (3) ports.
- .2 Each outlet shall be installed with the specified termination modules or a blank insert. No openings shall remain exposed.
- .3 Communications Contractor shall verify furniture manufacturer and modular faceplate requirement prior to placing order

Specified Product:

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	No. of Ports	Part No.	Style:
Corning	3-port		Keystone
Corning	4-port		Keystone
Belden	3-port		Keystone
Belden	4-port		Keystone
Hubbell	2-port	FP2BK	Keystone
Hubbell	4-port	FP4BK	Keystone
Commscope	3-port		Keystone
Commscope	4-port		Keystone
Wirewerks	3-port	WW000903BK	Keystone
Wirewerks	4-port	WW000904BK	Keystone

1.1.16. Wall Faceplates

- .1 Decora style adapters and faceplates shall be installed for all wall outlets, floor or raceway outlets and shall consist of a minimum of (2) ports.
- .1 Each outlet shall be installed with the specified termination modules or a blank insert. No openings shall remain exposed.

Specified Product:

	No. of Ports	Part No.	Style:
Corning	3-port		Keystone
Belden	3-port	AX102661	Keystone
Hubbell	3-port	IFP13W	Keystone
CommScope	3-port	M108FR3-262	Keystone
Wirewerks	3-port	WW-000056	Keystone

1.1.17. Surface Mount Boxes

- .1 Surface mount boxes shall be installed for all furniture outlets that do not have a modular furniture knockout, exposed ceiling outlets or any location not provided with an electrical backbox.
- .1 The surface mounted box shall consist of a minimum of (2) ports.
- .2 Each outlet shall be installed with the specified termination modules or a blank insert. No openings are to remain exposed.

Specified Product:

	No. of Ports	Part No.	Style:
Corning	2-port		Keystone
Belden	2-port	A0645273	Keystone
Hubbell	2-port	ISB2W	Keystone
Commscope	2-port		Keystone
Wirewerks	2-port	WW000071	Keystone

The Communications Contractor shall allow for the supply and installation of (10) blank plates and wall inserts to suit the application.

- 1.1.18. Blank inserts and faceplates shall be installed in all unused communication ports for workstation outlets. Blank insert plates shall be manufactured by the end to end solution manufacturer and be of the same colour as the workstation outlet.

### **3 EXECUTION**

#### **3.1 Termination Requirements**

- 1.1.19. All cabling shall be terminated using EIA/TIA 568A configuration.

#### **3.2 Workstation Outlets**

- 1.1.20. Install all workstation outlets level and flush to wall surface.
- 1.1.21. Provide a final installation that is clean of all fingerprints and dirt complete with identification labelling as per these specifications.

**END OF SECTION**

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## 1 **GENERAL**

### 1.1 **Work Included**

- 1.1.1. Comply with Section 27 00 03 – General Specifications and Requirements for Communications.

### 1.2 **General**

- 1.1.2. All cables penetrating the exterior building enclosure shall conform to Section 01 83 16.
- 1.1.3. All products shall be supplied by the Communications contractor unless specified otherwise.
- 1.1.4. The Communications contractor shall verify the number of POE equipment as per the site drawings and with the Owner.
- 1.1.5. The Communications contractor shall keep allowance for modular expansion of 20% on day one (1) of a fully operational system.

## 2 **PRODUCT**

### 2.1 **Outdoor Remote Media converter.**

- 1.1.6. The Communications contractor shall specify and supply materials including the mounting hardware in accordance with the Manufacturer's installation guidelines.
- 1.1.7. The Communications contractor shall coordinate installation location on site with Owner.

#### Specified Product:

	Series	Comment
Fiber Connections	GR20YPBYE0B-001-SW	2-Port Media converter
Fiber Connections	Polycase ML-70F15	Enclosure for 2-Port media converter
Fiber Connections	GR10YPBYY0B-004-AEC	1-Port Media converter
Fiber Connections	PTK-18426	Enclosure for 1-Port media converter
Fiber Connections	PMH-2	Pole mount hardware

### 2.2 **Hybrid Cable**

- 1.1.8. The Communications contractor shall verify lengths for each data location on site with the Owner.



- 1.1.9. The Communications contractor shall coordinate with Div.26 (Electrical) and Owner for cable pathways.

Specified Product:  
Series

Fiber Connections	HQ022DENXL2FB001-XX	2 Fiber OS2+2x12 AWG IP1-LC to LC duplex + M8 armoured Hybrid assembly
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- 1.1.10. XX denotes the length of the cable.

### 2.3 **Patch Panel with Power supply**

- 1.1.11. All hybrid cabling shall be terminated in powered patch panel as per the manufacturer's installations guidelines.

Specified Product:  
Series

Fiber Connections	PP2UT00-003 – 2U Power patch panel, 6slot, termination block, Class 2
Fiber Connections	PP4UT00-003 – 4U Power patch panel, 12 slot, termination block, Class 2
Fiber Connections	PS5600250AN-002 – Power Supply module
Fiber Connections	MM00-001 – Blank plate

### 2.4 **Media Module**

- 1.1.12. The Communications contractor shall specify and supply materials including the mounting hardware.

Specified Product:  
Series

Fiber Connections	MM60GPHSL0B-001
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## 3 **EXECUTION**

### 3.1 **Grounding**

- 1.1.13. The Communications contractor shall follow the manufacturer's installation guidelines for all grounding requirements.

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3.2 **Ethernet Cable**

- 1.1.14. The Communications contractor shall follow the manufacturer's installation guidelines for all cabling requirements .

3.3 **Hybrid Cabling**

- 1.1.15. Cabling shall be installed in conduits/pathways as per the manufacturer's instructions.
- 1.1.16. Cabling in racks and cabinets shall be neatly dressed using Velcro ty-wraps.
- 1.1.17. All cables shall be continuous with no splices other than those that may be identified on drawings.
- 1.1.18. Provide a minimum of 3.0 m (10'-0") of slack at the patch panel end of each cable. Neatly coil slack in cabinet and fasten with Velcro wraps.
- 1.1.19. All strands of cabling shall be terminated.
- 1.1.20. Clean all cabling of pulling lubricants prior to termination and labelling.

3.4 **Cable Routing**

- 1.1.21. Make all necessary adjustments to cable route(s) / pathway(s) to accommodate architectural, structural, mechanical and/or electrical conditions.
- 1.1.22. All pathways shall be parallel to building lines. If it is necessary to route cables otherwise to accommodate cable length written permission shall be obtained from the Technology Systems Consultant prior to installation.
- 1.1.23. Any deviation from cable routing shown on drawings (where shown) shall be approved in writing by the Technology Systems Consultant prior to installation and shall be documented on record drawings.

3.5 **Bend Radius**

- 1.1.24. Do not kink or exceed the cable minimum bend radius for all cabling. Maintain a minimum of ten (10) times the cable diameter or 30 mm (1.2") whichever is larger for a bend radius.

3.6 **Cable Lubricant**

- 1.1.25. Where there is the potential for excess stress on a cable(s) when pulling through conduit systems, apply a non-corrosive quick drying lubricant to the cable to facilitate pulling.
- 1.1.26. Completely remove all cable lubricant from cable jacket as cable exits the conduit system prior to termination and labelling.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1. Comply with Section 27 00 03 – General Specifications and Requirements for Communications.

### **1.2 General**

- 1.1.2. The Communications Contractor shall supply and install all cross-connects and patch cords at both ends unless otherwise noted.
- 1.1.3. Cross-connects and patch cords shall be of the same manufacturer, quality and category to provide a complete end to end solution which shall be warranted by the selected manufacturer.
- 1.1.4. Supply and install (2) patch cords for every horizontal cable installed. (Only (1) patch cord at patch panel end for voice cabling required).
- 1.1.5. Supply and install (2) duplex fibre optic patch cords for every two fibre optic strands installed.
- 1.1.6. Provide miscellaneous cross-connects to owner supplied circuits as required.

### **1.3 Patch Cords**

- 1.1.7. All patch cords used shall be 8 position 4 pair T568A/B: T568A/B patch cords unless otherwise noted.
- 1.1.8. All patch cords shall be CMR (FT4) rated and stamped accordingly and shall be consistent with the category and manufacturer of the UTP cabling system that shall be warranted as part of the end to end solution.

## **2 PRODUCT**

### **2.1 UTP Patch Cords**

- 1.1.9. All patch cords shall be CMR (FT4) rated and stamped accordingly.
- 1.1.10. Patch cords shall be manufactured of stranded conductor cable with (8) position (4) pair terminations at both ends.

Specified Product:

	Cat.	Rating	Colour	Length	System	Location
Belden	6	CMR/FT4	Blue	7'	Data	Telecom Room
Hubbell	6	CMR/FT4	Blue	7'	Data	Telecom Room
Commscope	6	CMR/FT4	Blue	7'	Data	Telecom Room
Wirewerks	6	CMR/FT4	Blue	7'	Data	Telecom Room
Belden	6	CMR/FT4	Blue	10'	Data	Workstation

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Hubbell	6	CMR/FT4	Blue	10'	Data	Workstation
Commscope	6	CMR/FT4	Blue	10'	Data	Workstation
Wirewerks	6	CMR/FT4	Blue	10'	Data	Workstation
Belden	6	CMR/FT4	Red	7'	Phones	Telecom Room
Hubbell	6	CMR/FT4	Red	7'	Phones	Telecom Room
Commscope	6	CMR/FT4	Red	7'	Phones	Telecom Room
Wirewerks	6	CMR/FT4	Red	7'	Phones	Telecom Room
Belden	6	CMR/FT4	White	7'	WAP	Telecom Room
Hubbell	6	CMR/FT4	White	7'	WAP	Telecom Room
Commscope	6	CMR/FT4	White	7'	WAP	Telecom Room
Wirewerks	6	CMR/FT4	White	7'	WAP	Telecom Room
Belden	6	CMR/FT4	Yellow	7'	Camera	Telecom Room
Hubbell	6	CMR/FT4	Yellow	7'	Camera	Telecom Room
Commscope	6	CMR/FT4	Yellow	7'	Camera	Telecom Room
Wirewerks	6	CMR/FT4	Yellow	7'	Camera	Telecom Room
Belden	6	CMR/FT4	Red	10'	Phones	
Hubbell	6	CMR/FT4	Red	10'	Phones	
Commscope	6	CMR/FT4	Red	10'	Phones	
Wirewerks	6	CMR/FT4	Red	10'	Phones	
Belden	6	CMR/FT4	White	10'	WAP	
Hubbell	6	CMR/FT4	White	10'	WAP	
Commscope	6	CMR/FT4	White	10'	WAP	
Wirewerks	6	CMR/FT4	White	10'	WAP	
Belden	6	CMR/FT4	Yellow	10'	Camera	
Hubbell	6	CMR/FT4	Yellow	10'	Camera	
Commscope	6	CMR/FT4	Yellow	10'	Camera	
Wirewerks	6	CMR/FT4	Yellow	10'	Camera	

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2.2 **Optical Fibre Patch Cords**

1.1.11. All patch cords shall be CMR (FT4) rated and stamped accordingly.

Specified Product:

	Cat.	Rating	Length	System	Location
Corning		CMR/FT4			
Belden		CMR/FT4			
Hubbell		CMR/FT4			
Commscope		CMR/FT4			
Wirewerks		CMR/FT4			

3 **EXECUTION**

3.1 **UTP Patch Cords**

1.1.12. Assume all ports shall be patched.

3.2 **Optical Fibre Patch Cords**

1.1.13. Assume all ports shall be patched.

3.3 **Cross-Connects**

1.1.14. Assume all pairs of all cables are cross-connected at both ends.

1.1.15. Install cross-connects and patch cords for each termination using cable management in a neat and workmanship fashion acceptable to the owner and the Technology Systems Consultant.

1.1.16. Provide cross-connects for all connections required by the Owner to complete the installation.

1.1.17. Use Velcro wraps to provide additional cable management as required.

1.1.18. Provide additional "D" rings and cable management for cross-connects as required.

**END OF SECTION**

**1 GENERAL**

**1.1 Work Included**

- 1.1.1 Comply with Section 27 00 03 – General Specifications and Requirements for Audio-Visual Communications Specifications and Scope.

**2 PRODUCT**

**2.1 Refer to Section 27 06 40 (Schedules for Audio-Visual Communications) for details.**

**2.2 Clock System**

- 2.2.1 Clock systems shall be powered with IP Ethernet/PoE technology.
- 2.2.2 Clock system software requirements shall be coordinated with Owner.
- 2.2.3 Acceptable manufacturers shall be Primex
- 2.2.4 Location and number of clocks shall be as per the drawings and shall be confirmed with Owner and Architect on site.

**3 EXECUTION**

**3.1 Coordination**

- 3.1.1 Audio-Visual Communications Contractor shall coordinate with Division 26 (Electrical Contractor) for the hard-wired electrical connection of any equipment requiring a hard wire connection.

**3.2 Installation**

- 3.2.1 Audio-Visual Communications Contractor shall install equipment using recommended manufacturer installation practices with approved support hardware appropriate for site conditions and installation type.

**3.3 Speakers**

- 3.3.1 Audio-Visual Communications Contractor shall be responsible for cutting ceiling tiles for the installation of speakers. Any damage to tiles shall remain the responsibility of the Audio-Visual Communications Contractor.

**3.4 Electronic Control**

- 3.4.1 Audio-Visual Communications Contractor shall create touch panel interface design as required and as noted in Part 1 of this Section.

**3.5 Touch Panel Interface Design**

- 3.5.1 The touch panel interface design layout shall be submitted for review by the Owner and the Technology Consultant prior to installation of hardware. Allow for initial interface design layout meeting with the Owner and the Technology Consultant and three additional design meetings for modifications.

- 3.5.2 The touch panel interface shall be designed with ease of use in mind.
  - 3.5.3 The Audio-Visual Communications Contractor shall document all programming for record.
  - 3.5.4 Audio-Visual Communications Contractor shall provide to the Owner un-compiled software for each program and touch panel interface design on CD for record and for future system modifications.
- 3.6 **Cables, Connectors, and Accessories**
- 3.6.1 Audio-Visual Communications Contractor shall supply and install all required cables, connectors, and accessories.
  - 3.6.2 Audio-Visual Communications Contractor shall use plenum rated cabling in all plenum ceiling spaces. Where it is unclear whether a specific space requires plenum rated cabling, the Audio-Visual Communications Contractor shall confirm with Technology Consultant prior to tender close. Use of non-plenum cabling in a plenum space installed within a plenum rated innerduct type of pathway shall not be allowed. Non-plenum cables installed in plenum spaces shall only be allowed if installed in fully enclosed metal pathways such as metal conduits (such as EMT) or fully enclosed metal tray.

**END OF SECTION**

**1 GENERAL**

**1.1 Work Included**

1.1.1 Comply with Section 27 00 03 – General Specifications and Scope.

**2 PRODUCT**

**2.1 Audio-Visual Cabinet**

2.1.1 Refer to Section 27 11 16 (Communications Cabinets, Racks, Frames and Enclosures) for details.

**3 EXECUTION**

**3.1 Coordination**

3.1.1 Audio-Visual Communications Contractor shall coordinate with Division 26 (Electrical Contractor) for the hard-wired electrical connection of any equipment requiring a hard wire connection.

**3.2 Cables, Connectors, and Accessories**

3.2.1 Audio-Visual Communications Contractor shall supply and install all required cables, connectors, and accessories.

3.2.2 Audio-Visual Communications Contractor shall use plenum rated cabling in all plenum ceiling spaces. Where it is unclear whether a specific space requires plenum rated cabling, the Audio-Visual Communications Contractor shall confirm with Technology Consultant prior to tender close. Use of non-plenum cabling in a plenum space installed within a plenum rated innerduct type of pathway shall not be allowed. Non-plenum cables installed in plenum spaces shall only be allowed if installed in fully enclosed metal pathways such as metal conduits (such as EMT) or fully enclosed metal tray.

**END OF SECTION**



**1 GENERAL**

**1.1 Work Included**

1.1.1 Comply with Section 27 00 03 – General Specifications and Scope.

**2 PRODUCT**

2.1 **Refer to Section 27 06 40 (Schedules for Audio-Visual Communications) for details.**

**3 EXECUTION**

**3.1 Coordination**

3.1.1 Audio-Visual Communications Contractor shall coordinate with Division 26 (Electrical Contractor) for the hard-wired electrical connection of any equipment requiring a hard wire connection.

**3.2 Cables, Connectors, and Accessories**

3.2.1 Audio-Visual Communications Contractor shall supply and install all required cables, connectors, and accessories.

3.2.2 Audio-Visual Communications Contractor shall use plenum rated cabling in all plenum ceiling spaces. Where it is unclear whether a specific space requires plenum rated cabling, the Audio-Visual Communications Contractor shall confirm with Technology Consultant prior to tender close. Use of non-plenum cabling in a plenum space installed within a plenum rated innerduct type of pathway shall not be allowed. Non-plenum cables installed in plenum spaces shall only be allowed if installed in fully enclosed metal pathways such as metal conduits (such as EMT) or fully enclosed metal tray.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1 Conform to the requirements of Divisions 0 and 1 and additional general information as prepared by the Architect or Prime Consultant, which apply to and form part of all sections of the work.
- 1.1.2 Read and comply with all sections of this document.
- 1.1.3 These instructions apply to and form part of all Electronic Safety and Security Sections and drawing(s).
- 1.1.4 Refer to section 28 00 05 for definitions of names, titles, terms, and abbreviations used in this document.
- 1.1.5 These documents have been prepared by Spectech specifically for use on this project and may not be reproduced in whole or in part without the express written consent of Spectech. These documents may not be used for any other purpose and/or for any other project and are considered confidential for the use of preparing a tender response.
- 1.1.6 This specification is divided into Sections which are not intended to identify contractual limits between Sub-Contractors nor between the Contractor and his Sub-Contractors. The requirements of any one Section apply to all Sections. Refer to other Divisions and Sections to ensure a complete and operational system.
- 1.1.7 These tender documents shall remain the property of the Electronic Safety and Security Consultant at all times.
- 1.1.8 The Electronic Safety and Security Contractor shall report any discrepancies between drawings and all applicable specifications to the Electronic Safety and Security Consultant immediately.
- 1.1.9 All drawings and details have been prepared to illustrate the existing and new conditions of the project and shall be considered diagrammatic. The Electronic Safety and Security Contractor shall ensure all components required to complete the fully operational system are installed with no additional cost to the Owner or the Electronic Safety and Security Consultant.
- 1.1.10 Provide all labour, materials, tools, and equipment required for the complete installation of work called for in all Sections of the Contract Documents.
- 1.1.11 The Electronic Safety and Security Contractor shall verify exact locations of all items shown and shall verify with the Technology Systems Consultant all new locations prior to installation. It shall be the responsibility of the Electronic Safety and Security Contractor to provide the Electronic Safety and Security Consultant detailed layouts of all rooms and locations of installation prior to installation for approval. All costs, including other trades as applicable, associated with changes resulting from non-approved installation will be the responsibility of the Electronic Safety and Security Contractor.

- 1.1.12 Minor changes in locations may be required by the Electronic Safety and Security Consultant in order to coordinate site conditions with other divisions and the Electronic Safety and Security Consultant reserves the right to make these changes with no additional cost to the Owner.

## **1.2 Schedule**

- 1.2.1 The Electronic Safety and Security Contractor shall be responsible to meet the project schedule as provided by the Project Manager and the Owner.
- 1.2.2 Work is generally to be performed during regular work hours unless noted otherwise in this document. The Electronic Safety and Security Contractor shall include for all necessary overtime labour in order to complete the project. The Electronic Safety and Security Contractor shall be responsible for providing labour in order to complete the work within the schedule with no additional cost to the Owner.
- 1.2.3 The Electronic Safety and Security Contractor shall supply a written project plan detailing schedule of installation in coordination with the overall project schedule. Project plan shall be prepared in MS Project.
- 1.2.4 At and near the completion of the project the Electronic Safety and Security Contractor will be responsible for providing project documentation for the Owner's further use. This will include:
- Updated Excel Spreadsheet documenting the following:
  - .1 Camera or Security Node Number
  - .2 Cable ID
  - .3 Location or door number
  - .4 Temporary As-Builts
  - .5 Contact Info for Cutover Technician
  - .6 Verification Report
- 1.2.5 All documents and information shall be provided as further detailed in Section 28 00 09 and delivered to the Electronic Safety and Security Consultant.

## **1.3 Labour**

- 1.3.1 The Electronic Safety and Security Contractor shall provide only skilled, trained tradesmen experienced in the installation of a certified installation. Each installer shall be certified with the manufacturer providing the warranty for this project.
- 1.3.2 The Electronic Safety and Security Contractor shall be responsible to provide Union or Non-union labour as required on the project site and meet all requirements without any delay or cost to the Owner, General Contractor, or other trades.

- 1.3.3 Sub-Contractors shall not be allowed to perform all or any portion of the project unless approved in writing by the Electronic Safety and Security Consultant and the Owner. Subcontractors shall be identified at time of tender to be considered for approval.
- 1.3.4 The Electronic Safety and Security Contractor shall comply at all times with local, provincial, and federal employee standards, safety acts, fire codes and other applicable legislations, codes and acts affecting the delivery of the project. The Electronic Safety and Security Contractor is responsible for the training and notifying their employees of any details associated with all codes, standards, acts and legislation applicable to this project.
- 1.3.5 WSIB (Workplace Safety Insurance Board) clearance certificate indicating a good standing shall be provided by the Electronic Safety and Security Contractor prior to acceptance of any contract.
- 1.3.6 Provide personal identification in a form acceptable to the Owner for all employees attending the site for this project when requested.

#### **1.4 Interpretation of Drawings and Specifications**

- 1.4.1 It is the responsibility of the Electronic Safety and Security Contractor to carefully read these specifications and drawing(s) and report any discrepancies Electronic Safety and Security Contractor immediately to the Electronic Safety and Security Consultant.
- 1.4.2 At the time of tendering the Electronic Safety and Security Consultant shall notify the Electronic Safety and Security Consultant in writing of any equipment, wiring feature, software, or device necessary for full operation of any of the systems which is not included in the specification documents or drawings. Failure to supply notification shall not relieve the Electronic Safety and Security Consultant of the responsibility for providing a fully functioning system at the bid price.
- 1.4.3 While every attempt has been made to ensure that all information (including specified products and part numbers) is correct, it is the responsibility of the Electronic Safety and Security Contractor to verify availability of products and verify all part numbers.
- 1.4.4 Specifications and drawings are schematic and represent the intent of the project.
- 1.4.5 Dimensions and measurements shown in these documents shall be verified by the Electronic Safety and Security Contractor on site prior to final installation.
- 1.4.6 Quantities and lengths identified are approximate and shall not be used to gauge or limit work.
- 1.4.7 These Specifications are an integral part of the accompanying drawing(s). Any item or subject omitted from one or the other, but which is either mentioned or implied shall be considered as properly and sufficiently specified.

- 1.4.8 Certain details indicated on the drawings are general in nature and are not specifically identified for each and every occurrence of use, however, such details shall be applicable to every occurrence on the drawings.
- 1.4.9 The location and size of existing services and equipment shown on the drawings are based on the best available information. The Electronic Safety and Security Contractor shall verify the exact location, type, size, and any other pertinent information prior to commencing work.

## **1.5 Installation**

- 1.5.1 Leave areas clear where space has been designated as reserved for future equipment and equipment for other trades.
- 1.5.2 Adequate space and provisions shall be left for removal of components and servicing of equipment, with minimum inconvenience to the operation of systems.
- 1.5.3 Where equipment is shown to be 'roughed in only' obtain information from the Electronic Safety and Security Consultant before proceeding with the work.

## **1.6 Coordination**

- 1.6.1 The Electronic Safety and Security Contractor shall provide an installation and make all changes associated with coordination with other trades and to accommodate unforeseen site conditions at no additional cost to the Owner.
- 1.6.2 Prepare interference drawings and sketches for presentation to the Electronic Safety and Security Consultant to review any anticipated conflicts with other trades.
- 1.6.3 Prepare detailed layouts of equipment rooms prior to installation for review by the Electronic Safety and Security Consultant. Layouts shall indicate other major pieces of equipment being supplied by other trades.
- 1.6.4 The Electronic Safety and Security Contractor shall be responsible for attending coordination meetings as requested by the General Contractor or Project Manager for the coordination of locations and services. The Contractor's project co-ordinator selected shall be assigned for the duration of the project and may only be changed with the written consent of the Electronic Safety and Security Consultant.
- 1.6.5 The Electronic Safety and Security Contractor in addition to coordination meetings shall attend weekly site meetings and be prepared to provide current project progress status, anticipated completion of future tasks and information on outstanding delivery items.
- 1.6.6 Access to the site shall comply to all rules, regulations, safety standards and security procedures established for the project or building. Fees for after hours access shall be considered included in the tender amount. No additional cost shall be accepted by the Owner for these requirements.

- 1.6.7 Cutting and patching of all surfaces as applicable to the electronic safety and security installation shall be the responsibility of and be performed by the Electronic Safety and Security Contractor. All work shall be performed to the standards set by codes and standards, Building Management, General Contractor, and the Owner.
- 1.6.8 Cutting and patching of all structural members shall be approved by the Structural Consultant prior to work starting.
- 1.6.9 Work causing noise, dust and/or odour shall be performed during evenings and/or weekends to prevent disturbance to the operation of the Owner's or surrounding businesses. Work shall be performed at agreed times and in coordination with each party. All damages caused for work performed not in compliance with this item shall be the responsibility of the Electronic Safety and Security Contractor.

#### **1.7 Temporary Services**

- 1.7.1 The Electronic Safety and Security Contractor shall provide all required materials, labour, tools, and equipment to meet the temporary requirements of the project in coordination with other trades and the General Electronic Safety and Security Contractor at no additional cost to the Owner.
- 1.7.2 All hoisting, mechanical lifts and special scaffolds shall be the responsibility of the Electronic Safety and Security Contractor and at no additional cost to the Owner.
- 1.7.3 All power supplies, extension cords and equipment cords shall be the responsibility of the Electronic Safety and Security Contractor and shall be installed in good working order and in accordance with all codes, standards and building regulations.

#### **1.8 Co-Operation with Other Divisions**

- 1.8.1 Electronic Safety and Security Cabling shall not touch or be supported from piping, ductwork, conduits, ceiling supports or any other service / equipment. Electronic Safety and Security Cabling shall be supported by approved j-hooks, cable slings, ladder / basket tray and/or conduit as outlined in this document.
- 1.8.2 Supply all items to be built in ample time for rapid progression of the work. Schedule and provide manpower and materials to proceed with work as required to satisfy the construction schedule.

#### **1.9 Existing Services and Equipment**

- 1.9.1 All changes and connections to existing services shall be made only in a manner and at a time approved by the Electronic Safety and Security Consultant and/or the Owner so as to avoid any interruption of such services during normal working hours. If necessary, changes and connections to existing services shall be made outside of normal business hours at no extra cost to the Owner.

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**1.10 Metric Conversions**

1.10.1 Particular attention shall be paid with regard to Imperial versus S.I. Metric conversions. This applies to all services including, but not limited to, equipment, material, and site services in both new and existing installations.

1.10.2 Conform to Canadian Metric Practice Guide CAN/CSA-Z234.1-89.

**1.11 Monthly Draws**

1.11.1 Monthly progress draws shall be submitted to the General Contractor for approval by the Electronic Safety and Security Consultant.

**1.12 Pricing of Changes**

1.12.1 Where a Contemplated Change Notice (CCN) has been issued and identifies potential changes to the scope of work and those changes have been price-identified in the Tender Form under the Alternate, Separate, Identified and/or Unit Pricing structure, the Electronic Safety and Security Contractor shall price all changes in accordance with the pricing provided in the Tender Form at the time of tender. All prices shall be provided in a broken-down format, identifying the pricing reference (i.e. The line item on the Tender Form).

1.12.2 Where a CCN has been issued and identifies potential changes to the scope of work and those changes have NOT been price-identified in the Tender Form under the Alternate, Separate, Identified and/or Unit Pricing structure, the Electronic Safety and Security Contractor shall provide a complete breakdown of all material, equipment and labour cost associated with each submission in the following format.

All material used in the change(s) shall be identified by:

Quantity  
Price Per Unit  
Material Cost  
Hours per Unit  
Total Hours

Summary shall include:

Total Material Value  
HST  
Technician rate (as per Tender Form)  
Forman rate  
Overhead  
Markup (profit)

Contemplated Change Notices shall include at no extra cost:

Administration

Record Drawings  
Clean up  
Co-ordination  
Engineering and Drafting  
Estimating  
Guarantee  
Hydro Inspection  
Material Delivery  
Material Expediting  
Mileage  
Parking  
Project Management  
Re-Assign Manpower  
Safety  
Schedule Extension  
Supervision  
Tool Charges  
Wastage  
Warranty

Foreman Charges: Foreman Charges shall not exceed 10% of the labour component of the price.

Overhead and Profit: All overhead fees and profit shall be fixed at 5% and 10% unless agreed to by the owner / consultant prior to installation.

## **2 PRODUCT**

### **2.1 General**

- 2.1.1 All equipment and products supplied shall be new and free of all manufacturer defects and delivery or installation damage.
- 2.1.2 All equipment and products supplied shall meet all manufacturer listed characteristics as identified in the latest manufacturer catalogue.
- 2.1.3 All products shall meet all applicable codes and standards and bare the UL/ULC label, be CSA approved and meet FCC/CRTC Regulations.
- 2.1.4 All products shall be provided in accordance with local, provincial, and national fire ratings for the installation on this project.
- 2.1.5 The only acceptable Manufacturers for this project and as further specified in this document will be the following:

HID	Access Control
Amag	Access Control
Bosch	Access Control
Assa Abloy	Access Control



Avigilon	Video Surveillance
Avigilon	Intercom System
Code Blue	EPP System
Bosch	EPP System

## **2.2 Substitutions**

- 2.2.1 Substitution of any product shall be prior approved in writing by only the Electronic Safety and Security Consultant.
- 2.2.2 The procedure for substitution approval will include the written submission by the Electronic Safety and Security Contractor including the following:
  - .1 Original specified product
  - .2 Proposed product being substituted
  - .3 Reason for substitution
  - .4 Shop drawings indicating all technical specifications
  - .5 Financial advantage
  - .6 Schedule delivery date
  - .7 Written approval from certifying system manufacturer
- 2.2.3 Based on the review of the information requested above, the Owner and/or Electronic Safety and Security Consultant reserve the right to reject any proposed substitution without delay or cost to the project or the Owner.

## **2.3 Material Handling**

- 2.3.1 The Electronic Safety and Security Contractor is responsible for the following:
  - .1 Delivery of all materials to site and transportation to the workplace in accordance with all safety regulations and procedures.
  - .2 Coordinate and schedule all hoisting with Building Management and the General Contractor.
  - .3 Provide and be responsible for lockable storage for all tools and material required to complete the installation through the duration of the project.
  - .4 Once the project is complete Remove all tools and excess materials within 2 business days once the project is complete.
- 2.3.2 The Owner and its representatives shall in no way be held liable for any missing material, equipment or tools required to complete the installation.

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### **3 EXECUTION**

#### **3.1 General**

- 3.1.1 The Electronic Safety and Security Contractor shall supply all materials, labour, tools and equipment to provide a complete warranted installation as outlined in the contract documents and suitable to the approval of the Owner, Electronic Safety and Security Consultant and inspection bodies having jurisdiction.
- 3.1.2 The Electronic Safety and Security Contractor shall be responsible for installing and providing pulling strings, ropes and fishing walls wherever conduit is not installed, or conduit is installed without these provisions.
- 3.1.3 Provide continuity of all existing services while completing the specified installation. Losses due to interruption of services will be the responsibility of the Electronic Safety and Security Contractor.
- 3.1.4 Arrange for all shutdowns one (1) week prior in writing with the Project Manager and those in control of services shall be disrupted. All overtime costs, fees, security, and other requirements shall be the full responsibility of the Electronic Safety and Security Contractor.
- 3.1.5 Should services be interrupted accidentally the Electronic Safety and Security Contractor shall provide material and labour to re-establish services immediately and shall continue without stoppage until all services have been re-established. All material and labour costs including overtime shall be borne solely by the Electronic Safety and Security Contractor. Any material and/or labour costs including overtime associated with other trades and/or the General Contractor to assist in any way the Electronic Safety and Security Contractor in re-establishing services shall be borne solely by the Electronic Safety and Security Contractor.

#### **3.2 Site Conditions**

- 3.2.1 The Electronic Safety and Security Contractor is responsible for maintaining a clean work environment and is responsible for the removal of all debris on a daily basis. Debris and removed materials shall be disposed of in conformance with all local by laws and regulations. Failing to comply and after reasonable time and written notice the General Contractor reserves the right to hire cleaners to complete the cleaning and back charge the Electronic Safety and Security Contractor.
- 3.2.2 The Electronic Safety and Security Contractor shall be responsible for the removal and reinstallation of all floor or ceiling tiles, hatch ways or access panels. All items shall be removed and replaced on a daily basis and left in the original condition. Special caution shall be taken to not break, chip or discolour with dirt or fingerprints any such items. The Electronic Safety and Security Contractor will be fully responsible for repair or replacement of all damaged pieces at the discretion of the Project Manager or Owner.
- 3.2.3 The Electronic Safety and Security Contractor is fully responsible for storage of all temporarily removed items for the project.

- 3.2.4 All materials and installation throughout the project will remain the responsibility of the Electronic Safety and Security Contractor until final completion for the project is accepted by the Owner. Damages to any item installed shall be replaced or repaired by the Electronic Safety and Security Contractor to provide a complete final installation at no additional cost to the Owner.
- 3.2.5 At the completion of the project or when the Owner requires, restore the original condition of all materials, equipment and surfaces within the work area affected by this installation.
- 3.2.6 All vehicular traffic entering the site shall be coordinated with the General Contractor and no parking or compensation for paid parking will be provided by the Owner.

### **3.3 Cutting, Patching and Repairing**

- 3.3.1 It is the responsibility of the Electronic Safety and Security Contractor to perform all cutting, patching and repair related to the Electronic Safety and Security Cabling work including any penetrations through walls or floors.

### **3.4 Hoisting Facilities**

- 3.4.1 This Division shall provide its own hoisting facilities regardless of height required to perform work.
- 3.4.2 Hoisting facilities may be provided by the General Contractor, although the General Contractor may at its own discretion not allow the Electronic Safety and Security Contractor to make use of such.

### **3.5 Safety**

- 3.5.1 The Electronic Safety and Security Contractor shall adhere to all safety laws, rules and regulations issued by the authorities having jurisdiction, General Contractor, Project Manager and the Owner.
- 3.5.2 The Electronic Safety and Security Contractor shall attend all Safety Program meetings requested by the General Contractor.
- 3.5.3 Provide adequate protection in public and work areas to pedestrian and other trade traffic using approved safety barriers, caution tape and signage.
- 3.5.4 At all times maintain clear fire exits, emergency routes and access to emergency equipment including fire hose cabinets, fire extinguishers and standpipe connections.
- 3.5.5 Smoking and combustion of any materials is strictly prohibited on all sites.
- 3.5.6 Provide information to all employees of emergency and fire safety plans for the work site and facility.
- 3.5.7 Provide protection as required by the authorities having jurisdiction to all employees for work performed in typically inaccessible or concealed spaces.

- 
- 3.5.8 If an approved subcontractor is used provide information and ensure all safety specifications herein are met.

**3.6 Site Adjustments**

- 3.6.1 Locations of all equipment, outlets or devices prior to installation may be revised to within (3) meters without any additional cost or change request.
- 3.6.2 Portions of the project may be at any time identified in writing to be "On Hold". Work in these areas shall not be started, continued, or completed until further direction is received. No additional cost shall be accepted by the Owner for areas put on hold.

**END OF SECTION**

## **1 GENERAL**

### **1.1 General**

1.1.1 The following definitions may be used in this document, as well as in any project documents such as but not limited to Addenda, Contemplated Change Notices, Change Orders, and Site Instructions:

Addendum	- Normative document used to provide additional requirements and recommendations to a published document (e.g., standards, contracts). When published, an addendum effectively becomes part of the document that it supports.
Bonding	- The permanent joining of metallic parts to form an electrically conductive path that will ensure electrical continuity and the capacity to conduct safely any current likely to be imposed.
Bonding Conductor (BC)	- A conductor used specifically for the purpose of bonding.
Building Entrance Facility	- The room or space inside a building where telecommunications cables enter and leave the building.
Electronic Safety and Security Contractor	- The successful bidder(s) responsible for the supply and installation of the Electronic Safety and Security solution as described in this Specification.
Category	- A rating that defines the performance of cabling components and systems. Describes mechanical properties and transmission characteristics of balanced twisted-pair cabling and provides a numbered designation.
Change Notice	- Normative document approved to provide additional requirements and recommendations that describes and authorizes the implementation of an engineering change to the product and its approved configuration documentation.
Owner	- Region of Peel EMS
Electronic Safety and Security Consultant	- Ghazdanafar Rizvi SPECTECH

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Contemplated Change Notice	- Normative document to provide additional requirements and recommendations that describes the implementation of an engineering change to the product and its approved configuration documentation for the purposes of pricing. This document does not authorize the implementation of a change to the product and its approved configuration documentation.
Cut Over	- The live date(s) is when the Owner will occupy the space as indicated by date and/or phasing.
Contract Drawings	All Electronic Safety and Security Systems / Security, Electrical, Architectural, Mechanical and Structural Drawings issued in relation to this project including any future changes and revision of said drawings
Contract Documents	All documents including Contract Drawings issued under this project
Grounded Conductor	- A system or circuit conductor that is intentionally grounded.
Grounding System	- A system of hardware and wiring that provides an electrical path from a specified location to an earth ground point.
Project	- Supply and installation of a complete Electronic Safety and Security solution to support Access Control, Intrusion Detection, Video Surveillance and Electronic Personal Protection system as described in this document.
Provide	- Supply and install.
Shop Drawing	- Drawings, diagrams, illustrations, schedules, performance charts, and other data prepared by the contractor which illustrate how specific portions of the work shall be installed. This includes but not limited to point-to-point high level integration diagram, riser diagram, termination diagram, panel layout, door types and product data sheet.

1.1.2 The following abbreviations may be used in this document:

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A	- Ampere
A/E	- Architect or Engineer
ac	- Alternating current
AFF	- Above Finished Floor
AME	- Architectural, Mechanical, Electrical
AN	- Access Node
ANSI	- American National Standards Institute
AP	- Access Point
ASCII	- American Standard Code for Information Interchange
ASTM	- American Society for Testing and Materials
ATD	- Asynchronous Time Division
AWG	- American Wire Gauge
b/s	- Bit per Second
BAS	- Building Automation System
BC	- Bonding Conductor
BIC	- Building Industry Consultant
BICSI®	- Building Industry Consulting Service International
bit	- Binary Digit
c/w	- Complete With
CA	- Cable
CAD	- Computer Aided Design
CATV	- Community Antenna Television (Cable Television)
CCN	- Contemplated Change Notice
CCTV	- Closed Circuit Television
CD	- Compact Disc
CD	- Change Directive (same as Change Notice and Change Order)
CEC	- Canadian Electrical Code
cm	- Centimetre
CMP	- Communications Plenum
CMR	- Communications Riser
CN	- Change Notice (same as Change Directive and Change Order)
CO	- Change Order (same as Change Notice and Change Directive)
coax	- Coaxial Cable
CP	- Consolidation Point
CPU	- Central Processing Unit
CSA	- Canadian Standards Institute
Cu	- Copper
dB	- Decibel
dB/km	- Decibel per Kilometre
demarc	- Demarcation Point
e/w	- Equipped With
EF	- Entrance Facility
EIA	- Electronics Industry Alliance
ELFEXT	- Equal Level Far-End Crosstalk

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e-mail	-	Electronic Mail
ER	-	Equipment Room
ESD	-	Electrostatic Discharge
FC	-	Fibre Connector
FCC	-	Federal Communications Commission
FDDI	-	Fibre Distributed Data Interface
FEXT	-	Far-End Crosstalk
FIPS	-	Federal Information Processing Standards
ft.	-	Foot / Feet
FT 1 / FT 3	-	Fractional T 1 / Fractional T 3
ft2	-	Square Foot / Feet
G	-	Giga
Gb	-	Gigabit
GB	-	Gigabyte
Gb/s	-	Gigabit per Second
GC	-	General Contractor
GHz	-	Gigahertz
Hz	-	Hertz
I	-	Current
IC	-	Intermediate Closet
IC	-	Intermediate Cross-connect
IDP	-	Intrusion Detection Panel
ID	-	Identification
ID	-	Inside Diameter
IEEE®	-	Institute of Electrical and Electronics Engineers, Inc. ®
IG	-	Isolated Ground
in	-	Inch
in2	-	Square Inch
ISO	-	International Organization for Standardization
IT	-	Information Technology
kb	-	Kilobit
kB	-	Kilobyte
kg	-	Kilogram
km	-	Kilometre
kV	-	Kilovolt
kVA	-	Kilovoltampere
LAN	-	Local Area Network
laser	-	Light Amplification by Stimulated Emission of Radiation
lb.	-	Pound
LED	-	Light Emitting Diode
LO	-	Laser Optimized
m	-	Metre
m2	-	Square Metre
mA	-	Milliampere
MAC	-	Move, Add, or Change
MAN	-	Metropolitan Area Network
Mb	-	Megabit

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MB	-	Megabyte
Mb/s	-	Megabit per Second
MB/s	-	Megabyte per Second
MC	-	Main Cross-connect
MGB	-	Main Grounding Busbar
MHz	-	Megahertz
mi	-	Mile
min	-	Minute
Misc.	-	Miscellaneous
mm	-	Millimetre
MM	-	Multimode
ms	-	Millisecond
mW	-	Milliwatt
MW	-	Megawatt
NAS	-	Network Attached Storage
NCTA	-	National Cable Television Association
NVR	-	Network Video Recorder
NIC	-	Network Interface Card
OD	-	Outside Diameter
OEM	-	Original Equipment Manufacturer
OF	-	Optical Fibre
OSP	-	Outside Plant
PBX	-	Private Branch Exchange
PP	-	Patch Panel
PVC	-	Polyvinyl Chloride
QoS	-	Quality of Service
Qty	-	Quantity
RCDD®	-	Registered Communications Distribution Designer
RF	-	Radio Frequency
RFI	-	Radio Frequency Interference
RJ	-	Registered Jack
RU	-	Rack Unit (1.75")
SC	-	Single Fibre Coupling Optical Fibre Connector
SCC	-	Standards Council of Canada
SI	-	International System of Units (Le Système International d'Unités)
SM	-	Singlemode
SNMP	-	Simple Network Management Protocol
STP	-	Shielded Twisted Pair
STP-A	-	Shielded Twisted Pair A
T 1	-	Trunk Level 1
TBB	-	Telecommunications Bonding Backbone
TC	-	Telecommunications Closet
TIA	-	Telecommunications Industry Association
TMGB	-	Telecommunications Main Grounding Busbar
TP	-	Twisted Pair
TR	-	Telecommunications Room

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TS	-	Technical Standard
TV	-	Television
U	-	(When preceded by a numeral) Rack Unit (equal to 1.75")
UD	-	Underfloor Duct
UL®	-	Underwriters Laboratories Inc.®
ULC	-	Underwriters Laboratories of Canada
UPC	-	Universal Product Code
UPS	-	Uninterruptible Power Supply
UTP	-	Unshielded Twisted Pair
V	-	Volt
VA	-	Volt-Ampere
VLAN	-	Virtual Local Area Network
VoIP	-	Voice over Internet Protocol
W	-	Watt
WAN	-	Wide Area Network
WAP	-	Wireless Application Protocol
WAP	-	Wireless Access Point
WHMIS	-	Workplace Hazardous Materials Information System
WS	-	Workstation
x	-	Mathematical Operation (Multiplication)
X	-	Cross-connect

## **2 PRODUCT**

2.1 **Not applicable to this Section.**

## **3 EXECUTION**

3.1 **Not applicable to this Section.**

**END OF SECTION**

## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1 Conform to Section 28 00 03 – General Specifications and Requirements for Electronic Safety and Security.

### **1.2 General**

- 1.2.1 The Electronic Safety and Security Contractor shall comply with the local Electrical Safety Cod, all Local, Provincial and Federal laws, where applicable and with requirements of the Canadian Standards Association (CSA) when mandatory. Make any changes or alteration required by the authorised inspector of the authority having jurisdiction, at no extra charge to the Client.
- 1.2.2 The latest version, including technical bulletins and addenda will be applicable to all codes and standards.
- 1.2.3 If a conflict between codes and standards occur the most stringent code or standard will be applicable.
- 1.2.4 Non-plenum (CMR) and plenum rated (CMP) cables shall be ULC (UL) Listed and/or SA Certified.
- 1.2.5 The following list highlights the typical applicable standards. All national and local codes and standards not listed for Products, Buildings, Fire, Health and Safety and Electrical will also apply.

ANSI INCITS 263	- Information Technology – Fibre Distributed Data Interface (FDDI) – Token Ring Twisted Pair Physical Layer Medium Dependent (TP-PMD)
ANSI/ASA S3.2-2009	- Method for Measuring the Intelligibility of Speech over Communication Systems
ANSI/ICEA S-80-576	- Standard for Category 1 & 2 Individually Unshielded Twisted Pair Indoor Cables (With or Without an Overall Shield) For Use in Communications Wiring Systems Technical Requirements
ANSI/ICEA S-83-596	- Indoor Optical Fibre Cable
ANSI/ICEA S-83-640	- Optical Fibre Outside Plant Communications Cable
ANSI/ICEA Z136.2	- American Standards for the Safe Use of Lasers in Manufacturing Environments
ANSI/TIA/EIA 455	- Fibre Optic Test Procedures
ANSI/TIA/EIA 472CAAA	- Detail Specification for All-Dielectric (Construction 1) Fibre Optic Communications Cable for Indoor Plenum Use, Containing Class Ia, 62.5 mm Core Diameter/125 Cladding Diameter Optical Fibre(s)
ANSI/TIA/EIA 472DAAA	- Detail Specification for All-Dielectric Fibre Optic Communications Cable for Outside Plant Use, Containing Class Ia, 62.5 mm Core Diameter/125 mm Cladding Diameter/250 mm Coating Diameter

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ANSI/TIA/EIA 492AAAA	-	Optical Fibre(s) Detail Specification for 62.5-mm Core Diameter/125-mm Cladding Diameter Class Ia Multimode, Graded-Index Optical Waveguide Fibres
ANSI/TIA/EIA 492AAAB	-	Detail Specification for 50.0-mm Core Diameter/125-mm Cladding Diameter Class Ia Multimode, Graded-Index Optical Waveguide Fibres
ANSI/TIA/EIA 492BAAA	-	Detail Specification for Class IVa Dispersion- Unshifted Singlemode Optical Waveguide Fibres Used in Communications Systems
ANSI/TIA/EIA 568-C.1	-	Commercial Building Telecommunications Cabling Standard: General Requirements
ANSI/TIA/EIA 568-C.2	-	Commercial Building Telecommunications Cabling Standard: Balanced Twisted Pair Cabling
ANSI/TIA/EIA 568-C.3	-	Commercial Building Telecommunications Cabling Standard: Optical Fibre Cabling Components Standard
ANSI/TIA/EIA 569-C	-	Commercial Building Standards for Telecommunications Pathways and Spaces.
ANSI/TIA/EIA 570-B	-	Residential Telecommunications Infrastructure Standard
ANSI/TIA/EIA 598-C	-	Optical Fibre Cable Color Coding
ANSI/TIA/EIA 604	-	Fibre Optic Connector Intermateability Standard (Focis3)
ANSI/TIA/EIA 606-B	-	Administration Standard for the Telecommunications Infrastructure
ANSI/TIA/EIA 607-B	-	Commercial Building Grounding and Bonding (Earthing) for customer premises
ANSI/TIA/EIA 758-B	-	Residential Telecommunications Infrastructure Standard
BICSI ITSIM	-	Information Transport System Installation and Methods Manual
CAN/ULC S101	-	Standard Method of Fire Endurance Tests of Building Construction and Materials
CAN/ULC S102	-	Standard Method of Testing for Surface Burning Characteristics of Building Materials and Assemblies
CAN/ULC S115	-	Standard Method of Fire Tests of Fire stop Systems
CEC, Part 1	-	The Canadian Electrical Code, Part 1
CENELEC EN 50173	-	Performance Requirements for Generic Cabling Schemes
CSA C22.1-12	-	Canadian Electric Code Part I: Safety Standards for Electrical Installations
CSA C22.2 232 M1998	-	Canadian Electric Code Part II: Optical Fibre Cables

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CSA C22.2 No. 0	- Canadian Electric Code Part II: General Requirements (Communications Cables)
CSA C22.2 No. 181.4	- Plugs, Receptacles, and Connectors for Communication Systems
CSA C22.2 No. 214	- Communications Cables
CSA T527	- Grounding and Bonding for Telecommunications in Commercial Buildings
CSA T528	- Design Guidelines for Administration of Telecommunications Infrastructure in Commercial Buildings
CSA T529	- Design Guidelines for Telecommunications Wiring Systems in Commercial Buildings
CSA T530	- Commercial Building Standard for Telecommunication's Pathways and Spaces
CSA Z462-12	- Standard on Workplace Electrical Safety (2 <sup>nd</sup> Edition)
FIPS PUB 174	- Commercial Building Telecommunications Wiring Standard. Federal Information publication Standard
FIPS PUB 197	- Advanced Encryption Standard (AES)
ICEA S-90-661	- Individually Unshielded Twisted Pair Indoor Cable for Use in Communications Wiring Systems
IEC 603-7, Part 7	- Detailed Specifications for Connectors, 8-Way, Including Fixed and Free Connectors with Common Mating Schemes
IEEE 802.11	- Local and Metropolitan Area Networks – Specific Requirements Part 11: Wireless LAN Medium Access Control and Physical Specifications
IEEE 802.3	- Standard Specification for Ethernet – A Method of Physical Communication in a local area network (LAN) – Maintained by the Institute of Electrical and Electronics Engineers (IEEE)
ISO/IEC IS 11801A J-STD-607	- Generic Cabling for Customer Premises
	- Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
NCTA-02/89 rev. 93	- NCTA Recommended Practices for Measurements on Cable Television Systems
NEMA WC 63	- Performance Standard for Field Testing of Unshielded Twisted-Pair Cabling System
OHSA	- Occupational Health and Safety Act - R.S.O. 1990, c. 0-1
TIA-222	- Structural Standards for Steel Antenna Towers and Antenna Supporting Structures
TIA-942	- Telecommunications Infrastructure Standards for Data Centers
UL 294	- Standard for Access Control Systems
UL 305	- Standard for Panic Hardware
UL 444 and UL 13	- Adopted Test and Follow-Up Service Requirements for The Optional Qualification of

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	100Ω Twisted-Pair
UL 636	- Standard for Holdup Alarm Units and Systems
UL 1076	- Standard for Proprietary Burglar Alarm Units and Systems
ULC-S302	- Standard for Installation and Classification of Burglar Alarm Systems for Financial and Commercial Premises, Safe and Vaults
ULC-S303	- Standard for Local Burglar Alarm Units and Systems
ANSI/BICSI 005-2013	- Electronic Safety and Security (ESS) System Design and Implementation Best Practices

## **2 PRODUCT**

### **2.1 Not applicable to this Section.**

## **3 EXECUTION**

### **3.1 Compliance to Codes and Standards**

- 3.1.1 The Electronic Safety and Security Contractor shall install all equipment and material in accordance with the standards aforementioned in this section.
- 3.1.2 Quality and workmanship shall be at the highest of professional tradesman levels to be accepted for completion. The Electronic Safety and Security Consultant shall have the sole right to reject any work not in accordance with industry standards.
- 3.1.3 Electronic Safety and Security Contractors shall provide installers trained in all applicable codes, standards, regulations, and installation standards.
- 3.1.4 All installers shall have successfully completed the approved manufacturer's installation training program. The Electronic Safety and Security Consultant reserves the right to receive written proof of such training at any time during the project. If such proof is not provided the Electronic Safety and Security Contractor will remove the installer from the site immediately and replace the installer within 24 hours.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1 Comply with Section 28 00 03 – General Specifications and Requirements for Electronic Safety and Security.

### **1.2 Acceptable Manufacturers**

- 1.2.1 All equipment and products supplied shall be new and free of all manufacturer defects and delivery or installation damage.
- 1.2.2 All equipment and products supplied shall meet all manufacturer listed characteristics as identified in the latest manufacturer catalogue.
- 1.2.3 All products shall meet all applicable codes and standards and bare the UL/ULC label, be CSA approved and meet FCC/CRTC Regulations.
- 1.2.4 All products shall be provided in accordance with local, provincial, and national fire ratings for the installation on this project.

### **1.3 Certification**

- 1.3.1 Certification shall be provided by the specified and selected product manufacturer directly to the Electronic Safety and Security Consultant.
- 1.3.2 The Electronic Safety and Security Contractor is responsible for providing to the Electronic Safety and Security Consultant a copy of the application for certification with 5 in days of project award.
- 1.3.3 Upon completion of the project the Electronic Safety and Security Contractor shall deliver to the Electronic Safety and Security Consultant for the Owner a copy of the manufacturer's warranty information, certificate and or plaque. This information shall accompany the final documentation described further in these specifications.
- 1.3.4 The Electronic Safety and Security Contractor shall currently be an authorized installer of the manufacturer providing the warranty.
- 1.3.5 Subcontractors shall not be acceptable to provide warranty unless pre-approved by the Electronic Safety and Security Consultant and the Owner at time of tender. Subcontractors will not be approved after tender is awarded.
- 1.3.6 The Electronic Safety and Security Contractor shall provide a written 2-year warranty inclusive of all parts and labour for the end to end solution. The Electronic Safety and Security Contractor shall also state and agree in writing to providing response for any warranty request within 24 hours during this warranty period.

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## **2 PRODUCT**

2.1 **Not applicable to this Section.**

## **3 EXECUTION**

### **3.1 Scope**

3.1.1 The specific Electronic Safety and Security scope of this project includes the complete supply, installation and commissioning of the following Electronic Safety and Security Systems.

- .1 Access Control
- .2 Video Surveillance/CCTV
- .3 Intercom System
- .4 Electronic Personal Protection system

3.1.2 The specific Electronic Safety and Security scope of this project includes but is not limited to:

- .1 Supply of one (1) electronic copy PDF format of shop drawings for all products prior to placing material order to acquire written approval from the Electronic Safety and Security Consultant.
- .2 Supply and installation of a complete access control system including cabling, accessories, and software.
- .3 Supply and installation of a complete video surveillance system including accessories and software.
- .4 Supply and installation of a complete intercom system including cabling and accessories.
- .5 Supply and installation of a complete electronic personal protection system including cabling and accessories.
- .6 Complete integration of the Access Control, Video Surveillance, Intercom and Electronic personal protection system.
- .7 Complete testing of each system in a timely fashion and in coordination with other trades and services to ensure completely tested systems prior to activation by the Owner.
- .8 Test Electronic Safety and Security Systems operations based on a point-by- point walkthrough review.
- .9 Perform end-user training.
- .10 Supply and installation of all active and passive hardware and cables as specified within this document to support the Electronic Safety and Security Systems.
- .11 Supply temporary and final record drawings as specified.



- .12 Complete all final documentation requirements including documentation and site reviews as per Section 28 00 09.

3.2 **Phasing**

- 3.2.1 This project shall be completed in (1) one phase. Co-ordination with the General Contractor and other trades is imperative and shall form part of the scope of this project. This installation will not necessarily be completed over a continuous time period and may be completed over two or more time periods to allow for co-ordination with other groups / trades.

**END OF SECTION**

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## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1 Conform to Section 28 00 03 – General Specifications and Requirements for Electronic Safety and Security.

### **1.2 Shop Drawings**

- 1.2.1 Provide 1 PDF format of manufacturer prepared shop drawings identifying complete technical specifications for each product being supplied as part of the end-to-end solution including fire stopping, pathways and other miscellaneous products.
- 1.2.2 Shop drawings shall be stamped and signed “For Review” complete with date submitted.
- 1.2.3 Manufacturers shop drawings showing various model or styles shall be labelled with identification arrows and or highlights showing which items are being proposed. Arrows and or highlights shall be reproducible through standard photocopying.
- 1.2.4 Shop drawings shall be approved by the Electronic Safety and Security Consultant prior to starting installation and the Electronic Safety and Security Contractor will be responsible for the cost of replacing of all installed product not approved.
- 1.2.5 Approved shop drawings shall be included in the Project Manual for this project.

### **1.3 Project Documentation**

- 1.3.1 The Electronic Safety and Security Contractor shall provide hand marked record drawings showing all cable numbers on floor plans, rack elevations, backboard layouts and cable routing at the completion of the project. Drawings shall include all architectural and project changes. Provide within ten (10) days of substantial completion of the project two (2) hard copies for review and approval by the Electronic Safety and Security Consultant.
- 1.3.2 The Electronic Safety and Security Contractor shall prepare record drawing(s) using AutoCAD or better. The Electronic Safety and Security Contractor shall issue one (1) AutoCAD copy and one (1) PDF copy of record drawings within ten (10) days of project completion. If the Electronic Safety and Security Contractor cannot comply with this requirement, Spectech will update all hand drawn record drawings to AutoCAD. The cost for this service shall be based on per diem rates at the time of completion. The Electronic Safety and Security Contractor shall be responsible for the costs associated with this work.
- 1.3.3 Prepare a complete Verification report for each door or security device, complete with the technician’s signature and date

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- 1.3.4 At the completion of the project be prepared to submit 1 copy of a project manual in PDF format to the Electronic Safety and Security Consultants for review and approval. This project manual shall include:
- .1 Contractor's Name, contact information and lead installer/foreman's contact info
  - .2 Letter detailing, total cost of project (including changes), square footage, project highlights, Architect/Interior Designer and Owner name and contact information.
  - .3 Final bill of materials
  - .4 Approved shop drawings
  - .5 WHIMS data sheets on all applicable materials including fire stopping
  - .6 Maintenance and/or operation manuals for all equipment
  - .7 Connectivity database
  - .8 Test results
  - .9 Record drawings
  - .10 Letter of 2 year installation warranty
  - .11 Manufacturer's Certification and warranty documentation
- 1.3.5 Upon written approval from the Electronic Safety and Security Consultant prepare (3) additional project manuals for distribution to the Owner in PDF or hardcopy format as requested.
- 1.3.6 The Electronic Safety and Security Contractor shall prepare a separate Connectivity Database in Excel spreadsheet format.

#### **1.4 Site Documentation**

- 1.4.1 The Electronic Safety and Security Contractor shall be responsible for maintaining a complete set of record marked up drawings on site for the Electronic Safety and Security Consultants review at all times. Drawings shall be up to date with all architectural and project changes.
- 1.4.2 Maintain a log of date, time, and reason for any delays in performing the installation. Details shall include names, conditions, and specific reason for delay.
- 1.4.3 The Electronic Safety and Security Contractor shall prepare a separate Connectivity Database in Excel spreadsheet format.
- 1.4.4 Final documentation not provided within 30 days of project completion and with reasonable notification may result in the commissioning of another agent to prepare such documents. Costs for this work will be deducted from all Holdback amounts available to the Electronic Safety and Security Contractor.

## **2 PRODUCT**

### **2.1 Documentation Requirements**

2.1.1 The following items shall be delivered as scheduled after project award:

Delivery Item	Delivery Schedule	Presentation
Shop Drawings (PDF)	10 days after project award	Email/ Electronic PDF
Monthly Draw Breakdown (PDF)		

2.1.2 The following items shall be kept up to date during project construction.

Delivery Item	Delivery Schedule	Presentation
Continuously Updated Drawings	During construction on-site	Electronic PDF

2.1.3 The following items shall be delivered after project completion (in a single PDF):

Delivery Item	Delivery Schedule	Presentation
Contractor's Information	10 Days after Cutover	Electronic PDF
Project Details	10 Days after Cutover	Electronic PDF
Final Bill of Materials	10 Days after Cutover	Electronic PDF
Approved Shop Drawings	10 Days after Cutover	Electronic PDF
WHIMS Data Sheets	10 Days after Cutover	Electronic PDF
Maintenance / operation manuals	10 Days after Cutover	Electronic PDF
Verification Report	10 Days after Cutover	Electronic PDF
Record Drawings	10 Days after Cutover	Electronic PDF
Contractor's 2 year Warranty	10 Days after Cutover	Electronic PDF
Manufacturer Warranty	10 Days after Cutover	Electronic PDF
CCTV Schedule:	10 Days after Cutover	Excel Format
• Camera Number		
• Software Version		
• Camera Type		

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- Internal/External
  - Level (floor)
  - Lan Room
  - Manufacture
  - Model Number
  - IP Address
  - Subnet
  - Gateway
  - Primary DNS
  - Secondary DNS
  - NTP
  - Time Zone
  - Day Light Savings  
Enabled
  - Cable ID (Label)
  - Switch
  - Switch Port
  - MID Span
  - MID Span Port
  - UTP Extender
  - UTP Extender Port
  - Fibre (F), Coax (C),  
UTP (U)
  - Comments on  
Location

Access Control Schedule: 10 Days after Cutover Excel Format

- Door Number
- Level (Floor)
- Manufacture
- Software Version
- Door Module Model
- Card Reader Make  
and Model
- Request to Exit  
Sensor Make and  
Model
- Request to Exit Button  
Make and Model
- Door Contact Make  
and Model
- Electric Strike Make  
and Model
- IP Address
- Subnet

- 
- Gateway
  - Primary DNS
  - Secondary DNS
  - NTP
  - Time Zone
  - Day Light Savings  
Enabled
  - Cable ID (Label)
  - Switch
  - Switch Port
  - Comments on  
Location

2.1.4 Should the Owner or General Contractor require hardcopies of any documents listed here as to be provided in an electronic format, the Electronic Safety & Security Contractor shall provide as requested at no additional cost.

### **3 EXECUTION**

3.1 **Not applicable to this Section.**

**END OF SECTION**

## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1 Conform to Section 28 00 03 – General Specifications and Requirements for Electronic Safety and Security.

### **1.2 General**

- 1.2.1 Use only fire stopping products that have been tested for specific fire resistance rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire rating involved for each separate instance.

### **1.3 Materials**

- 1.3.1 Products manufactured by Hilti, Specified Technologies Inc. (STI), or equivalent are acceptable.
- 1.3.2 Obtain fire stop systems for each type of penetration and construction condition indicated from a single manufacturer (i.e. Do not mix manufacturers for the same type of penetration).

### **1.4 Definitions**

- 1.4.1 Fire stopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies.
- 1.4.2 Smoke and Acoustical Sealing: Material or combination of materials used to maintain an effective barrier against the spread of smoke and hot gases, and to restore the STC rating in through penetrations in non-fire rated wall and floor assemblies.

### **1.5 Performance Requirements**

- 1.5.1 Fire Stop Systems shall conform to the fire (F), hose (H) and temperature (T) ratings of Codes and shall have a flame spread rating of 25 or less, National Fire Protection Association (NFPA Class "A").
- 1.5.2 Fire Stop Systems acceptable for this project are those that have been tested to the CAN/ULC S115 Standard.
- 1.5.3 Fire Stop Systems shall be CSA approved, non-permanent, dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming or backer materials.
- 1.5.4 Fire stopping shall maintain a minimum one-hour rating, meet applicable Federal, Provincial, Local building codes, and be tested by a SCC and accredited Third Party Testing Agency in accordance with the Standards.

- 1.5.5 In locations containing high moisture, fire stopping shall be compatible with Formalin.
- 1.5.6 Fire rated fittings allowing easy cable additions may be used. All non-permanent caulking or foams shall be replaced with the removal or addition of any cabling before final acceptance by the owner.
- 1.5.7 Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, add-ons and changes will occur.
- 1.5.8 Where non-mechanical products are utilized, provide products that upon curing do no re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water, or other forms of moisture characteristic during or after construction.
- 1.5.9 Where it is not practical to use a mechanical device, openings within floors and walls designed to accommodate communications cabling shall be provided with re-enterable products that do not cure or dry.
- 1.5.10 Openings for cable trays shall be sealed using re-enterable fire stopping pillows.

#### **1.6 Quality Assurance**

- 1.6.1 Products/Systems: Provide fire stopping systems that comply with the following requirements:
  - .1 Fire stopping tests are performed by a qualified, testing and inspection agency. A qualified testing and inspection agency is UL, or another agency performing testing and follow-up inspection services for fire stop system acceptable to authorities having jurisdiction.
  - .2 Fire stopping products bear the classification marking of qualified testing and inspection agency.
- 1.6.2 Installer Qualifications: Experience in performing work of this section who is qualified by the fire stopping manufacturer as having been provided the necessary training to install fire stop products in accordance with specified requirements.

#### **1.7 Delivery, Storage and Handling**

- 1.7.1 Manufacturer's original, unopened, undamaged containers, identification labels intact identifying product and manufacturer, date of manufacture; lot number; shelf life, if applicable; qualified testing and inspection agency's classification marking; and mixing instruction for multicomponent products.
- 1.7.2 Handle and store products according to manufacturer's recommendations published in technical materials. Leave products wrapped or otherwise protected and under clean and dry storage conditions until required for installation.
- 1.7.3 Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.



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1.8 **Project Conditions**

- 1.8.1 Do not install fire stopping products when ambient or substrate temperatures are outside limitations recommended by manufacturer.
- 1.8.2 Do not install fire stopping products when substrates are wet due to rain, frost, condensation, or other causes.
- 1.8.3 Maintain minimum temperature before, during, and for a minimum 3 days after installation of materials.
- 1.8.4 Do not use materials that contain flammable solvents.
- 1.8.5 Coordinate construction of openings and penetrating items to ensure that through-penetration fire stop systems are installed according to specified requirements.
- 1.8.6 Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration fire stop systems.
- 1.8.7 Schedule installation of fire stopping after completion of penetrating item installation but prior to covering or concealing of openings.
- 1.8.8 Supply and install temporary fire stopping at the end of every work shift or when location of work is changing from one work area to another. This shall be done to maintain the penetration's fire rating in areas where no work is being done.

**2 PRODUCT**

2.1 **Fire Stop Grommets & Discs**

- 2.1.1 Shall be used only for penetrations of individual 4-pair UTP or F/STP cables.

Specified Product:

	Part No.	# Of Cables	Hole Diameter
Hilti	CFS-D	1	1" (25mm)
Specified Technologies Inc. (STI)	RFG1	1	9/16" (14mm)
Specified Technologies Inc. (STI)	RFG2	2	1" (25mm)

2.2 **Fire Stop Sealants**

- 2.2.1 Single component latex formulations that upon cure do not re-emulsify during exposure to moisture.

Specified Product:

Hilti	CP 606 FS-ONE MAX Sealant
Specified Technologies Inc. (STI)	SpecSeal® Series SSS Sealant
Specified Technologies Inc. (STI)	SpecSeal® Series LCI Sealant

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**2.3 Fire Stop Putty**

2.3.1 Intumescent, non-hardening, water resistant putties containing no solvents, inorganic fibres or silicone compounds.

Specified Product:

Hilti	CP 617 Firestop Putty Pads
Hilti	CP 618 Firestop Putty Stick
Specified Technologies Inc. (STI)	SpecSeal® Series SSP Putty

**2.4 Fire Rated Cable Pathways**

2.4.1 Device modules comprised of steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill.

Specified STI Products:

EZ-Path Multi-Gang Wall Bracket	EZP544W
EZ-Path (No Options)	EZD44
Single EZ-Path Kit	EZDP44

Only where wall thickness exceeds 10" use the following  
(Adjust quantity of EZ-Path units and accessories to suit cable quantity):

Single EZ-PATH Kit	EZDP33FWS
Two Gang EZ-PATH Kit	EZDP233GK
Three Gang EZ-PATH Kit	EZDP333GK
Four Gang EZ-PATH Kit	EZDP433GK
Radius Control Module	RCM33
Extension Module	EZD33E

Specified Hilti Products:

Firestop Gang Plate	CFS-SL GP
Single Speed Sleeve Kit	CFS-SL SK

Only where wall thickness exceeds 10" use the following  
(Adjust quantity of Sleeve units and accessories to suit cable quantity):

Single Speed Sleeve Kit	CP 653
Two Gang Speed Sleeve Kit	CFS-SL GP, CFS-SL GP CAP, and Speed Sleeves
Three Gang Speed Sleeve Kit	CFS-SL GP and Speed Sleeves
Four Gang Speed Sleeve Kit	CFS-SL GP and Speed Sleeves
Extended Speed Sleeve	CFS-SL GA L

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### **3 EXECUTION**

#### **3.1 Examination**

- 3.1.1 Before beginning installation, verify that substrate conditions previously installed under other sections are acceptable for installation of fire stopping in accordance with manufacturer's installation instructions and technical information.
- 3.1.2 Surfaces shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellents, and any other substances that may inhibit optimum adhesion.
- 3.1.3 Provide masking and temporary covering to protect adjacent surfaces.
- 3.1.4 Do not proceed until unsatisfactory conditions have been corrected.

#### **3.2 Installation**

- 3.2.1 Install through-penetration fire stop systems in accordance with Performance Criteria and in accordance with the conditions of testing and classification as specified in the published design.
- 3.2.2 Comply with manufacturer's instructions for installation of fire stopping products.

#### **3.3 Field Quality Control**

- 3.3.1 Keep areas of work accessible until inspection by authorities having jurisdiction.
- 3.3.2 Where deficiencies are found, repair fire stopping products, so they comply with requirements.

#### **3.4 Non-Monitored Penetrations**

- 3.4.1 Where fire watch is not in effect, or the Electronic Safety and Security Contractor has not been able to confirm whether fire watch is in effect, all fire penetrations, whether all cables have been pulled or not, removed or not, shall be fire stopped at the end of every workday prior to the Electronic Safety and Security Contractor leaving the site. At no time shall a penetration be un-attended or without fire stopping material in areas where work is not in progress.

**END OF SECTION**

**1 GENERAL**

**1.1 Work Included**

1.1.1 Conform to Section 27 00 00 – Communication Specifications.

**1.2 General**

1.2.1 All CCTV UTP cabling shall be installed by the Communications Contractor.

1.2.2 The Electronic Safety and Security Contractor shall coordinate with the Communications Contractor the final CCTV cabling locations and terminations.

1.2.3 CCTV UTP cabling shall be installed in conduit indicated on drawings and as per Section 28 05 28 of this specification.

**2 PRODUCT**

2.1 **Not Applicable to this Section**

**3 EXECUTION**

3.1 **Not applicable to this Section**

**END OF SECTION**

## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1 Conform to Section 28 00 03 – General Specifications and Requirements for Electronic Safety and Security.

### **1.2 General**

- 1.2.1 Access control cabling shall be installed in conduit indicated on drawings and as per Section 28 05 28 of this specification.
- 1.2.2 Ensure that all cables are sufficiently long to allow for slack, vertical runs, wastage, connectorization and future moves.

## **2 PRODUCT**

### **2.1 UTP Cables**

- 2.1.1 Conform to Section 27 00 00 – Communication Specifications.

### **2.2 Multi-Conductor Copper Cabling**

- 2.2.1 All access control cabling shall be stranded, twisted, overall shield copper conductor, CSA certified and stamped with CMR/FT6 rating accordingly.
- 2.2.2 All multi-conductor copper cables shall meet the minimum requirements identified below.

Conductor	Rating	AWG	Device
6	CMR/FT6	22	Card Reader
		Shielded	
4	CMR/FT6	22	Door Contact
4	CMR/FT6	22	Request to Exit Sensor
2	CMR/FT6	22	Request to Exit Push Button
2	CMR/FT6	18	Electric Strike

## **3 EXECUTION**

### **3.1 Access Control Cabling**

- 3.1.1 Cabling shall be run in conduit and shall be concealed in finished areas.
- 3.1.2 Cabling shall be terminated as per manufacturer's guidelines and remove only enough cable jacket to perform termination.
- 3.1.3 Comply with manufacturer's recommended bundling practices for installation. Ensure that excess pressure is not placed on the cable at any point that may result in the compression or deformation of the cable jacket and internal pair/conductor geometry.

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- 3.1.4 Cables shall not be scrapped, dented, or otherwise damaged before, during or after installation. All damaged cabling shall be replaced at no extra cost to the Owner.
  - 3.1.5 The splicing of any access control cables is not permitted.
  - 3.1.6 After installation, and before termination, all wiring and cabling shall be checked and tested to insure there are no grounds, opens, or shorts on any conductors or shields. A V.O.M. shall be utilized to accomplish these tests and a reading of greater than 20 Megohms shall be required to successfully complete the test.
  - 3.1.7 Ensure that all cables are of sufficient length to allow for slack, vertical runs, wastage, and connectorization.

**END OF SECTION**

**1 GENERAL**

**1.1 Work Included**

1.1.1 Conform to Section 27 00 00 – Communication Specifications.

**1.2 General**

1.2.1 Follow manufacture specified guideline for grounding and bonding of all electronic safety and security devices and equipment.

**2 PRODUCT**

**2.1 Not applicable to this section**

**3 EXECUTION**

**3.1 General**

3.1.1 The Electronic Safety and Security Contractor shall ensure a complete grounding system is installed for the project. If any portion of the system to be installed by Division 26 is incomplete it shall be the responsibility of the Electronic Safety and Security Contractor to advise the Electronic Safety and Security Consultant.

**END OF SECTION**

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## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1 Conform to Section 28 00 03 – General Specifications and Requirements for Electronic Safety and Security

### **1.2 General**

- 1.2.1 The Electronic Safety and Security Contractor shall be responsible for measuring and confirming cable pathways prior to installation of any cabling to ensure no cabling will exceed the specified distance limitations. Where the distance limitations are exceeded, the Electronic Safety and Security Contractor shall inform the Electronic Safety and Security Consultant prior to installation of cabling. No compensation for removal of cabling will be accepted if not adhered to.

### **1.3 Indoor Cable Distribution**

- 1.3.1 Ensure proper installation practices are followed for all indoor cable distribution.
- 1.3.2 The Electronic Safety and Security Contractor shall install and distribute cabling using conduit or cable tray as indicated on drawings. Where cables leave the indicated pathways, the Electronic Safety and Security Contractor shall supply and install additional pathways to support cabling up to point of termination.

## **2 PRODUCT**

### **2.1 J-Hooks**

- 2.1.1 J-hooks shall be made of metal and/or plastic and shall be Plenum rated.
- 2.1.2 J-hooks shall be supplied and installed with all necessary fastening suitable for the building structure being used to support the cabling and as per the manufacturer's installation requirements or guidelines.
- 2.1.3 J-hooks shall be manufactured by Erico or Panduit and sized to suit.

Specified Product:

Erico	CAT12
Erico	CAT21
Erico	CAT32
Erico	CAT64
Panduit	JP75
Panduit	JP131
Panduit	JP2
Panduit	JP4

Notes: Product Codes shown above indicate only Series numbers and are



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not application specific.

## 2.2 **Velcro Wraps**

- 2.2.1 Velcro wraps shall be supplied and installed to support and neatly bundle all cabling.
- 2.2.2 No nylon or plastic wraps will be permitted on this project and will be removed and replaced at the expense of the Electronic Safety and Security Contractor.
- 2.2.3 Velcro Wraps shall be black in colour.

Specified Product:

		Width	Tensile Strength
Panduit	HLM-15R0	0.330"	18
Panduit	HLS-15R0	0.750"	50
Panduit	HLS-75R0	0.750"	50
Panduit	TTS-20R0	0.750"	40
Panduit	TTS-35R3-0	0.750"	40

## 3 **EXECUTION**

### 3.1 **Indoor Cable Distribution**

- 3.1.1 All pathways shall be installed to run parallel to building lines at all times.
- 3.1.2 Pathways shall be installed in coordination with other trades in order to minimize interferences and obstructions. The Electronic Safety and Security Contractor shall be responsible for relocating installed pathways at no cost to the Owner.
- 3.1.3 All cable supports shall be installed to the permanent structure of the building and be limited to areas that will not damage the structural stability such as tensioned beams and slabs. It is the responsibility of the Electronic Safety and Security Contractor to submit information to the structural engineer for review and approval prior to installation.
- 3.1.4 Anchors for J-hooks shall not be drilled into post tensioned beams under any circumstances. All anchors shall be drilled into slab.
- 3.1.5 Pneumatic hammers shall not be used unless the Electronic Safety and Security Contractor has written authorization from the building owner/landlord.
- 3.1.6 The Electronic Safety and Security Contractor shall minimize the removal/disturbance of fire spray insulation while installing cable supports and/or accessories.
- 3.1.7 All pathways and cabling installation shall maintain clearances from all electrical, communications, audio video and heat sources as outlined below.

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Fluorescent Fixtures	15 cm
Electrical distribution cabling and conduits less than 1KVA	1.0 m
Electrical distribution cabling and conduits greater than 1KVA	3.0 m
Transformers and Motors	1.2 m
HVAC system including ducts	30 cm
Mechanical piping	15 cm

- 3.1.8 Prepare all conduits and pathways prior to installation of cabling. This shall include bushing or reaming all conduit openings, pulling of wire brush and mandrel to clean out ducts and identifying any potential issues that may cause damage to cables during installation. Report all items to the Electronic Safety and Security Consultant immediately.

### 3.2 **J-Hooks**

- 3.2.1 Suspended ceiling and T-Bar hangers shall not be acceptable in any situation.
- 3.2.2 J-Hooks shall be installed every 3' to 4' to support cabling (ensure that the distance between j-hooks is not consistent; do not place j-hooks exactly the same distance apart repeatedly).
- 3.2.3 All cabling shall be installed to have no more than 3" sag between J-hooks. All cabling shall be fastened using Velcro Ty-Wraps only. The Electronic Safety and Security Contractor will be responsible for all costs associated with removing other fasteners and install the specified product.
- 3.2.4 If the quantity of cables exceeds 80% of the manufacturer's capacity rating install the next larger size or substitute with cable slings at no additional cost to the Owner.
- 3.2.5 J-hooks shall be installed in coordination with other building services and without interruption to the Owner or surrounding Owners within the building.

### 3.3 **Velcro Wraps**

- 3.3.1 Velcro Wraps shall be installed at every J-hook, between every pair of J-hooks or within 2' of a J-hook to neatly bundle cabling.
- 3.3.2 Velcro Wraps shall be installed every 3' to neatly bundle cabling installed in cable tray.
- 3.3.3 Velcro Wraps shall be installed every 6" to neatly bundle cabling at all locations on cabinets and enclosures.

### 3.4 **Fire Stopping**

- 3.4.1 For all fire stopping requirements refer to Section 28 00 13 – Fire Stopping.

3.5 **Grounding**

- 3.5.1 For all grounding and bonding requirements refer to Section 28 05 26 – Grounding and Bonding for Electronic Safety and Security.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1 Conform to Section 28 00 03 – General Specifications and Requirements for Electronic Safety and Security.
- 1.1.2 Where labelling schemes are not provided the Electronic Safety and Security Contractor shall develop a labelling scheme with the Electronic Safety and Security Consultant prior to the installation of any permanent labels on the Electronic Safety and Security Systems components.

### **1.2 Cable Labelling**

- 1.2.1 All cabling runs shall be labelled in two (2) locations at each end of the cable.

### **1.3 Active Equipment Labelling**

- 1.3.1 Each piece of active equipment, such as servers, controllers, etc. shall be labelled with one label on the front and one label on the back (where applicable).

### **1.4 Labelling Schemes**

- 1.4.1 The Electronic Safety and Security Contractor will be responsible to confirm labelling schemes with the Electronic Safety and Security Consultant prior to preparation and installation of any labelling.

Access Control:

A/CN-Ca-D

where: CN = Controller Number  
Ca = Cable Number  
D = Door Number (as per drawing)

Video Surveillance:

C/Cam-Ca

where: Cam = Camera Number (as per drawing)  
Ca = Cable Number

Active Equipment:

E/ID

where: E = Equipment Type (Controller, Control Panel, etc.)  
ID = Identification Number (1, 2, 3, etc.)

## **2 PRODUCT**

### **2.1 Cable and Active Equipment Labelling**

- 2.1.1 All products shall meet UL 969 standards and be rated for indoor or outdoor use as applicable to the installation.

- 2.1.2 Cable labels shall be self-laminating, vinyl with white printing area and sized to allow label to wrap around 2.5 times minimum. Labels also shall be sized to suit the labelling requirement maintaining a minimum 10-point font size.
- 2.1.3 Active equipment labels shall be adhesive style made of polyester with a white printing area and sized to suit the designated label location. Labels shall be printed with a minimum ¼" high font.
- 2.1.4 All equipment cabinets labels shall be black lamacoid plates with white 60-point Arial Narrow, engraved upper case letters enclosed by white border.
- 2.1.5 Labels should be visible during the installation of and normal maintenance of the infrastructure. Labels should be resistant to the environmental conditions at the point of installation (such as moisture, heat, or ultraviolet light) and should have a design life equal to or greater than that of the labelled component.
- 2.1.6 Provide vinyl substrate with a white printing area and black print. If cable jacket or equipment is white, provide cable label with printing area that is any other color than white, preferably orange, or yellow – so that the labels are easily distinguishable.

### **3 EXECUTION**

#### **3.1 General**

- 3.1.1 Supply and install labels for all cables and all active and passive devices.
- 3.1.2 All labels shall be printed on a laser printer. No handwritten labels shall be accepted.
- 3.1.3 All temporary labels shall be removed from cables and equipment prior to commissioning.

#### **3.2 Cable Labels**

- 3.2.1 Cable labels shall be installed on clean and dry cable and mounted within 100mm or 4" of each end of each cable.

**END OF SECTION**

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## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1 Conform to Section 28 00 03 – General Specifications and Requirements for Electronic Safety and Security.

### **1.2 Warranty and Service Agreement**

- 1.2.1 All equipment, materials, and labour shall be guaranteed for a period of 1 year from the date of final acceptance by the Owner.
- 1.2.2 Provide any software maintenance updates or upgrades at no additional cost to the Owner for this period.
- 1.2.3 Perform two (2) scheduled preventative maintenance site visits per year during the warranty period.
- 1.2.4 Response Times - Normal business hours shall be 8 AM to 5 PM Monday through Friday. Calls for service before noon shall be responded to on-site before the end of the day. Calls after noon shall be responded to on-site by noon the following business day.
- 1.2.5 Provide extra costs for time outside of normal business hours if the Owner requires emergency service.
- 1.2.6 Submit an all-inclusive Annual Maintenance Agreement cost for years 2, 3, 4 and 5, including two (2) preventative maintenance sites visits per year.
- 1.2.7 Submit normal and after-hours labour costs and typical costs for equipment for items not covered under the Warranty, like: Acts of God, vandalism, misuse.

## **2 PRODUCT**

### **2.1 Not applicable to this Section.**

## **3 EXECUTION**

### **3.1 General**

- 3.1.1 The Electronic Safety and Security Consultant reserves the right to witness test any or all of the systems as required. The Electronic Safety and Security Contractor will provide (3) day notice prior to starting testing in any particular phase of the project.
- 3.1.2 The Electronic Safety and Security Contractor shall arrange and include all time required to tour site with manufacturer in order to warranty the systems. This includes for additional visits if required.
- 3.1.3 The Electronic Safety and Security Engineer's Representative shall make general reviews at the job site and shall review the following for configuration:
  - .1 Quality of construction
  - .2 Adherence to design requirements

.3 Conformance with shop drawings and submittal information.

3.1.4 Commissioning

.1 The Electronic Safety and Security Contractor shall identify all components, functions and systems that shall be commissioned.

.2 The Electronic Safety and Security Contractor shall develop device checklists, functional test forms and system integration test forms that shall be executed by the Electronic Safety and Security Contractor.

.3 Each device checklist shall include but not limited to:

.1 Unique identifier of each device and component of the respective system

.2 Location of device

.3 Name of commissioning agent

.4 Name of witness

.5 Date of commissioning

.6 For each device, all function and performance requirements indicated in the relative system specifications sections of this document, all function and performance requirements indicated on all associated drawings, all industry standard tests, all manufacturer recommended tests, all test that are required to confirm that the respective device is in proper working order.

.7 Confirmation of device tests performed

.8 Confirmation of tests passed or failed and related comment

.4 Each functional test form shall include but not limited to:

.1 Identification of system under test

.2 Location of system

.3 Name of commissioning agent

.4 Name of witness

.5 Date of commissioning

.6 For each system, all function and performance requirements indicated in the relative system specifications sections of this document, all functions indicated on all associated drawings, all industry standard functional tests, all manufacturer recommended functional tests and all functional tests that are required to confirm that the respective system is in proper working order.

.7 Confirmation of functional tests performed

.8 Confirmation of tests passed or failed and related comment

.5 Systems Integration Functional Test Forms

Each system integration test form shall include but not limited to:

.1 Identification of systems under test

- 
- .2 Location of systems
  - .3 Name of commissioning agent
  - .4 Name of witness
  - .5 Date of commissioning
  - .6 All integrated function and performance requirements that are indicated in the electronic safety and security system integration specifications section of this document, all integrated functions indicated on all associated drawings, all industry standard integration functional tests, all manufacturer recommended integrated functional tests and all integrated functional tests that are required to confirm that the respective systems are integrated and are in proper working order.
  - .7 Confirmation of integrated functional tests performed
  - .8 Confirmation of tests passed or failed and related comment
  - .6 The Electronic Safety and Security Contractor shall forward the device checklists, functional test forms and systems integration test forms to the Electronic Safety and Security Consultant for review and approval prior to commencing commissioning.
  - .7 Pre-Start-up Test
    - .1 The Electronic Safety and Security Contractor shall perform prestart-up tests to verify that the devices and systems that are to be commissioned are powered, calibrated, operational, and ready for device and functional testing.
  - .8 Perform Device Tests
    - .1 The Electronic Safety and Security Contractor shall perform device tests for all devices in accordance with the device checklists.
  - .9 Perform Functional Tests
    - .1 The Electronic Safety and Security Contractor shall perform functional tests for all devices and systems in accordance with the functional test forms
  - .10 Glass Break Simulator
    - .1 The glass break simulator shall be a portable, battery-operated tester that ensures reliable locating and testing of glass break detectors.
    - .2 The glass break simulator:
    - .3 Generate plate or tempered glass sound samples.
    - .4 Include a 7.6mm (3") full range speaker that accurately reproduces the full range of frequencies generated by shattering glass.
    - .5 Single or automatic / continuous sound (sound every 10



seconds) operation.

- .11 Perform System Integration Tests
  - .1 The Electronic Safety and Security Contractor shall perform system integration functional tests for all devices and systems in accordance with the system integration functional test forms.
- .12 Perform Retests as Necessary
  - .1 For all failed tests, the Electronic Safety and Security Contractor shall make all necessary repairs and perform retests. Failure of the integrated test may require the retest of one or more individual tests. Repairs and retests shall be by the Electronic Safety and Security Contractor until all tests are passed.
- .13 Turnover
  - .1 The Electronic Safety and Security Contractor shall prepare a comprehensive commissioning report that include but not limited to completed device checklists, completed functional test forms, completed systems integration functional test forms with measured data. The commissioning report shall be submitted along with system operation and maintenance manuals for review and approval by the Electronic Safety and Security Consultant.

**END OF SECTION**

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## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1 Conform to Section 28 00 03 – General Specifications and Requirements for Electronic Safety and Security.

### **1.2 Purpose**

- 1.2.1 The buildings and facilities Access Control System primary function is to protect the assets. The contents of this document are critical and are considered confidential. This information shall not be disclosed to anyone other than authorized personnel.

### **1.3 General**

- 1.3.1 All equipment and materials used shall be standard components that are regularly manufactured and used in the manufacturer's system.
- 1.3.2 All systems and components shall have been thoroughly tested and proven in actual use.
- 1.3.3 All systems and components shall be provided with the availability of a toll-free (U.S. and/or Canada), 24-hour technical assistance program (TAP) from the manufacturer. The TAP shall allow for immediate technical assistance for either the dealer/installer or the end user at no charge for as long as the product is installed.
- 1.3.4 The Access Control system shall allow for modular expansion of 15% on day one (1) of a fully operational system.
- 1.3.5 All systems and components shall be provided with a one-day turnaround repair express and 24-hour parts replacement. The repair and parts express shall be guaranteed by the manufacturer on warranty and non-warranty items.
- 1.3.6 The access control system shall be an inter-connected group of components consisting of but not limited to the following devices:
  - .1 Controllers
  - .2 Communication devices
  - .3 Access control software
  - .4 Readers
  - .5 Fobs or cards
  - .6 Door locks
  - .7 Lock power supplies
  - .8 Personal computers
  - .9 Servers
- 1.3.7 The system shall have of the following functions:

- 
- .1 Regulate and monitor access at system-controlled doors.
  - .2 Control access to elevator floors and monitor elevator floor button activity.
  - .3 Monitor connected detectors (supervised and auxiliary inputs) with the ability to arm and disarm them manually or automatically.
  - .4 Control event-initiated devices connected to system outputs, such as alarms or video recorders, with the ability to automatically or manually arm or disarm them.
  - .5 Report an alarm condition.
  - .6 Distribute an annunciated alarm condition via an email notification off-site.
  - .7 Establish a hierarchy of alarm types to prioritize handling alarm conditions.
  - .8 Maintain a comprehensive database recording all site activity.
  - .9 Integrate with the closed-circuit television system (CCTV).
  - .10 Operate a fully integrated photo badge and verification module allowing for a complete ID badging operation.
  - .11 Interface with intrusion controllers.
  - .12 Remotely access the Client software via the Internet or a corporate intranet with a WEB module.

#### 1.3.8 Building Integration

- .1 The system shall be capable of integrating multiple buildings within one collective access control/alarm monitoring entity whether the buildings are in relative proximity or at distant locations. The access control system's design shall further allow expansion or modification within existing buildings or the integration of new buildings at any time.
- .2 The system shall be structured to provide a continually expandable growth path from the capabilities and features specified within this document without the necessity of exchanging previously installed controllers or software.

#### 1.3.9 Communication Modes

- .1 The software application modules shall be designed to communicate to the access control units using one or a combination of the following connection modes:
  - .2 Network (TCP/IP)
  - .3 Internet

#### 1.3.10 Multiple System Users

- 
- .1 The system shall support multiple system user workstations with access to the system database. The number of concurrent users shall only be limited by the software licensing agreement.
  - .2 The software shall provide selectable controls to govern individual user activity with log on accounts and passwords. System user activity shall be recorded to the database and accessible for operator audit and review.
  - .3 The system software shall provide an application that allows multiple users remote connectivity via a corporate intranet or the Internet to input and manage selective system functions.
  - .4 Provide (1) Server and Seven (7) Client Software licences (4 to be deployed on site and 3 for future owner's use).

#### 1.3.11 Cardholder Access

- .1 Access shall be governed by controlled entry point (doors) using an assigned credential, such as a token or card, that is presented to a sensing device referred to as a card reader.
- .2 At least one token or card shall be supplied for each individual who requires access through the controlled doors.
- .3 The system shall support the following reader formats:
  - .1 Proximity (125 kHz)
  - .2 Mifare Contactless Smart Card
  - .3 FIPS-201, FIPS201-PIV & TWIC
  - .4 Large Card Format (up to 75 bits)
  - .5 HID Corporate 1000
  - .6 Radio frequency transmitter/HID proximity combination
  - .7 Biometrics
  - .8 Contactless Smart Card & iClass
  - .9 Personal Identification Number (PIN) only
  - .10 Magnetic Stripe
  - .11 Barcode
- .4 Each Fob/card shall be internally encoded with an individual number. The system shall provide the means to enter these numbers into a database for transmission to each controller.
- .5 The reader shall be capable of scanning the internal number encoded in each token and transmit this information to the controller.
- .6 The controller shall process the card/token data and unlock the appropriate controlled door only if the card/token is determined to be valid for access through that door.
- .7 Where heightened and more stringent security is required, the system shall offer one of the following additional facilities to be available:

- 
- .1 A keypad can be used in tandem with a proximity reader. A cardholder would be required to present a valid token and/or enter a Personal Identification Number (PIN) code to gain access. Only one (1) reader port shall be used when both a reader and a keypad are in place.
  - .2 A combination biometric/Mifare smartcard reader can be used whereby the physical biometrics of the cardholder must match the biometric data stored on the card for 1 to 1 identification before access is granted.
  - .8 Where PIN codes are used, they shall be randomly created by the access control software. An operator shall have the ability to change PIN codes with a minimum 5-digit key number controlling algorithm process.
  - .9 An access request at a reader shall be determined based on the following conditions. Should any of the conditions be false, access would be denied. This shall result in an 'Access Denied' event recorded in the database.
    - .1 Is the card valid for this day?
    - .2 Is the card valid for this time?
    - .3 Is today a holiday? If yes, is the card valid for this holiday?
    - .4 Does the PIN match the card presented?
    - .5 Is the card valid for this site?
    - .6 Is the card valid for this door?
  - .10 Doors shall be unlocked for valid cardholders requesting entry within one second following the reader scan regardless of all other system activity.

#### 1.3.12 Door Identification and Control

- .1 The system shall provide the means to identify each portal or door that is controlled by a controller with a unique alpha description and provide the following controls or functions:
  - .1 User-defined door relay unlock time of 2 to 99 seconds, adjustable in 1 second increments.
  - .2 User-defined door held open time of 2 to 99 seconds, adjustable in 1 second increments.
  - .3 Controllers shall automatically re-lock the controlled portal when the door is sensed as closed or when the door relay unlock time expires.
  - .4 Provide a handicap accessibility feature such that an access control relay can be connected to a door operator with separate door time settings.
  - .5 Provide a pre-alert that advises when a door remains open at the half interval of the door held open time.
  - .6 Each controller shall provide a dedicated request to exit input

- 
- for each door (i.e., motion request to exit device, an exit button, etc.).
  - .7 Control a door where a reader and keypad are used conjointly with the following access modes:
    - .1 Card or Keypad – Only 1 of the two is used to gain entry
    - .2 Card Only – Only the reader is used to gain entry
    - .3 Card and Keypad – The reader and keypad are used to gain entry
  - .2 The above access modes may be set to time zones with the ability to automatically institute a change in the access mode at any time within a 24-hour clock to satisfy security requirements.
  - .3 Monitor the status of all doors controlled by controllers with the status stated in one of the following conditions:
    - .1 Locked
    - .2 Unlocked
  - .4 Provide a manual override to lock or unlock doors controlled by the access control units.
  - .5 Provide a programmable facility to automatically unlock and relock specified doors during an assigned time zone to allow access without the use of a token or card.
  - .6 Provide a safety mechanism 'First Person In' to prevent assigned doors programmed for auto unlock from unlocking at the start of a designated time zone until a valid token is first presented by an authorized cardholder.

#### 1.3.13 Local Anti-Pass Back Mode

- .1 The system shall allow doors to be 'anti-pass back' enabled. Local anti-pass back is restricted to monitoring and enforcing IN/OUT conditions at doors connected to the same access control unit.
- .2 The 'anti-pass back' function shall have a manual override.
- .3 The system shall have multiple modes of local anti-pass back:
  - .1 Hard Mode – designated cardholders are denied access on violating anti- pass back enforcement
  - .2 Soft Mode – designated cardholders are allowed access but an anti-pass back violation is reported
  - .3 Timed Mode – designated cardholders are denied access on violating anti- pass back enforcement except anti-pass back enforcement is based on a time interval (can be employed on a single reader)
  - .4 Executive (Stealth) Mode – excludes designated cardholders from anti- pass back enforcement

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#### 1.3.14 Alarm Monitoring Functions

- .1 The system shall provide forced entry detection at secure door locations. A forced entry shall be generated immediately whenever the door is opened without authorization.
- .2 Authorization shall be determined by token or card or request to exit transaction at the door or by command from the host system as described.
- .3 The system shall provide door held open detection at controller-controlled doors. A door held open event shall be generated immediately whenever the door is held open longer than its specified time limit.
- .4 The system shall feature the provision to monitor auxiliary and supervised input points or detection zones. The system shall be capable of detecting state changes between four distinct conditions for each of these points:
- .5 Alarm
  - .1 Secure
  - .2 Trouble due to open circuit wiring
  - .3 Trouble due to short circuit wiring
- .6 The system shall also have the provision for reader supervision when connected with a "heartbeat capable" reader to detect and report one of the following alarm conditions:
  - .1 Reader communication failure
  - .2 Reader tamper alarm
- .7 When any change of state on an input point is detected, the computer shall be notified and shall generate a message stating the nature of the alarm, the location, and the time. The computer shall record the alarm such that it can be later retrieved for an audit report.

#### 1.3.15 Control Of Event Initiated Devices

- .1 The system shall have the ability to control event-initiated devices that respond to alarm events. Said devices may be armed or disarmed automatically by user-defined time zones or armed and disarmed manually by operator intervention.
- .2 The condition for each alarm output shall be user-defined to include any of the following:
  - .1 Forced entry at a system-controlled door
  - .2 Door held open time violation of a system-controlled door
  - .3 Monitored alarm point detects a violation
- .3 The system shall provide an alarm in the event a controller is tampered with.

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1.3.16 Communication Failures

- .1 The system shall notify Client workstations of any communication failures with controllers or the communication application.
- .2 The system software shall provide full integration of all system components for overall access control management. The system software shall be regulated by individuals deemed as system operators. The system software shall include the following specifications.

1.3.17 User Interface

- .1 The software user interface shall be based on Windows® conventions and standards. The main screen shall have pull down menus as well as quick buttons for direct access to frequently used functions.
- .2 The software shall provide multiple language interfaces:
  - .1 English
  - .2 French
- .3 The software shall be designed to allow each operator to select a language of his or her preference and at any time change languages without having to exit and re-start the software. The software further supports concurrent operators to work with different interface languages simultaneously and have access to context- sensitive help in the operator's choice of language.
- .4 The software shall employ keyboard shortcuts for rapid access to certain functions.
- .5 The operator shall be able to run the system software in a minimized state and still receive notification of alarm events.
- .6 The system interface shall provide formatted forms for facility management. These forms shall provide the user with the ability to add, edit, delete, or view site-specific information including instructions pertaining to alarms and emergencies.
- .7 The system shall provide the operator with the ability to add, edit or view the following functions:
  - .1 site information and access control units
  - .2 minimum 511 door groups and 511 elevator groups
  - .3 door and elevator group access levels and associated time zones for each door and elevator floor
  - .4 cardholder records
  - .5 administrator/operator records
  - .6 readers/doors in the system
  - .7 elevator information
  - .8 time zones, schedules, holiday (3) types, and holiday dates
  - .9 alarm response instructions and contacts



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- .10 manual overrides & system utilities
  - .8 The system shall further provide the operator with the facility to define, view, and print summaries based on system-wide activity recorded by the database.
- 1.3.18 System Software Requirements
- .1 The system shall be based on independent, intelligent devices that are interconnected and communicate to a rack mount IBM-compatible Access Control System Servers with the following minimum specifications:
    - .2 Central Processing Unit: Intel Pentium Dual Core 2.2 GHz or higher.
    - .3 2048MB (2GB) DDR II 800MHz PC6400 Memory
    - .4 Dual 250GB SATA II 7200RPM, 16MB Cache Hard Drives, in a Raid 1 Array
    - .5 USB Port: 4
    - .6 COM Port: 1
    - .7 8X Slim CD-RW/DVD Combo Optical Drive
    - .8 Mouse or compatible pointing device
    - .9 Removable Media Storage Device such as a CD/DVD Writer for database backup
    - .10 Network Interface Card (NIC) with TCP/IP protocol
    - .11 Graphics card that supports 1024 x 768 or higher screen resolution
    - .12 Operating System: as required
    - .13 1U Rackmount Chassis with a 250W Power Supply
    - .14 Provide all servers in all configurations as required for a complete and operational access control system.
- 1.3.19 Software Architecture
- .1 The system software shall be designed so that it may be installed on a single PC or on multiple PCs and in both circumstances capable of operating on a LAN/WAN (TCP/IP) from any communication node on the network.
  - .2 The system software shall be modular in design and consist of the following standard components:
    - .1 Client (Operator Input/Monitoring/Reporting)
    - .2 communication manager
    - .3 database engine – SQL Server 2014 SP1 c/w all cumulative update builds
  - .3 The system shall support upgrading to full SQL.
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1.3.20 Client Software

- .1 Event processing, data entry, system management functions, and auditing system activity shall be performed from a PC with the Client software module.
- .2 The system shall support multiple concurrent Client operators commensurate with the license agreement.
- .3 The system software shall have the capability to program and monitor remote site systems simultaneously.
- .4 The system software shall support digital signature capture devices with integrated software.
- .5 The system software shall provide the means of streaming site activity data to a serially connected device such as a pager.
- .6 Alarm Annunciation and Processing
  - .1 System occurrences deemed as violations shall be articulated as alarm events at the computer.
  - .2 The system software shall allow assigning user-defined names for any reader port or input point to distinguish its location for the benefit of the operator.
  - .3 The system shall further provide the following alarm notification/processing:
    - .4 Display the alarm in an alarm events window which cites crucial alarm information for expedient alarm handling.
    - .5 An alarm notification pop-up window shall come to the foreground so long as the access control client program is running.
    - .6 An audible warning sounds.
    - .7 The system shall provide a designated form with specific alarm event information and instructions accessible to the operator. The information shown shall include:
      - .1 Alarm time
      - .2 Alarm type
      - .3 User-defined description
      - .4 Location
      - .5 Alarm response instructions
      - .6 Alarm contacts
      - .7 Alarm response comments
    - .8 It shall be possible for the operator to 'Acknowledge' an alarm clearing it from the alarm events window or 'Pend' an alarm for further investigation.
    - .9 The operator shall be provided with the means to cite and save commentary on the disposition of an alarm event.

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- .10 The system shall be integrated with the CCTV system and shall provide all operators with the means to view is located still images captured by the associated cameras during the alarm event.
  - .11 As an additional aid to the alarm event, the system shall provide all operators with the option to open a floor map to pinpoint the location of the door or device that tripped the alarm. Complete floor maps/plans of all floors where access control system device/s are located shall be provided, imported, and integrated in the access control system to provide such functions.
  - .12 The system shall allow the operator to examine information for all alarms currently waiting for processing one at a time without acknowledging them and/or clear all alarms in the system.
  - .13 The system database shall log each occurrence of an alarm event.
  - .14 The system operator shall be furnished with the means to view current or pending alarms or search for alarms by device type, by a specific controller, by alarm type, by site name, or by a date range.
  - .15 The system shall incorporate the ability to email an alarm or critical message to a device that has an Internet email address.
  - .16 The system shall provide the means to establish a hierarchy of alarm priority levels to assist operators in determining an alarm's degree of importance. The system shall allow user-defined properties to be assigned to each alarm priority:
    - .1 Each alarm priority can be assigned to an access control unit, a door, an auxiliary input, a supervised input, or an optional input device with each device assigned to a specific alarm type or group of alarm types.
    - .2 Each alarm priority can be assigned a unique description with customized display characteristics.
    - .3 Each alarm priority can be assigned to a system time zone to regulate when the alarm priority is in effect. When the time zone is not in effect, the alarm is still reported but without its assigned properties.
    - .4 Each alarm priority can be routed to specific logged on system operators at specific computers.
    - .5 Each alarm priority can be assigned a sound (WAV) file to audibly annunciate the alarm priority so as to assist the operator in distinguishing the level of alarm importance
  - .17 In the event of AC power failure to the access control units, the system software shall have the means to report the AC power failure as an alarm with user-selectable time duration before
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- the alarm is tripped.
- .18 Where keypads are installed, the system shall offer a “duress” alarm type. A distressed cardholder would press the designated duress key then enter the PIN code. The system would allow access and annunciate a duress alarm for an expedient response to the situation.
- .7 Building Emergencies/Evacuations/Lockdowns
- .1 The system shall provide the means to automatically generate a printed card IN/OUT status report which can be used in emergencies or building evacuations to determine who is in and out of the building.
- .1 The card IN/OUT status report printout can be set to specified timed intervals for continuous updating until the emergency or situation is resolved.
- .2 The card IN/OUT status report can be emailed for remote location notification.
- .2 The system shall offer an optional standalone executable “lockdown” application designed to turn off one or multiple time zones to affect a lockdown.
- .1 The lockdown shall be designed to be triggered on a transaction type event such as a card presentation at a reader for rapid reaction to an emergency situation.
- .2 The system shall be able to lockdown all doors regulated by the time zone that has been turned off for maximum system- wide control.
- .8 Cardholders
- .1 The system software shall offer system-defined fields and user-defined fields to identify each cardholder.
- .2 The system shall also provide the ability to insert a digital photograph on each cardholder record (optional). The photographs may be inserted on ID cards or displayed while observing on-line transactions to enhance security protocols.
- .3 The system shall store cardholder images in the database and said images shall be preserved/updated to the database during backup operations.
- .4 The system shall provide the ability to designate cardholders with a temporary status and restrict the card to a defined date range and/or a maximum number of uses. At the conclusion of the date range or when the number of uses reaches zero, the system shall render the card inactive and deny further entry.
- .5 An operator shall be able to view from each individual cardholder record the last 25 transactions over the previous 7 days for auditing, investigating activity, or locating a cardholder’s whereabouts.
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- .6 The system shall furnish a mechanism to load blocks of numerically- sequenced cards with the same facility code for expedient card loading.
- .7 Where multiple sites exist, the system shall provide the means to quickly copy cardholder records to alternative sites. Each cardholder who requires access to multiple sites shall require only one card to access all authorized sites.
- .8 In the event a card is lost or stolen or upon employment termination, the system shall allow a card to be cancelled and rendered invalid within seconds.
- .9 As an alternative to permanently deleting a card, the system shall allow a cardholder record to be designated as 'Archived'. While the archived status is in effect, the record is maintained in the database, but the card is invalid and denied entry to all previously authorized access points. The archived status shall remain in effect until it is re-activated by an operator.
- .10 In order to locate and review cardholder records, the system shall provide extensive search capabilities that allow broad latitude of cardholder search criteria to retrieve one or multiple cardholder records. The system shall also include a search criterion entitled 'Not Used Since' that lists inactive cards based on a defined date for maintaining up-to-date records.
- .11 The system shall be capable of exporting cardholder records in Acrobat® PDF format for the benefit of non-system users.
- .12 The system shall also offer a time saving mechanism to import and export cardholder records as CSV files with other external databases. This allows transferring cardholder records to and from the access control database reducing data entry.
- .13 The system shall provide a facility to view an access level summary for individual cardholders to determine which system regulated doors and elevator floors are and are not accessible to the cardholder.
- .9 Time Zones and Schedules
- .1 The system shall provide minimum 256 time zones (254 are user- definable) and minimum 512 schedules (510 are user-definable) for door and elevator control and input, and output points.
- .2 Each time zone and schedule shall be configurable within a minimum seven (7) day week.
- .3 The system shall offer minimum three (3) holiday schedules which can be used as overrides to regular time zones and schedules for statutory holidays, special occasions, plant shutdowns etc.
- .4 The system shall support a minimum of sixty-four (64) holiday dates that the three (3) holiday schedules can be assigned to.
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- When a holiday date is in effect, the assigned holiday type schedule overrides the time zone for that date. The system shall further provide a facility to specify recurring holidays eliminating the need of resetting those holidays each year.
- .5 If holidays have been specified, the system shall be capable of listing all holiday dates and types.
- .6 The system shall automatically invoke a holiday schedule when the system clock matches any date defined as a holiday. A holiday schedule shall override all other time zones and schedules. Access shall be predicated on the times and authorizations of the holiday schedule for the stated holiday date. At the start of the next non-holiday calendar date the system shall invoke the regular time zone settings and access conditions.
- .10 Door And Elevator Group Access Levels
- .1 The system shall allow creating minimum 511 door groups and 511 elevator groups of which each cardholder may be assigned to minimum 2 door groups and minimum 2 elevator groups.
- .2 The system shall as a means for providing greater security and control segregate door and elevator groups into separate entities with independent time zones and access levels.
- .3 The system shall provide the following three access levels for door groups and elevator groups:
- .1 24-hour access
- .2 No access
- .3 Access based on a time zone
- .11 System Operators
- .1 The system shall provide the means to maintain a secure administrative environment. Only operators given an administrator account with a unique User ID and Password are permitted access to the system software.
- .2 Unauthorized individuals shall be denied access to the system software.
- .3 The system shall provide a means of setting discretionary operator functionality for each user account.
- .4 The system shall allow each operator individualized access for adding, editing, deleting, and viewing database information, as well as interrogating and issuing commands to the controllers depending on the functions enabled in the operator's account.
- .5 The system shall support an unlimited number of system operator accounts. Passwords shall not be displayed or printed by the system at any time during usage. It shall be possible to change passwords at any time.
- .6 The system shall provide the means of tracking operator

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activity with the capability of generating a detailed summary.

.12 Manual Overrides

- .1 The system shall furnish an operator with manual control of doors from a Client computer as detailed below:
  - .1 Unlock a door and leave it unlocked
  - .2 Unlock a door momentarily, such that it automatically re- locks after the normal door relay unlock interval
  - .3 Lock a door
  - .4 Unlock or lock all doors controlled by a selected controller
  - .5 Unlock or lock all doors for the currently logged on site
  - .6 Schedule a timed unlock period for a specified door
- .2 The system shall provide an operator with the ability to manually override elevator floor control by toggling individual or all floors to secured or unsecured. The system shall allow the operator to restore the elevator floors to their regulated state.
- .3 The system shall provide an operator with the means to manually arm or disarm auxiliary and supervised inputs and outputs. The system shall allow the operator to restore the inputs to their regulated state.

.13 Other Control

- .1 The system shall provide a function which allows a designated cardholder to independently invoke a change of state for specified doors and devices when a card is presented at a specified reader.
- .2 The system shall be able to lock or unlock doors on an unscheduled basis, arm or disarm points connected to devices such as motion sensors, lock out other cardholders to prevent false alarms, implement a supervisory override to restrict access, or control lights, HVAC systems etc.
- .3 The system shall be capable of either toggling a door's lock/unlock state or toggling a time zone's off/on state and shall offer the following multiple modes of operation:
  - .1 Door Toggle
  - .2 Time Zone Toggle with Cardholder Lockout
  - .3 Time Zone Toggle with Cardholder Lockout and Exit Delay
  - .4 Time Zone Toggle without Cardholder Lockout

.14 Daylight Savings

- .1 The system shall provide an interface that allows the operator to set daylight savings hours. After operator input and controller uploading, the system shall update all access control units with

the time changes. The system shall not be dependent on an adjustment of the computer's clock to affect the time changes.

.15 Site Management Activity Reports

.1 The system shall furnish the operator with the capability of transposing site activity recorded by the database into any of the following report types:

- .1 Transaction Report
- .2 System Log Entry Report
- .3 Alarm Listings Report
- .4 Cumulative Hours Report
- .5 Card In/Out Status Report
- .6 Deleted Cardholder Reports

.2 The system shall furnish the operator with the ability to filter reports based on specifying relevant field criteria.

.3 In the case of Transaction Reports, the system shall be capable of allowing an operator to automatically schedule the system software to self- generate a formatted report. The system shall further provide a mechanism to automatically send the report to a specified email address.

.4 To allow reports to be distributed to non-system users, the system software shall have the ability to save reports in Acrobat® PDF format and in some instances CSV format.

.5 Where a controlled enter/exit environment exists, the system shall provide the means to generate a cumulative hour's report (optional) specifying when cardholders entered and exited access points.

.6 Where a controlled enter/exit environment exists, the system shall also be capable of providing a cardholder status report as to whether the card is in or out.

.7 The system shall provide the operator with a report previewer to review the results of the specified report request.

.16 System Settings Reports

.1 The system shall furnish the operator with the capability of generating system settings reports including the following summaries:

- .1 Site Setup Report
- .2 Reader Access Level Report
- .3 Cardholder Report
- .4 System Users Report

.2 To allow reports to be distributed to non-system users, the system software shall have the ability to save reports in Acrobat® PDF format and in some instances CSV format.



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- .3 The system shall provide the operator with a report previewer to review the results of the specified report request.
  - .17 Printing Reports and System Information
    - .1 The system shall provide print capabilities on transaction reports and other system information.
    - .2 The system shall allow the operator to direct a print request to the printer interfaced with the Windows® operating system. The report shall be fully formatted complete with report name, headings, page numbers, time and date, and site name.
    - .3 The system shall be capable of monitoring printer status. The operator shall be advised whenever the printer is not available.
  - .18 On-Line Transactions
    - .1 The system shall provide the capability for an operator to view site transactions as each event occurs for enhanced facility security. The operator shall be able view up to 3 separate on-line transaction windows simultaneously.
    - .2 The operator shall have the capability of using an array of filters to list only the desired transactions or transaction types on screen.
    - .3 The system shall allow an operator to view transactions for remote sites in different time zones in real time.
    - .4 The system shall provide the capability to show photos and details of cardholders enacting the transaction.
    - .5 The on-line transaction window shall have a “card enrollment” function in which an operator shall have the convenience of enrolling an unregistered card that has been presented at a reader.
  - .19 System Status
    - .1 The software shall provide the means to list all PCs and associated access control applications currently logged on the system.
  - .20 Communication and Polling
    - .1 The system shall use a communication manager module to direct communication between the system database and the controllers. The communication manager shall have the following attributes for robust and flexible system communication:
      - .2 The system can be configured with multiple communications managers for maximum communication efficiencies.
      - .3 The communication manager can be configured as a Windows™ service or as an application.
      - .4 Minimum 5 communication managers may be installed on 1 PC/server to economize on communication efficiencies.
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- .5 The communication manager shall allow a user-defined polling frequency within a system allotted time range to adjust communication efficiency for sites with heavier activity.
  - .6 The communication manager shall allow a user-defined look-back time within a system allotted time range to view site transactions.
  - .7 The communication application shall be designed to regulate data flow in multiple installation configurations to poll all sites, individual sites, or specified controllers within individual sites.
  - .21 Database Management
    - .1 The system shall record all operator input data, all operator tasks, all site(s) activity, and all alarm events to database. The database shall be ODBC compliant.
    - .2 System-wide database information shall be stored on a hard drive within the host computer. The system database storage capacity shall be limited only by the hard disk capacity or the limitation of the server application.
    - .3 The system database information shall be distributed among the controllers as well as stored on the access control system server.
    - .4 The system shall advise the operator when the database has reached 75% of its maximum allowable size.
    - .5 The system shall have the provision to automatically upload to the controllers added, edited, or deleted database information that pertains to time zones, cardholders, operators, or access levels without operator intervention.
    - .6 The system interface shall advise the operator whenever the controllers require uploading other changes made to the database. This ensures all devices operate according to the most current information. The system shall provide the capability to perform database uploads to the controllers on demand.
    - .7 The system shall provide the facility to automatically backup the database on a user-defined schedule. During the backup of the database file, there shall be no interruption to the system and the on-going collection of data.
    - .8 The system shall provide the operator with the option to automatically purge old database backup files based on a "days lapsed" format. The system shall further provide the option of viewing in CSV format the average number of daily transactions for the specified purge-files date range.
    - .9 Database files can be backed up onto another medium such as a writable CD while the database events continue to be recorded without interruption to the collection of system activity.
    - .10 The contents of the database shall be available to operators for
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- retrieving site information in user-defined reports.
- .11 The system shall be capable of exporting and importing the cardholder segment of the database in CSV format. The system shall further provide the option to automatically schedule the software to import cardholder CSV files by time and day.
- .22 Database Disaster Recovery
- .1 The system shall include a disaster recovery utility as a means of recovering site data in the event that the database is lost because of file corruption, computer malfunction, or hard disk breakdown.
- .2 The disaster recovery utility shall download data stored in the access control units and retrieve crucial site information including all or partial cardholder names to the database in a quick and timely manner to re-establish full operation of the access control system.
- .3 The disaster recovery utility shall be able to recover data from all controllers whether they are located on one site or multiple sites.
- .23 Remote Internet/Intranet Access
- .1 The system shall provide an Internet/Intranet Access application that allows remote connectivity for managing system functions.
- .2 The Internet/Intranet application shall have user ID and password authentication for secure log on.
- .3 The Internet/Intranet application shall include the following functions:
- .1 Add, edit, or delete cardholder records
- .2 Show or modify door group and elevator group access levels
- .3 Manually toggle elevator floor buttons to secure and unsecure
- .4 Format and produce transaction reports
- .5 View door status, lock, unlock, or pulse system-controlled doors
- .4 The Internet/Intranet application shall be programmed with an automatic logout function. After a lapsed time of mouse or keystroke inactivity, the application automatically logs the user out to protect the site from potential unauthorized user activity.
- .24 CCTV and Video Control System
- .1 The system shall provide a CCTV application module to integrate with a closed-circuit camera system within the access control system. The camera system shall not be proprietary to

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the access control system.

- .2 The system shall allow the display of a live video feed with photo verification enabled simultaneously.
- .3 The CCTV application shall provide the operator with the ability to program cameras to various commands such as pan, tilt, zoom, and pre-positions.
- .4 The operator shall be able to program cameras to activate on selected alarm events.
- .5 The operator shall have the ability to view a live video feed with camera selection and view mode options or retrieve historical video from past alarm events.
- .6 The operator shall have the option to open multiple CCTV screens simultaneously for enhanced monitoring capabilities.
- .7 The system shall interface with a compatible Digital Video Recorders (DVR), Network Video Recorders (NVR), IP addressable cameras, and RS-232 platform multiplexers. DVRs and NVRs shall provide the ability to view the recorded images for an alarm event pinpointing the exact event that was recorded during the alarm.

#### 1.3.21 Output Module

- .1 The system shall provide an optional module that outputs data in a flat file format (CSV) that can be integrated with 3rd party software.

#### 1.3.22 ASCII Output

- .1 The system shall provide a facility to output data serially in ASCII format.

#### 1.3.23 On-Line Help, Manuals, and Setup Aids

- .1 The system shall provide context-sensitive help and shall be presented in the same language as the user interface on the Client module:
  - .1 English
  - .2 French
- .2 The on-line help shall be context sensitive whereby, when the operator presses a designated key, the relevant help screen opens.
- .3 The system shall include a hard copy of a software installation guide.
- .4 The system's Client application shall have a setup function that directs the operator through the process of setting up a site.

#### 1.3.24 Automatic System Start-up

- .1 The Access Control System shall provide automatic communication manager start-up such that no operator action shall be required to start the system after a power off condition.

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## **2 PRODUCT**

### **2.1 Manufactures**

2.1.1 Acceptable Manufactures are: Amag, HID, Bosch and Assa Abloy

### **2.2 Door Controller**

2.2.1 All products and materials used must be Commercial grade and compatible with the access control system

2.2.2 The controllers shall be modular POE single or double door controllers and provided as indicated on drawings.

2.2.3 Controllers shall be powered via 15.4 Watt POE and provide 12V output for remote devices.

2.2.4 Controllers shall have no relays or moving parts and provide an on-board LCD to provide local configuration, troubleshooting and testing.

2.2.5 Controllers for locations without drop ceiling shall have built in Request to Exit (REX) motion sensor.

2.2.6 Controller for locations with drop ceiling the Request to Exit (REX) motion sensor and integral local Piezo busser shall be mounted below the drop ceiling.

2.2.7 Controllers shall be:

Specified Product:

	Model No.	Details
Amag	M2150	Symmetry Door Controller

Parts showed above are for reference only, additional components may be required.

### **2.3 Proximity Card Readers**

2.3.1 The proximity card reader shall be a black in colour.

2.3.2 The reader shall be combo style suitable for mounting on standard 1104 electrical box or mullion as indicated on drawings.

Specified Product:

	Model No.	
HID	Signo40	Wall locations
HID	Signo20	Mullion locations

Parts showed above are for reference only, additional components may be required.

### **2.4 Access Cards and Key-Fobs**

2.4.1 All Credentials shall be HID iCLASS® Card 2080 or equivalent.

2.4.2 Proximity cards shall be standard readily available cards.

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Specified Product:		
	Quantity	Type
HID	200	Card

## **2.5 Request to Exit Detector**

### **2.5.1 Minimum Features/Specifications**

- .1 Detector Type: Passive infrared
- .2 Filter Technology: Digital Signal Processing (DSP)
- .3 Detector Lens: Curtain-type Fresnel lens
- .4 Detection Range:
  - Narrow Targeting Area: 3 m (10 ft)
  - Whole Body: 6 m (20 ft)
- .5 Piezo Buzzer: 90 dB at 28 VDC, 5-28 VDC,
- .6 Main Relay Contacts: SPDT, 1A max @ 30 VDC max
- .7 Main Relay Timer: Adjustable, 0.5 to 60 seconds
- .8 Main Relay Recycle Timer: Fixed, 0.75 seconds off
- .9 Lock Control Relay: -state relay, N.C., 2A max @ 30 VDC, timed at 2 seconds fixed
- .10 Tamper Switch: N.C., 100 mA max @ 30 VDC max
- .11 Indicator Light: Red/Green LED
- .12 Mounting: Optional back plate for mounting on a standard single-gang electrical box
- .13 REX colour to be confirmed before purchase and shall be coordinated with the Interior Designer and Client.

Specified Product:

	Model No.	
Bosch	DS160 Series	REX Sensor

Parts showed above are for reference only, additional components may be required.

## **2.6 Request to Exit Button**

- ### **2.6.1 REX color to be confirmed before purchase and shall be coordinated with the Architect and Client.**

Specified Product:

	Model No.
Assa	DRB002NS
Abloy	Series

Parts showed above are for reference only, additional components may be required.

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## **2.7 Access Control Panel Enclosures**

- 2.7.1 All access control panels/enclosures shall be provided to house all controllers.
- 2.7.2 All access control panels/enclosures shall be a single key locking metal box.
- 2.7.3 Size as required
- 2.7.4 Equipped with door tamper switch. Connect each door tamper switch to the access control system.
- 2.7.5 The quantity and size of access control panels/enclosures shall not exceed the real estate provided for mounting access control panels/enclosures. Refer to contract drawings and coordinate as such.

## **2.8 Access Control Software**

- 2.8.1 The Electronic Safety and Security Contractor shall supply a site software.
- 2.8.2 The ESS Contractor shall integrate the site software with the Owner's centralised server.
- 2.8.3 The ESS Contractor shall coordinate all the software and integration requirements on site with Owner.

Specified Product:

	Model No.	
Amag	Symmetry Version	Software
	9.1 & above	

Parts showed above are for reference only, additional components may be required.

## **2.9 Electric Locks**

- 2.9.1 All electric locks provided by others.
- 2.9.2 Electronic locking devices shall have a separate power supply to support the locks specified below. The unit shall incorporate integral battery charging capabilities and a fused line voltage input for a minimum of eight (8) individual locks. All power supplies shall be equipped with optional battery pack for up to 48 hours. The unit shall be equipped with a fire alarm system interface as required.

## **2.10 Peripheral Devices**

- 2.10.1 Door Contacts (Steel)
  - .14 1" dia. contact for use in steel doors.
  - .15 Flush or surface mount as required
  - .16 Self-lock mounting
  - .17 Rugged Construction
- 2.10.2 Door Contacts (Wood)

- .18 3/8" dia. contact for use in wood doors.
- .19 Flush or surface mount as required
- .20 "Wings" protect contact reed from being crushed from swelling wood
- .21 Installed quickly in over drilled holes
- .22 Superior false alarm immunity
- 2.10.3 Door Contacts (Overhead Door)
  - .23 Miniature and low-profile design
  - .24 Stainless steel armoured cable for added security and reliability
  - .25 Aluminium bar stock to resist corrosion in harsh environments
  - .26 Floor or track mount as required

### **3 EXECUTION**

#### **3.1 Coordination**

- 3.1.1 The Electronic Security Systems Contractor (ESSC) shall assume control and accountability for furnishing and installing all electronic security systems as hereafter specified.
- 3.1.2 The ESSC shall be responsible for the systems specified in this Section, including coordination with related trades.
- 3.1.3 The ESSC shall coordinate all work and submittal details with the electronic door hardware supplier to ensure proper sizing of control equipment and shall be responsible for proper sizing of interface equipment (i.e., relays, contact ratings, etc.) to eliminate interface problems.
- 3.1.4 Related work required to be provided:
  - .1 Door Hardware/ Electronic Locks coordination for system operation and interface
  - .2 Electrical Works
  - .3 Control Work and/or annunciation
  - .4 All 120 Volt wiring and connections from power panels to terminal strips in electronic low-voltage panels, power supplies and devices
  - .5 All raceway, conduit to the device(s), including all back boxes and pull strings and the installation of all special back boxes.

#### **3.2 Controller and Peripheral Devices**

- 3.2.1 Provide and install access control panels/enclosures as required to house and protect all controllers.
- 3.2.2 All controllers and peripheral devices shall be installed and configured in accordance with manufacturer's installation instructions and recommendations, as per the Owner's requirements and as per contract drawings and specifications.



- 3.2.3 Coordinate the exact mount location of peripheral device devices with the electrical contractor to ensure that all conduits and back boxes are installed in the optimal locations.
- 3.2.4 Coordinate exact mounting locations of all controllers on site with security Engineer's Representative and client.
- 3.2.5 Supply and install all peripheral devices as indicated on contract drawings and documents.
- 3.2.6 Refer to Architectural Door and Door Hardware Schedules and ensure that each peripheral device is coordinated with its respective door and door hardware.
- 3.2.7 All peripheral devices shall be compatible with the access control system.
- 3.2.8 Submit shop drawings of all peripheral devices to the Security Engineer's Representative for approval prior to procurement and installation.
- 3.2.9 Allow for "needs assessment sessions" with client to determine the exact mode/s of operation of each peripheral device.
- 3.2.10 Configure each peripheral device and each controller to suit the client's requirements.

### **3.3 Power Supply**

- 3.3.1 Supply and install power supplies as required for a fully functional access control system. Power supplies shall include but not limited to all controller power supplies, all electric lock power supplies and all peripheral device power supplies.
- 3.3.2 All power supplies shall be installed to manufactures recommendations and as required to furnish a fully functional access control system.
- 3.3.3 All power supplies shall be sized to facilitate connection of each electrified lock and each powered device to separately fused power output.

### **3.4 Electric Locks**

- 3.4.1 All electric locks shall be supplied and installed by the door hardware contractor.
- 3.4.2 Electrified locks shall include but not limited to:
  - .1 Electric strikes
  - .2 Magnetic locks/Maglocks
  - .3 Electric mortise locks
  - .4 Electric latch retraction
- 3.4.3 Coordinate with the door hardware contractor and electrical contractor, make all wire connections to all electric locks as required for a complete access control system.
- 3.4.4 Supply and install wiring as required for complete operation all access control devices and systems.
- 3.4.5 Include for all costs and work associated with acquiring permits for all magnetic locks.

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### **3.5 Installation**

- 3.5.1 Install all system components and appurtenances in accordance with the respective manufacturer's specifications, referenced practices, guidelines, and applicable codes. Furnish all necessary interconnections, services, and adjustments required for a complete and operable system as specified. Control signal, communications, and data transmission line grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.
- 3.5.2 Install the wiring system and integrate the system as indicated in this specification. All wiring is to be installed in dedicated conduit throughout. Wiring shall not be pulled into conduits or placed in raceways, compartments, outlet boxes, junction boxes, or similar fittings with other building wiring.
- 3.5.3 All low voltage wiring outside the control console, cabinets, boxes, and similar enclosures, shall be plenum rated where required by code.
- 3.5.4 All wiring conductors shall be individually numbered and each cable or wiring group being extended from a panel or cabinet to a building mounted device shall be identified with the name and number of the particular device.
- 3.5.5 All exposed wiring inside and outside the control console, cabinets, boxes, and similar enclosures, shall be dressed down neatly and secured with wiring cleats or wire ties.
- 3.5.6 All exposed metallic flexible conduit and armored cable shall be dressed down neatly and secured with low profile, metal fasteners.
- 3.5.7 All cabinets, boxes, and similar enclosures containing security system components and/or cabling and which are easily accessible to employees or to the public shall be provided with a lock. Boxes above ceiling level in occupied areas of the building shall not be considered to be accessible.
- 3.5.8 All junction boxes and small device enclosures below ceiling level and easily accessible to employees or the public shall be covered with a suitable cover plate and secured with tamper proof screws.
- 3.5.9 End-of-Line resistors shall be installed at the field device location and not at the controller panel location.
- 3.5.10 System devices identified on building drawings are intended to generally indicate areas where such devices are to be located. Determine and coordinate the final locations of these devices on site with the electrical contractor to ensure that all conduits and associate Back boxes are located where respective devices will be installed. Be responsible for all costs resulting from failure to execute the above.
- 3.5.11 Riser diagrams are schematic and do not show every conduit, wire box, fitting, or other accessories. Provide such materials as necessary for a complete and functioning installation. Install in accordance with referenced codes and these specifications. Use weatherproof equipment or covers where installed in areas exposed to weather.

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- 3.5.12 All equipment shall be mounted with sufficient clearance to meet all applicable codes and facilitate observation and testing. All equipment shall be securely fastened with appropriate fittings to ensure positive grounding and be free of ground loops.
  - 3.5.13 Determine conductor requirements for each device in accordance with the Contract Documents and manufacturer requirements.
  - 3.5.14 Install cable in accordance with Security System manufacturer requirements
  - 3.5.15 Neatly route cables parallel or perpendicular to building lines.
  - 3.5.16 Provide J hooks and other cable support systems (spaced at regular intervals) within accessible ceiling spaces. Fasten cables to the cable support systems and provide strain relief to protect cables and ensure compliance with required cable bends.
  - 3.5.17 Keep free-air cables a minimum of 18" from high voltage (120 VAC and above) circuits (e.g. light fixtures, wire run parallel with conduit, transformers, electric panels, etc.).
  - 3.5.18 Run cables at least six inches from the communications cable plant, intercom wires, input/output wires, and siren wires.
  - 3.5.19 Route wire and cable as required preventing interference and signalling contamination of both Security System cable and cable associated with other systems. Coordinate the routing of wire and cable requiring isolation from power, radio frequency (RF), telephone, etc.
  - 3.5.20 Provide sleeves and code compliant fire proofing techniques for all penetrations of fire rated partitions, masonry walls, and slabs, where the penetrations are made by or used for installation of Security Systems.
  - 3.5.21 Separate high voltage (120 VAC and above) cables from low voltage cables within enclosures
  - 3.5.22 Run wire and cable continuous from device location to the final point of termination. No mid-run cable splices will be allowed
  - 3.5.23 Bundle and tie wire and cable with cable ties.
  - 3.5.24 Cover exposed high voltage (120 VAC and above) power terminations within DGP's, power distribution cabinets and other security enclosures.

### **3.6 Labelled frames, Door and Enclosures**

- 3.6.1 In no instance shall any UL labeled door, frame or enclosure be drilled, cut, penetrated, or modified in any way.

### **3.7 Manufacturer's Field Services**

- 3.7.1 Provide manufacturer's field services for final system checkout and acceptance testing as required.

### **3.8 Protection**

- 3.8.1 Protect installed products until completion of project.

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**END OF SECTION**

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## 1 **GENERAL**

### 1.1 **Work Included**

- 1.1.1 Conform to Section 28 00 03 – General Specifications and Requirements for Electronic Safety and Security.

### 1.2 **General**

#### 1.2.1 Systems Minimum Requirements

- .1 All intercom station and duress alarm station shall be connected via IP based network and be able to be connected in such a manner to create a single system. All necessary data and audio routing between the exchanges shall be via IP and only require the necessary VoIP software licenses based on the system design. No additional proprietary hardware will be necessary to do the networking via IP between exchanges
- .2 System shall consist of duplex master stations with direct access buttons. Each master shall be capable of calling all other stations in the system unless specifically blocked or restricted through programming.
- .3 All master station shall be desk mounted.
- .4 Substations shall be flush or surface mounted, tamper and weather resistant where needed and located as required for direct access calling to control room masters.
- .5 All features and functions shall be programmed on site with a standard PC via IP.

#### 1.2.2 System Requirement

- .1 Call-Related Functions:
  - .1 Video Door Station Call: A designated group of master stations can be called from any video door station; any designated master can answer the call. 170 degrees view from the door station camera can be viewed from the master station and zoom and pan/tilt operations are functional.
  - .2 Sub Station Call: A designated group master stations can be called from any substations; any designated master can answer the call. External speaker and emergency call button can also be added.
  - .3 Group Call/All Call: A designated group of up to the full capacity of the system with any mix of master stations and door stations can be called from a master station. System needs to be pre-programmed to function.
- .2 Transfer-Related Function:
  - .1 Call (Communication) Transfer: A master station can transfer a conversation to any master station within the system.

- .3 Call Forwarding-Related Functions:
  - .1 Call Forwarding: Incoming calls can be automatically forwarded to another receiving station or telephone. The receiving station number or telephone number can be registered at the original forwarding station. Unit number will be assigned to each telephone number.
  - .2 Time-Based Call Forwarding: All incoming calls to the original station can be automatically rerouted to a designated master station or telephone number during a specific period of the day.
  - .3 No Answer Call Forwarding: Calls to the original station are automatically rerouted to a designated receiving station if the called party does not respond within a pre-set period of time.
- .4 Monitoring-Related Functions:
  - .1 Monitoring: Any door, room or substation can be monitored from a master station. A master station can also disable this function if monitoring is not necessary.
  - .2 Scan Monitoring: Any pre-programmed door stations or room sub stations can be scan monitored.
- .5 Priority Call-Related Functions:
  - .1 Priority Call: Any call from the master station or substation can be pre- programmed with priority level based on normal call, priority call, and urgent call. Urgent call will have the highest priority within individual calls.
  - .2 Mobile App for cell phones and tablets
  - .3 Identify visitors, unlock doors, and talk between stations from a smart phone or tablet. The Mobile app shall be available for Android™ and iOS® devices.

## **2 PRODUCT**

### **2.1 Intercom Substation**

- 2.1.1 Avigilon Video Intercom Reader Pro, Flush Mount.

### **2.2 Intercom System Management Software**

- 2.2.1 Provide intercom system management software to facilitate complete administration and operation of intercom system.

## **3 EXECUTION**

### **3.1 Installation**

- 3.1.1 Upon project commencement, the Contractor shall provide qualified technical personnel on- site. Personnel shall be present on each consecutive working day until the system is fully functional and ready to begin the testing phase of this project.

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- 3.1.2 During the installation process the contractor shall maintain an up-to-date set of as-built shop drawings, which shall always be available for review by the client and/or Engineer's Representatives. This set of documents should be clearly annotated with as-built data as the work is performed. These documents will be reviewed as part of the approval process when evaluating payment request applications. At a minimum, the drawings should contain the following information:
- .1 Quantity and location of all equipment installed.
  - .2 Cable and wire runs along with the designation tags assigned to each.
  - .3 Wiring diagrams that indicate terminal strip layout, identification, and terminations.
  - .4
- 3.1.3 The contractors Project Manager shall maintain continuous coordination with the Engineer's Representatives. The engineers shall be kept informed of the progress and all conflicts that arise during the course of this project.
- 3.1.4 Coordinate with the electrical contractor; provide to the electrical contractor all proprietary intercom substation back boxes for rough in.
- 3.1.5 Provide and install all wiring as required.
- 3.1.6 All installation, configuration, setup, program, and related work shall be performed by technicians thoroughly trained by the manufacturer in the installation and service of the equipment provided.
- 3.1.7 Install all devices and wiring as recommended by the intercom system manufacture.
- 3.1.8 Provide and install all miscellaneous hardware for a complete turnkey intercom system.
- 3.1.9 Provide and install all master intercom stations and intercom substations as indicated on contract documents.
- 3.1.10 Coordinate with the owner, configure, and program the intercom system as required to suit operations of the facility as directed by the owner.

**END OF SECTION**

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## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1 Conform to Section 28 00 03 – General Specifications and Requirements for Electronic Safety and Security.

### **1.2 General**

- 1.2.1 All equipment and materials used shall be standard components that are regularly manufactured and used in the manufacturer's system.
- 1.2.2 The security video system shall be an IP network-based, fully distributed digital video system. The security video system will utilize local area networks (LAN) as a transmission medium for video, configuration, as well as storage of all data. The security video system shall provide full video control at control station, with additional full selection capability at any point within the network from a workstation. The security video system shall provide unlimited expansion capability for the addition or modification of video inputs. The system design is based on a Network Video CCTV system and components.
- 1.2.3 The security video system shall allow for modular expansion of 15% on day one (1) of a fully operational system.
- 1.2.4 Security contractor shall carry cost for the relocations of all interior CCTV cameras 30ft horizontally and 15ft vertically to determine the final mounting location and viewing angle.
- 1.2.5 The contractor shall provide all security video cameras, pan/tilt/zoom (PTZ) cameras, mounts, housings, power supply systems, network cables, connectors, equipment racks, monitors and consoles, computer-controlled network switchers, workstations, network video recorders, encoders, decoders, displays, and all other hardware and software to provide a fully operational system.
- 1.2.6 Video Management System Performance Requirements

- .1 Configurations

- The network video management system shall be an integrated hardware and software platform that serves as the CCTV surveillance system management tool. The Video Surveillance system shall be Internet Protocol (IP) based system complete with IP CCTV cameras, Network Video Recorders (NVRs), CCTV System Server, CCTV System Video Management Client and Server Software to facilitate management of all NVRs and CCTV cameras as well as to facilitate viewing of all video stream for all CCTV cameras from multiple client workstation computers via a TCP/IP data network.

- .2 Basic architecture

- The system shall optionally be integrated with Security Management System (SMS). The TCP/IP network interconnects cameras, servers and Stations and associated equipment.

- .3 Integration with Security Management System (SMS)



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- .2 The Video Surveillance System (VSS) shall be integrated with Security Management System for building management and security-related applications and provide the following:
    - .1 Alarms and events shall initiate recordings. These recordings shall show what happened before an alarm/event occurred.
    - .1 The Video Surveillance System shares the SMS user interface (Station)
    - .2 Users can view the Video Surveillance System videos on any Station on the network.
    - .3 Video Surveillance System uses SMS security features to define each operator's viewing rights.
    - .4 The Video Surveillance System alarms and events are automatically sent to SMS or for inclusion in the Alarm and Event Summaries.
    - .5 Recordings associated with SMS alarms and/or events can be viewed directly from the SMS Alarm or Event Summary.
    - .6 An operator Station can control dedicated surveillance monitors.
  - .3 Alarms can be associated with video content and displayed on video alarm monitors.
    - .1 Video Surveillance System shall be capable of integration with legacy CCTV equipment or take full advantage of open TCP/IP network technologies to deliver software-based camera switching, control and digital recording. The Video Surveillance System will have open architecture and integrate with third-party products and applications.
    - .2 Video Surveillance System shall be capable of redundant configuration where video streams shall be capable of being redirected in the event of failure to minimize disruption and ensure uninterrupted recording.
    - .3 The user interface

Video Surveillance System includes an easy-to-use Web-based interface which runs on standard Windows computers. The video displays will be accessed using either Station or Internet Explorer.
    - .4 Network architecture options

The Video Surveillance System shall be capable of utilizing Conventional design that has no physical or logical protection between the various types, VLAN and a network dedicated to security system
    - .5 Video Surveillance System Data Transmission

The Video Surveillance System will utilize both Multicasting and Unicast transmission techniques
    - .6 Network management

The Video Surveillance System will have as minimum an appropriate set of network management tools that provide information such as but not limited to Network utilization, Warning if utilization reaches a user-defined threshold and Notification if a switch fails.
    - .7 Security
-

The NVMS will provide a range of security features and supports both domain and workgroup security. The NVMS shall support internet explorer security, operator-based security and workstation-based security.

**.8 Video Surveillance System servers**

The Video Surveillance System servers shall store the configuration and runtime information of system, distribute status information to the clients, accepts requests from the clients to view video, connects to video sources, transmit video from the cameras to the clients and store recorded video.

**.9 Recording Parameters**

The CCTV system including the CCTV system server and network video recorders shall be sized and equipped to record all video streams from all CCTV cameras with no latency as follows:

All CCTV resolution shall be 1080P at 7 – 15 frames per second for a period of 31 days.

**Viewing Parameters**

The CCTV system including the CCTV system server and network video recorders shall be sized and equipped to view video streams from CCTV cameras with no latency as follows:

Minimum 64 cameras at 4CIF resolution and 7 frames per second and

Simultaneously minimum 96 cameras at 720P resolution and 7 frames per second on Main CCTV and alarm Monitors

**.10 Recording and Viewing Parameters shall be concurrent.**

**.11 Custom applications and scripts**

The Video Surveillance System shall allow custom application and scripts to integrate with other applications.

**.12 Supporting video intercoms**

The Video Surveillance System shall support intercom functionality.

**1.2.7 Client shall provide PC workstation**

**1.2.8 System Function Requirements**

- .1** Provided equipment, wiring and other materials for a complete turnkey CCTV system as shown and as specified. The systems shall be modular and expandable to an unlimited number of cameras.
- .2** The system shall consist of State-of-the-art interior and exterior IP dome CCTV cameras c/w lenses as required to facilitate the required field of views, local or remote power supplies, camera mounts as required, dome housing, dome housing complete with blower and heater, Network Video Recorders, CCTV System Servers, Video Management Client and Server Software and associated licence.
- .3** The Video Surveillance/CCTV systems shall provide fully integrated NVRs and camera management interface for command-and-control video surveillance that supports the following functionality:
- .4** Support network connectivity to multiple NVRs, servers, and network connected client workstations.
- .5** The communications interface between the NVRs, servers, and network connected client workstations shall be via 10/100/1000Mb Ethernet connectivity using industry standard TCP/IP protocol.

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- .6 The Video Surveillance/CCTV systems shall provide multi-window video management consoles for real time video device monitoring and control from any central management station. NVRs, cameras and assigned pre-sets shall be displayed alphabetically and grouped by facility in a navigation pane for easy operator access.
  - .7 Operators shall be able to simultaneously view and control multiple live video cameras across multiple NVR units. Camera control shall be mouse driven on-screen and shall support pan, tilt, zoom, iris, focus, and camera pre-set call-up functions.
  - .8 Operators shall be able to perform quick recall video playback on any selected camera view to request last 15sec, 30sec, 1min, 2min, 5min, or selection from last 4 events listed for the selected camera.
  - .9 Operators shall be able to access, and playback recorded video events with on-screen controls that support play forward, play reverse, fast forward, fast reverse, single frame advance, single frame reverse, pause, stop, and variable speed control functions.
  - .10 Operators shall be able to playback tagged video events stored locally on NVR units, based on date, time, alarm, event, text, and motion search queries from an embedded history/archive database.
  - .11 Operators shall be able to save still image snapshots to file in the jpg file format from any live or recorded playback video stream.
  - .12 Operators shall be able to save video clips to file in native or AVI file formats from any live or recorded playback video stream.
  - .13 Operators shall be able to create and burn evidence CDs of selected video clips with required video player.
  - .14 The Video Surveillance/CCTV system shall support request for live and recorded video transmission from NVR units at various resolutions and display sizes, independent of actual NVR resolution setting for local recorded video. Such a feature shall be user configurable to facilitate network adaptability.
  - .15 The Video Surveillance/CCTV system shall allow the assignment of CCTV cameras and pre-sets to Video Surveillance/CCTV system alarm and card access events; for automating real-time camera control, automatic live video pop-up on alarm, video event tagging and providing quick access to live and recorded video from any central management station.
  - .16 The Video Surveillance/CCTV systems shall provide simultaneous support for multi- vendor video drivers.
  - .17 The Video Surveillance/CCTV system shall monitor status of all NVR units for processing and reporting Online / Offline status, Record status, Disk capacity status, Camera video loss and Camera alarm.

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## **2 PRODUCT**

### **2.1 Manufactures**

- 2.1.1 Acceptable Manufactures are Avigilon.

### **2.2 General**

- 2.2.1 All products and materials must be new and approved in the shop drawing submittals. Provide all equipment for a complete and operational IP based Security CCTV System Provide client with the necessary licenses as required for a complete and operational IP based video surveillance system
- 2.2.2 All Exterior devices shall be sealed and protected against weather conditions including heat, cold, moisture, dust, and sand.

### **2.3 Video Surveillance System Server**

- 2.3.1 Enterprise Central Management Server complete with multi-Core Processor, RAID 5 Storage, and Redundant Power Supply or equivalent.
- 2.3.2 Details shown on drawings are for reference only the Security contractor shall verify exact quantities required.

### **2.4 Network Video Recorder (NVR)**

- 2.4.1 Details shown on drawings are for reference only the Security contractor shall verify exact quantities required.
- 2.4.2 The CCTV system network video recorder shall be a professional enterprise solution suited for commercial use and complete with the following features:
  - .1 Real-time full motion video per channel
  - .2 Synchronous audio for every channel of video
  - .3 PC Decode feature will output cameras to additional screens connected to video card, both on Server and Client computer.
  - .4 MPEG-4 and H.264 compression technology
  - .5 Live View: Real-Time minimum 30fps per channel
  - .6 Recording: Real-Time minimum 30fps per channel
  - .7 Records compatible Megapixel IP Cameras at up to 5MP
  - .8 Outputs at minimum 1920x1080 (1080P).
- 2.4.3 Software and Hardware
  - .1 Multi-zone motion detecting (entire frame or up to 12 detection zones per channel) with Privacy Mask option
  - .2 Four recording modes: Continuous recording, Motion Detection, External Sensor, or Sensor/Motion
  - .3 Alarm email message auto-sending with photo attachment
  - .4 SMS Text message auto-sending when using a modem

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- .5 Hardware watchdog support with auto-reboot
  - .6 Position and color configurable OSD & Logo with Date/Time stamp
  - .7 Digital Watermarks
    - .1 It is a requirement for all exported recordings and exported audit logs to be digitally signed. This is required to prove authentication (origin of the recording and audit log) and integrity (exported recording and audit log have not been altered or tampered with).
    - .2 The NVMS system shall provide a default digital certificate for signing the exported recordings and audit logs. Customization shall also be provided to allow for the user to supply his/her own digital certificate.
    - .3 A utility shall be provided to display the exported recording, view the audit log, and verify the digital signatures. A visual indication shall be provided to whether the exported recording and audit log have been altered or tampered with.
    - .4 P/T/Z/F & Speed Dome control through software or keyboard - no additional hardware required. Protocols shall be as required to facilitate complete operation of all CCTV cameras.
  - .8 Search/playback by date/time directory (random-access)
    - .1 Advanced Smart Search: only search footage within a designated area in playback mode instead of viewing countless hours of video
    - .2 Backup options include CD, DVD, USB, Network, Remote Backup, Blu- Ray
    - .3 Viewing live video
    - .4 Receiving and transmitting audio
    - .5 Recording administration
    - .6 Playing back recorded video
    - .7 Save recorded video sequences
    - .8 Export recorder video sequences (MPG, AVI, other)
    - .9 PTZ telemetry
  - .9 Alarm events
    - .1 SNMP Interfaces: system status, major alarms
    - .2 Sequence view of camera pre-set positions
    - .3 Modifying settings for a camera
    - .4 Modifying recording settings for a camera
    - .5 Adding and deleting cameras
    - .6 Creating schedules for recordings and video motion detection
    - .7 Modifying video motion detection settings and tuning
    - .8 Archiving mechanisms (automation of archiving)
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- .9 Report capabilities
- .10 Network
  - .1 DDNS for dynamic IP addresses
- .11 Remote access, administration, and recording on client computer through NVR Client on LAN (network) or WAN (Internet)
- .12 View multiple locations from one NVR Client
  - .1 Bi-directional two-way remote communications between multiple NVR servers in various locations
  - .2 Remote view and PTZ Control on Mobile Phone or PDA use iPhone App or Android App
  - .3 NVR Client's Compatible OS: Windows 8, Windows 7 Windows XP, 2000, Server, Vista, 7, including 64-bit compatibility with remote NVR Client or Linux OS.
- .13 Expansion / Option
  - .1 Video management Software (VMS)
- .14 Hot-Swap Hard Drive Bays with RAID Levels 5 redundancy.
- .15 The Total quantity of network video recorders shall not exceed 12 Rack units of rack space.
- .16 Redundant Power Supply.

#### 2.4.4 Indoor Fixed CCTV Camera

- .1 Minimum features:
  - Image Sensor – CMOS Progressive Scan
  - Lens – As required to facilitate required field of view.
  - Minimum Light Sensitivity – 0.25 LUX Color and .005 LUX Black and White
  - Video Compression – H.264, Motion JPEG
  - Minimum Video Resolution (Pixels) 1920x1080 (2 Mega Pixels)
  - Intelligent Video – Motion Detection, Tamper Alarm,
  - Security – Level Passwords, IP Filtering, HTTPS Encryption, IEEE 802.1X,
  - Network – IPv4/v6, QoS
  - Power – Power over Ethernet IEEE 802.3af/802.3at Type 1 Class 2, max. 4.8 W, typical 3.5 W
  - Operating conditions - 0 °C to 50 °C (32 °F to 122 °F) Humidity 10–85% RH (non-condensing)
  - Application Programming Interface - Open software integration, ONVIF Profile
  - Intelligent video - Video motion detection, Active tampering alarm
  - Form Factor - Tamper and vandal resistant housing and tinted smoked bubble
  - Mounting – as required

#### Specified Product:

Brand	Model No.	Comment
Avigilon	H5A-D	Surface Mount
Avigilon	H5A-DC	In-Ceiling Mount

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Parts showed above are for reference only, additional components may be required.

#### 2.4.5 Indoor 180 Degrees CCTV Camera

##### .1 Minimum features:

Image Sensor – CMOS Progressive Scan  
Lens –f=4.44 - 142.6 mm, 1.6 - 4.41, Autofocus, 62.8° - 2.23° horizontal angle of view  
Minimum Light Sensitivity – 0.3 LUX Color and .003LUX Black and White  
Pan/Tilt/Zoom Pan - 360° endless, 0.05° – 450°/s Tilt: 180°, 0.05° – 450°/s 32x  
Optical zoom and 12x Digital zoom, Total 384x zoom E-flip, 256 pre-sets, Tour recording, Guard tour, Control queue, On-screen directional indicator, Set new pan 0°  
Video Compression – H.264, Motion JPEG  
Minimum Video Resolution (Pixels) 1920x1080 (3 x 2 Mega Pixels)  
Image settings - Wide dynamic range (WDR), Highlight compensation, Manual shutter time, Compression, Color, Brightness, Sharpness, White balance, Exposure control, Exposure zones, Backlight compensation, Fine tuning of behavior at low light, Rotation, Text, and image overlay, 32 individual 3D privacy masks, Image freeze on PTZ, Automatic defog  
Intelligent Video – Motion Detection, Tamper Alarm,  
Wide Dynamic Range  
Electronic image stabilization function  
Adaptive IR option  
Automatic defog function  
Security – Level Passwords, IP Filtering, HTTPS Encryption, IEEE 802.1X,  
Network – IPv4/v6, QoS  
Power – Power over Ethernet IEEE 802.3af/802.3at Type 2 Class 4, max. 26 W, typical 11.1 W  
Operating conditions - -40 °C to 50 °C (-58 °F to 122 °F) Humidity 10-100% RH (condensing)  
Application Programming Interface - Open software integration, ONVIF Profile  
Intelligent video - Video motion detection, Active tampering alarm  
Form Factor Tamper and vandal resistant housing and clear smoked bubble  
Mounting – as required  
Other – Tamper and vandal resistant housing and clear bubble with integrated heater and blower.

##### Specified Product:

Brand	Model No.	Comment
Avigilon	9C-H4A-3MH-180	Multi-Sensor

Parts showed above are for reference only, additional components may be required.

#### 2.4.6 Indoor 360 Degrees CCTV Camera

##### .1 Minimum features:

Image Sensor – CMOS Progressive Scan  
Lens –f=4.44 - 142.6 mm, 1.6 - 4.41, Autofocus, 62.8° - 2.23° horizontal angle of view  
Minimum Light Sensitivity – 0.3 LUX Color and .003LUX Black and White  
Pan/Tilt/Zoom Pan - 360° endless, 0.05° – 450°/s Tilt: 180°, 0.05° – 450°/s 32x  
Optical zoom and 12x Digital zoom, Total 384x zoom E-flip, 256 pre-sets, Tour

recording, Guard tour, Control queue, On-screen directional indicator, Set new pan 0°

Video Compression – H.264, Motion JPEG

Minimum Video Resolution (Pixels) 1920x1080 (4 x 2 Mega Pixels)

Image settings - Wide dynamic range (WDR), Highlight compensation, Manual shutter time, Compression, Color, Brightness, Sharpness, White balance, Exposure control, Exposure zones, Backlight compensation, Fine tuning of behavior at low light, Rotation, Text and image overlay, 32 individual 3D privacy masks, Image freeze on PTZ, Automatic defog

Intelligent Video – Motion Detection, Tamper Alarm,

Wide Dynamic Range

Electronic image stabilization function

Adaptive IR option

Automatic defog function

Security – Level Passwords, IP Filtering, HTTPS Encryption, IEEE 802.1X,

Network – IPv4/v6, QoS

Power – Power over Ethernet IEEE 802.3af/802.3at Type 2 Class 4, max. 26 W, typical 11.1 W

Operating conditions - -40 °C to 50 °C (-58 °F to 122 °F) Humidity 10-100% RH (condensing)

Application Programming Interface - Open software integration, ONVIF Profile

Intelligent video - Video motion detection, Active tampering alarm

Form Factor Tamper and vandal resistant housing and clear smoked bubble

Mounting – as required

Other – Tamper and vandal resistant housing and clear bubble with integrated heater and blower.

Specified Product:

Brand	Model No.	Comment
Avigilon	12C-H4A-4MH-360	Multi-Sensor

Parts showed above are for reference only, additional components may be required.

#### 2.4.7 Outdoor Fixed CCTV Camera

##### .1 Minimum features:

Image Sensor – CMOS Progressive Scan

Lens – As required to facilitate required field of view

Minimum Light Sensitivity – 0.2 LUX Color and .004 LUX Black and White

Video Compression – H.264, Motion JPEG

Minimum Video Resolution (Pixels) 1920x1080 (2 Mega Pixels)

Intelligent Video – Motion Detection, Tamper Alarm,

Wide Dynamic Range

Security – Level Passwords, IP Filtering, HTTPS Encryption, IEEE 802.1X,

Network – IPv4/v6, QoS

Power – Power over Ethernet IEEE 802.3af/802.3at Type 1 Class 2, max. 4.8 W, typical 3.5 W

Operating conditions - -40 °C to 55 °C (-40 °F to 131 °F) Humidity 10-100% RH (condensing)

Application Programming Interface - Open software integration, ONVIF Profile

Intelligent video - Video motion detection, Active tampering alarm

Form Factor - Tamper and vandal resistant housing and clear bubble

Mounting – as required



Other – Tamper and vandal resistant housing and clear bubble with integrated heater and blower

Specified Product:

Brand	Model No.	Comment
Avigilon	H5A-DO	

Parts showed above are for reference only, additional components may be required.

#### 2.4.8 Outdoor 180 Degrees CCTV Camera

##### .1 Minimum features:

Image Sensor – CMOS Progressive Scan

Lens –f=4.44 - 142.6 mm, 1.6 - 4.41, Autofocus, 62.8° - 2.23° horizontal angle of view

Minimum Light Sensitivity – 0.3 LUX Color and .003LUX Black and White

Pan/Tilt/Zoom Pan - 360° endless, 0.05° – 450°/s Tilt: 180°, 0.05° – 450°/s 32x

Optical zoom and 12x Digital zoom, Total 384x zoom E-flip, 256 pre-sets, Tour recording, Guard tour, Control queue, On-screen directional indicator, Set new pan 0°

Video Compression – H.264, Motion JPEG

Minimum Video Resolution (Pixels) 1920x1080 (3 x 2 Mega Pixels)

Image settings - Wide dynamic range (WDR), Highlight compensation, Manual shutter time, Compression, Color, Brightness, Sharpness, White balance, Exposure control, Exposure zones, Backlight compensation, Fine tuning of behavior at low light, Rotation, Text, and image overlay, 32 individual 3D privacy masks, Image freeze on PTZ, Automatic defog

Intelligent Video – Motion Detection, Tamper Alarm,

Wide Dynamic Range

Electronic image stabilization function

Adaptive IR option

Automatic defog function

Security – Level Passwords, IP Filtering, HTTPS Encryption, IEEE 802.1X,

Network – IPv4/v6, QoS

Power – Power over Ethernet IEEE 802.3af/802.3at Type 2 Class 4, max. 26 W, typical 11.1 W

Operating conditions - -40 °C to 50 °C (-58 °F to 122 °F) Humidity 10-100% RH (condensing)

Application Programming Interface - Open software integration, ONVIF Profile

Intelligent video - Video motion detection, Active tampering alarm

Form Factor Tamper and vandal resistant housing and clear smoked bubble

Mounting – as required

Other – Tamper and vandal resistant housing and clear bubble with integrated heater and blower.

Specified  
Product:

Brand	Model No.
Avigilon	9C-H4A-3MH-180

Parts showed above are for reference only, additional components may be required for mounting, performance, etc.

#### 2.4.9 Outdoor 360 Degrees CCTV Camera

##### .1 Minimum features:

Image Sensor – CMOS Progressive Scan

Lens –f=4.44 - 142.6 mm, 1.6 - 4.41, Autofocus, 62.8° - 2.23° horizontal angle of view  
Minimum Light Sensitivity – 0.3 LUX Color and .003LUX Black and White  
Pan/Tilt/Zoom Pan - 360° endless, 0.05° – 450°/s Tilt: 180°, 0.05° – 450°/s 32x  
Optical zoom and 12x Digital zoom, Total 384x zoom E-flip, 256 pre-sets, Tour recording, Guard tour, Control queue, On-screen directional indicator, Set new pan 0°  
Video Compression – H.264, Motion JPEG  
Minimum Video Resolution (Pixels) 1920x1080 (4 x 2 Mega Pixels)  
Image settings - Wide dynamic range (WDR), Highlight compensation, Manual shutter time, Compression, Color, Brightness, Sharpness, White balance, Exposure control, Exposure zones, Backlight compensation, Fine tuning of behavior at low light, Rotation, Text, and image overlay, 32 individual 3D privacy masks, Image freeze on PTZ, Automatic defog  
Intelligent Video – Motion Detection, Tamper Alarm,  
Wide Dynamic Range  
Electronic image stabilization function  
Adaptive IR option  
Automatic defog function  
Security – Level Passwords, IP Filtering, HTTPS Encryption, IEEE 802.1X,  
Network – IPv4/v6, QoS  
Power – Power over Ethernet IEEE 802.3af/802.3at Type 2 Class 4, max. 26 W, typical 11.1 W  
Operating conditions - -40 °C to 50 °C (-58 °F to 122 °F) Humidity 10-100% RH (condensing)  
Application Programming Interface - Open software integration, ONVIF Profile  
Intelligent video - Video motion detection, Active tampering alarm  
Form Factor Tamper and vandal resistant housing and clear smoked bubble  
Mounting – as required  
Other – Tamper and vandal resistant housing and clear bubble with integrated heater and blower.

Specified

Product:

Brand

Model No.

Avigilon

H4AMH-AD-DOME1

Parts showed above are for reference only, additional components may be required for mounting, performance, etc.

#### 2.4.10 Power Supply

- .1 All CCTV cameras shall be powered by POE.

### 3 **EXECUTION**

#### 3.1 **General**

3.1.1 The Electronic Safety and Security Contractor shall assume control and accountability for furnishing and installing all video surveillance system as specified hereafter.

3.1.2 The Electronic Safety and Security Contractor shall be responsible for the systems specified in this Section, including coordination with related trades.

- .1 Related work required to be provided:

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Communications (IT)

Electrical Works

All 120 Volt wiring and connections from power panels to terminal strips in electronic low-voltage panels, power supplies and devices.

All raceway, conduit to the device(s), including all back boxes and pull strings and the installation of all special back boxes.

#### 3.1.3 Camera Accessories

- .1 Provide and install camera housing and mounting accessories for complete operation of the videos surveillance system.
- .2 Coordinate the exact mount location of devices with the electrical contractor to ensure that all conduits and back boxes are installed in the optimal locations.
- .3 Coordinate exact mounting locations of all cameras on site with security Engineer's Representative and client.
- .4 Submit shop drawings to the Security Engineer's Representative for review prior to procurement and installation.
- .5 Allow for "needs assessment sessions" with client to determine the exact camera settings.

#### 3.1.4 Power supply

- .1 Supply and install power supplies as required for a fully functional video Surveillance System.
- .2 All power supplies shall be installed to manufacturer's recommendations.

#### 3.1.5 Installation

- .1 Supply, install, configure, and configure all CCTV system wiring, devices, and software as required for a complete and operational CCTV System.
- .2 All camera installation, configuration, setup, program, and related work shall be performed by technicians thoroughly trained by the manufacturer in the installation and service of the equipment provided.
- .3 Provide all camera brackets as required for each camera's application.
- .4 Carefully follow instructions in documentation provided by the manufacturer to ensure all steps have been taken to provide a reliable, easy-to-operate system.
- .5 All equipment shall be tested and configured in accordance with instructions provided by the manufacturer prior to installation.
- .6 All firmware found in CCTV System active devices shall be the latest and most up to date provided by the manufacturer.
- .7 All equipment requiring users to log on using a password shall be configured with user/site- specific password/passwords. No system/product default passwords shall be allowed.

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- .8 Final CCTV camera viewing requirements to be determined by owner. Coordinate with the owner and obtain viewing parameters for each CCTV Camera. Adjust all CCTV cameras to meet the owner's requirements.
  - .9 Adjust each CCTV camera to obtain the best quality image or CCTV camera image that is acceptable to the client.
  - .10 All domes must have the password protection feature enabled to protect against unauthorized changes to dome programming. All PTZ domes will be operated in continuous mode running an operator defined pattern, pre-set tour, or combination pattern/pre-set tour. PTZ dome movement criteria are to be coordinated with the System Operator(s) and Design Engineer's Representative to ensure camera coverage meets defined needs. PTZ domes must be programmed for "auto-resume" after a pre-defined time period, and on power-up.

**END OF SECTION**

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**1. GENERAL**

**1.1 Section Includes:**

- 1.1.1 Materials and installation for a complete and functional fire alarm system.
- 1.1.2 Control panel to carry out fire alarm and protection functions including receiving alarm signals, initiating single stage alarm, supervising system continuously, actuating zone annunciators, and initiating trouble signals.
- 1.1.3 Trouble signal devices.
- 1.1.4 Power supply facilities.
- 1.1.5 Manual alarm stations.
- 1.1.6 Automatic alarm initiating devices.
- 1.1.7 Audible signal devices.
- 1.1.8 End-of-line devices.
- 1.1.9 Annunciators.
- 1.1.10 Visual alarm signal devices.
- 1.1.11 Ancillary devices.

**1.2 Related Sections**

- 1.2.1 Section 01 33 00 – Submittal procedure
- 1.2.2 Section 01 78 00 – Closeout procedure
- 1.2.3 Section 01 91 00 General Commissioning requirements
- 1.2.4 Section 26 05 00 – Common Work Results – Electrical
- 1.2.5 Section 26 05 21.02 – Wires and Cables
- 1.2.6 Section 26 05 34 – Conduits, conduit fastenings and conduit fittings

**1.3 References**

- 1.3.1 Province of Ontario:
  - .1 Ontario Building Code
  - .2 Ontario Fire Code
  - .3 Ontario Electrical Safety Code
- 1.3.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).
- 1.3.3 Underwriter's Laboratories of Canada (ULC), latest versions of:

- .1 CAN/ULC-S524, Standard for the Installation of Fire Alarm Systems.
  - .2 CAN/ULC-S525, Audible Signal Device for Fire Alarm Systems.
  - .3 CAN/ULC-S526, Visual Signal Devices for Fire Alarm Systems.
  - .4 CAN/ULC-S527, Control Units.
  - .5 CAN/ULC-S528, Manual Pull Stations for Fire Alarm Systems.
  - .6 CAN/ULC-S529, Smoke Detectors for Fire Alarm Systems.
  - .7 CAN/ULC-S530, Heat Actuated Fire Detectors for Fire Alarm Systems.
  - .8 CAN/ULC-S531, Standard for Smoke Alarms.
  - .9 CAN/ULC-S536, Standard for Inspection and Testing of Fire Alarm Systems
  - .10 CAN/ULC-S537, Standard for Verification of Fire Alarm Systems.
- 1.3.4 National Fire Protection Agency:
- .1 NFPA 72, National Fire Alarm Code.
  - .2 NFPA 90A, Installation of Air Conditioning and Ventilating Systems.

#### **1.4 Submittals**

##### **1.4.1 Product Data:**

- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

##### **1.4.2 Shop Drawings:**

- .1 Submit shop drawings stamped and signed by professional engineer licensed in the province of Ontario and in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Shop Drawings: Stamped and signed by professional engineer registered or licensed in Ontario, Canada.
- .2 Include:
  - .1 Layout of equipment.
  - .2 Zoning.
  - .3 Complete wiring diagram, including schematics of modules.

1.4.3 Quality Assurance Submittals: Submit following in accordance with Section 01 33 00 - Submittal Procedures.

- .1 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .2 Instructions: Submit manufacturer's installation instructions.
- .3 Manufacturer's Field Reports: Manufacturer's field reports specified.

1.4.4 Closeout Submittals:

- .1 Submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals in accordance with ANSI/NFPA 20.
- .2 Authority of Jurisdiction will delegate authority for review and approval of submittals required by this Section.
- .3 Submit to Authority of Jurisdiction two sets of approved submittals and drawings immediately after approval but no later than 15 working days to prior to final inspection.
- .4 Submit the following:
  - .1 Manufacturer's Data for:
    - .1 Control panel and modules.
    - .2 Storage batteries.
    - .3 Battery charger.
    - .4 Manual pull stations.
    - .5 Heat detectors.
    - .6 Open-area smoke detectors.
    - .7 Duct smoke detectors.
    - .8 Alarm bells.
    - .9 Alarm horns.
    - .10 Visible appliances.
    - .11 Main annunciator.
    - .12 Remote annunciator panel.
    - .13 Graphic annunciator panel.
    - .14 Master fire alarm boxes.
    - .15 Auxiliary transmitter.
    - .16 Master box pedestal.
    - .17 Radio master box pedestal.
    - .18 Master box.
    - .19 Radio master box location light.
    - .20 Radio fire alarm master box.
    - .21 Radio fire alarm auxiliary transmitter.
    - .22 Radio fire alarm interface panel.
    - .23 Combination auxiliary transmitter and interface panel.
    - .24 Freeze protection thermostatic switch.
    - .25 Electro-magnetic door holder-releases.

- .26 Valve tamper switches.
- .27 Wiring.
- .28 Ground rods.
- .29 Conduit.
- .30 Outlet boxes.
- .31 Fittings for conduit and outlet boxes.
- .32 Trouble buzzer.
- .33 Projected beam smoke detector.
- .34 Surge suppression devices.
- .35 Mark data which describe more than one type of item to indicate which type will be provided.
- .36 Submit one original for each item and clear, legible, first-generation photocopies for remainder of specified copies.
- .2 System Wiring Diagrams:
  - .1 Submit complete wiring diagrams of system showing points of connection and terminals used for electrical connections in the system.
  - .2 Show modules, relays, switches and lamps in control panel.
- .3 Design Data - Power Calculations:
  - .1 Submit design calculations new work specified to substantiate that battery capacity exceeds supervisory and alarm power requirements.
  - .2 Show comparison of detector power requirements per zone versus control panel smoke detector power output per zone in both standby and alarm modes.
  - .3 Show comparison of notification appliance circuit alarm power requirements with rated circuit power output.
- .4 Instructions for Operation:
  - .1 Projected beam smoke detector.
- .5 Schedules:
  - .1 Conductor wire marker schedule.
- .6 Test Reports:
  - .1 Verification report to conform to CAN/ULC - S537

## 1.5 **Quality Assurance**

### 1.5.1 Qualifications:

- .1 Installer to be a company or person specializing in fire alarm system installations with five years documented experience approved by manufacturer.

### 1.5.2 Provide services of representative or technician from manufacturer of system, experienced in installation and operation of type of



system being provided, to supervise installation, adjustment, preliminary testing, and final testing of system and to provide instruction to project personnel.

1.5.3 Extra Materials:

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

1.5.4 Maintenance Service:

- .1 Provide one year's free maintenance with two inspections by manufacturer during warranty period. Inspection tests to conform to CAN/ULC-S536. Submit inspection report to Engineer.

**1.6 Delivery, Storage and Handling**

1.6.1 Packing, shipping, handling and unloading:

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

**2 . PRODUCTS**

**2.1 Materials**

- 2.1.1 Equipment and Devices: ULC listed and labelled and supplied by single manufacturer.
- 2.1.2 Power supply shall be in accordance with CAN/ULC-S524.
- 2.1.3 Audible signal devices shall be in accordance with CAN/ULC-S525.
- 2.1.4 Visual signal devices shall be in accordance with CAN/ULC-S526.
- 2.1.5 Control unit shall be in accordance with CAN/ULC-S527.
- 2.1.6 Manual pull stations shall be in accordance with CAN/ULC-S528.
- 2.1.7 Thermal detectors shall be in accordance with CAN/ULC-S530.
- 2.1.8 Smoke detectors shall be in accordance with CAN/ULC-S529.
- 2.1.9 Smoke alarms shall be in accordance with CAN/ULC-S531.

**2.2 System Operation: Single Stage - Signals Only**

- 2.2.1 Single Stage Operation.
- 2.2.2 Operation to Actuation Following:
  - .1 Manual station.
  - .2 Heat detector.

- .3 Smoke detector.
- .4 Automatic fire sprinkler system.
- .5 Fire extinguishing system.
- .6 Fire standpipe system.
- 2.2.3 Actuation of single operation device to initiate following:
  - .1 Building evacuation alarm devices to operate continuously.
- 2.2.4 Actuation of any supervisory device to:
  - .1 Cause electronic latch to lock-in supervisory state at central control unit and data gathering panel/transponder.
  - .2 Indicate respective supervisory zone at central control unit and remote annunciator.
  - .3 Cause audible signal at central control unit to sound.
  - .4 Activate common supervisory sequence.
- 2.2.5 Resetting alarm device not to return system indications/functions back to normal until control unit is reset.
- 2.2.6 Trouble on system to:
  - .1 Indicate circuit in trouble at central control unit.
  - .2 Activate "system trouble" indication, buzzer and common trouble sequence. Acknowledging trouble condition to silence audible indication; visual indication to remain until trouble is cleared and system is back to normal.
- 2.2.7 Troubles on System: Suppressed during course of alarm.
- 2.2.8 Trouble condition on any circuit in system not to initiate alarm conditions.

## **2.3 Control Panel**

- 2.3.1 Central Control Unit (CCU):
  - .1 Suitable for DCLA communication style shall be in accordance with CAN/ULC-S524.
  - .2 Features specified are minimum requirements for microprocessor-based system with digital data control and digital multiplexing techniques for data transmission.
  - .3 Minimum capacity of 250 500 1,000 2,000 3,000 addressable monitoring and 250 500 1,000 addressable control/signal points. Points may be divided between two communication channels in distributed system, each channel operating independently of other. Faults on one communication channel not to affect operation of other channel.
  - .4 System to provide for priority reporting levels, with fire alarm points assigned highest priority, supervisory and monitoring lower priority, and third priority for troubles. Possible to

- 
- assign control priorities to control points in system to guarantee operation or allow emergency override as required.
- .5 Integral power supply, battery charger and standby batteries.
  - .6 Basic life safety software shall be retained in a non-volatile Erasable Programmable Read-Only-Memory (EPROM). Extra memory chips shall be easily field-installed. Random-Access-Memory (RAM) chips in panel to facilitate password-protected field editing of simple software functions (i.e. zone labels, priorities) and changing of system operation software.
  - .7 Circuitry to continuously monitor communications and data processing cycles of microprocessor. Upon failure, audible and visual trouble indication to activate.
  - .8 Communication between CCU and remote DGP's/TPR's to be supervised, DCLA. Should communications fail between CCU and remote units, audible and visual trouble to be indicated at CCU. Data communication to be binary DC, baseband, time-division multiplex, half-duplex. Each data channel shall be capable of communicating up to distance of 3,000 m.
    - .1 Communication between nodes in networked system to be supervised, DCLA. Should communications fail between any two nodes, other nodes on loop to continue to communicate with each other and programmed functions on communicating nodes to continue operating.
  - .9 Support up to four RS-232-C I/O ports. CCU output to be parallel ASCII with adjustable baud rates to allow interface of any commercially available printer, terminal or PC.
  - .10 Equipped with software routines to provide Event-Initiated-Programs (EIP); change in status of one or more monitor points, may be programmed to operate any or all of system's control points.
  - .11 Software and hardware to maintain time of day, day of week, day of month, month and year.
  - .12 On-board, 20-column, DC strip printer, thermal head with automatic paper take-up, and silent operation; operational while system is operating on standby power. Expanded font available for selected printing conditions.
  - .13 Printer to record activities on system controlled by EIA RS-232-C link from within CCU.
-

- .14 Software to operate variable sensitivity addressable smoke detectors and annunciate their status and sensitivity settings at control panel.

## **2.4 Data Gathering Panels (DGP's)/Transponders**

- 2.4.1 Fire control modules shall be distributed throughout building in separately enclosed units (DGP's) and interconnected to central control unit utilizing multiplex data transmission techniques.
- 2.4.2 Modules shall be concentrated in single central location in modular central control panel.
- 2.4.3 Fire alarm integrated DGP's shall be microprocessor based, provide interface between standard alarm input/output devices and central control unit.
- 2.4.4 Each DGP shall be circuitry with the ability to detect failure in communication with CCU resulting from faults in communication wiring. In event of loss of communication with CCU, DGP capable of operating in stand-alone mode. In this mode, DGP capable of reacting to connected input devices, and apply stand-alone programming to determine state of connected outputs. Stand-alone programming instructions: independent of, but capable of executing same type of algorithms as, that of CCU.
- 2.4.5 Each DGP shall be a self-contained unit, with integral power supply, battery charger and standby batteries. Short circuit, over voltage, and brown-out monitoring to protect powered components by automatically switching to standby batteries whenever trouble condition exists in power supply.
- 2.4.6 Addressable DGP's
  - .1 DGP's shall be addressable type, provide two-way data communication with up to 30 ,90, 128 addressable devices/interface modules, utilizing digital poll/response protocol communication format. Each addressable device: uniquely identified by own address, set at time of installation.
  - .2 Addressable DGP's shall have stand-alone capability.
  - .3 Interface modules shall facilitate the connection of non-addressable devices (i.e. flow switch) to addressable DGP; provided in different types for connection to monitoring devices (i.e. flow/tamper switch), signalling devices (i.e. bells, horns), and control functions (i.e. fan shutdown, door release); communicate with addressable DGP over minimum number of wires (specified by manufacturer).
  - .4 Addressable DGP's shall be self-contained, as specified.

- .5 Possible to connect variable-sensitivity addressable smoke detectors together with other addressable devices to same addressable communication loop

## **2.5 Power Supplies**

- 2.5.1 120 V, 60 Hz as primary source of power for system.
- 2.5.2 Voltage regulated, current limited distributed system power.
- 2.5.3 Primary power failure or power loss (less than 102 V) will activate common trouble sequence.
- 2.5.4 Interface with battery charger and battery to provide uninterruptible transfer of power to standby source during primary power failure or loss.
- 2.5.5 During normal operating conditions fault in battery charging circuit, short or open in battery leads to activate common trouble sequence and standby power trouble indicator.
- 2.5.6 Standby batteries shall be sealed, maintenance free.
- 2.5.7 Continuous supervision of wiring for external initiating and alarm circuits to be maintained during power failure.

## **2.6 Initiating/Input Circuits**

- 2.6.1 Receiving circuits for alarm initiating devices such as manual pull stations, smoke detectors, heat detectors and water flow switches, wired in DCLA configuration to central control unit and DGP's/transponders.
- 2.6.2 Alarm receiving circuits (active and spare) shall be compatible with smoke detectors and open contact devices.
- 2.6.3 Actuation of alarm initiating device shall cause system to operate as specified in "System Operation".
- 2.6.4 Receiving circuits for supervisory, N/O devices. Devices shall be wired in DCLA configuration to central control unit DGP's/transponders.
- 2.6.5 Actuation of supervisory initiating device shall cause system to operate as specified in "System Operation".

## **2.7 Alarm Output Circuits**

- 2.7.1 Alarm output circuit shall be connected to signals, wired in Class A configuration to central control unit DGP's/transponders.
  - .1 Signal circuits' operation to follow system programming; capable of sounding bells chimes horns continuously at 20 spm. Each signal circuit shall be rated at 2 A, 24 VDC; fuse-protected from overloading/overcurrent.
  - .2 Manual alarm silence, automatic alarm silence and alarm silence inhibit to be provided by system's common control.

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**2.8 Auxiliary Circuits**

- 2.8.1 Auxiliary contacts for control functions.
- 2.8.2 Actual status indication (positive feedback) from controlled device.
- 2.8.3 Alarm and supervisory trouble on system to cause operation of programmed auxiliary output circuits.
- 2.8.4 Two sets of separate contacts for elevator capture to main floor of egress and to alternate floor of egress.
- 2.8.5 Upon resetting system, auxiliary contacts to return to normal or to operate as pre-programmed.
- 2.8.6 Fans shall stagger-started upon system reset; timing circuit to separate starting of each fan or set of fans connected to auxiliary contact on system.
  - .1 Timing circuit shall be controlled by CCU.
- 2.8.7 Auxiliary circuits shall be rated at 2 A, 24 VDC or 120 VAC, fuse-protected.

**2.9 Wiring**

- 2.9.1 Twisted copper conductors shall be rated 600 V.
- 2.9.2 To initiating circuits shall be 18 AWG minimum, and in accordance with manufacturer's requirements.
- 2.9.3 To signal circuits shall be 16 AWG minimum, and in accordance with manufacturer's requirements.
- 2.9.4 To control circuits shall be 14 AWG minimum, and in accordance with manufacturer's requirements.

**2.10 Manual Alarm Stations**

- 2.10.1 Addressable Manual Pull Station:
  - .1 Pull lever, break glass rod, semi-flush wall mounted type, single action, single stage, electronics to communicate station's status to addressable module/transponder over two wires and to supply power to station. Station address to be set on station in field.

**2.11 Automatic Alarm Initiating Devices**

- 2.11.1 Heat detectors, fixed temperature, rated 57°C.
- 2.11.2 Thermal fire detectors, combination fixed temperature and rate of rise, non-restorable fixed temperature element, self-restoring rate of rise, fixed temperature 57°C, rate of rise 8.3°C per minute.
- 2.11.3 Addressable thermal fire detectors, combination fixed temperature and rate of rise, non-restorable fixed temperature element, self-restoring rate of rise, fixed temperature 57°C, rate of rise 8.3°C per minute.

- .1 Electronics to communicate detector's status to addressable module/transponder.
- .2 Detector address to be set on detector base in field.
- 2.11.4 Smoke detector shall be photoelectric type air duct type with sampling tubes with protective housing.
  - .1 Twist-lock type with fixed base.
  - .2 Wire-in base assembly with integral red alarm LED, and terminals for remote alarm LED.
- 2.11.5 Addressable Smoke Detector:
  - .1 Photoelectric type.
  - .2 Electronics to communicate detector's status to addressable module/transponder.
  - .3 Detector address to be set on detector base in field.
- 2.11.6 Addressable Variable-Sensitivity Smoke Detectors:
  - .1 Photoelectric type.
  - .2 Electronics to communicate detector's status to addressable module/transponder.
  - .3 Detector address to be set on detector base in field.
  - .4 Sensitivity Settings: Three settings, determined and operated by control panel. No shifting in detector sensitivity due to atmospheric conditions (dust, dirt) within certain parameters.
  - .5 Ability to annunciate minimum of two levels of detector contamination automatically with trouble condition at control panel.

## **2.12 Audible Signal Devices**

- 2.12.1 Bells shall be surface mounted, single stroke, polarized, 24 V DC, 150mm, 85 dB.
- 2.12.2 Bells shall be vibrating type, gongs of special alloy steel, 24 V DC, 150 mm, 85 dB.
- 2.12.3 Horns shall be 85 dB, weatherproof surface mounting, 24 V DC.

## **2.13 Visual Alarm Signal Devices**

- 2.13.1 Strobe type shall be flashing , red , 24 V DC.
- 2.13.2 Designed for surface mounting on as indicated.

## **2.14 End-Of-Line Devices**

- 2.14.1 End-of-line devices to control supervisory current in alarm circuits and signalling circuits, sized to ensure correct supervisory current for each circuit. Open ,short or ground fault in any circuit will alter

supervisory current in that circuit, producing audible and visible alarm at main control panel and remotely as indicated.

**2.15 Remote Annunciators**

2.15.1 LED Remote alphanumeric type, with designation cards to indicate zones.

2.15.2 Display:

- .1 Alarms and troubles for alarm initiating circuits.
- .2 Supervisory alarms and troubles for supervisory initiating circuits.
- .3 Common system trouble.

2.15.3 Trouble Buzzer:

- .1 Acknowledging trouble at main panel to silence trouble buzzers in system.

2.15.4 Supervised, with LED test button and alarm acknowledge button.

2.15.5 Minimum wiring configuration with main panel and other remote annunciators.

**2.16 Graphic Display**

2.16.1 Passive type.

**2.17 Remote Printer**

2.17.1 System Printer shall give a hard copy record of system events complete with following features:

- .1 120 V AC, 60 Hz.
- .2 80 columns.
- .3 120 cps.
- .4 Utilizes fan fold paper.
- .5 Connected to RS-232 output at central control panel.

**2.18 Remote Terminal**

2.18.1 CRT screen shall be 120 V, 60 Hz, to incorporate 100% solid state circuitry, with 30 cm screen and front mounted controls for brightness, contrast, vertical and horizontal hold and power ON/OFF switch.

**2.19 As-Built Riser Diagram**

2.19.1 Fire alarm system riser diagram shall be in glazed frame on black lamicoid sheet with bevelled edges, white lettering and designations, minimum size 600 mm x 600 mm.



## **2.20 Ancillary Devices**

2.20.1 Remote relay unit to initiate fan shutdown.

## **3 . EXECUTION**

### **3.1 Examination**

3.1.1 Verification of Conditions: Verify conditions of substrates previously installed under other Sections or Contracts are acceptable for fire alarm installation in accordance with manufacturer's written instructions.

1. Visually inspect substrate in presence of Engineer.
2. Inform Engineer of unacceptable conditions immediately upon discovery.
3. Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Engineer.

### **3.2 Installation**

3.2.1 Install systems in accordance with CAN/ULC-S524 and TB Fire Protection Standard.

3.2.2 Install central control unit and connect to AC power supply, AC DC standby power.

3.2.3 Install manual alarm stations and connect to alarm circuit wiring.

3.2.4 Locate and install detectors and connect to alarm circuit wiring. Mount detectors more than 1 m from air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.

3.2.5 Connect alarm circuits to main control panel.

3.2.6 Install signal bells chimes horns and visual signal devices and connect to signalling circuits.

3.2.7 Connect signalling circuits to main control panel.

3.2.8 Install end-of-line devices at end of alarm and signalling circuits.

3.2.9 Install remote annunciator panels and connect to annunciator circuit wiring.

3.2.10 Install door releasing devices.

3.2.11 Install remote relay units to control fan shutdown.

3.2.12 Sprinkler System: Wire alarm and supervisory switches and connect to control panel.

3.2.13 Room Detection System:

- .1 Install detectors and make necessary connections between room detection panel and main fire alarm panel.
- .2 Locate and install audible signals visual alarms.

- .3 Locate and install detectors under raised floor. Fasten to steel brackets approximately 300 mm above sub- floor level to clear cables and conduits.
- 3.2.14 Connect fire suppression systems to control panel.
- 3.2.15 Splices are not permitted.
- 3.2.16 Provide necessary raceways, cable and wiring to make interconnections to terminal boxes, annunciator equipment and CCU, as required by equipment manufacturer.
- 3.2.17 Ensure that wiring is free of opens, shorts or grounds, before system testing and handing over.
- 3.2.18 Identify circuits and other related wiring at central control unit, annunciators, and terminal boxes.

### **3.3 Field Quality Control**

- 3.3.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and CAN/ULC-S537.
- 3.3.2 Fire Alarm System:
  - .1 Test such device and alarm circuit to ensure manual stations, thermal and smoke detectors sprinkler system transmit alarm to control panel and actuate first stage alarm general alarm ancillary devices.
  - .2 Check annunciator panels to ensure zones are shown correctly.
  - .3 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of systems.
  - .4 Addressable Circuits System Style DCLA:
    - .1 Test each conductor on all DCLA addressable links for capability of providing three or more subsequent alarm signals on each side of single open-circuit fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the three signals. Correct imposed fault after completion of each series of tests.
    - .2 Test each conductor on all DCLA addressable links for capability of providing three or more subsequent alarm signals during ground-fault condition imposed near midmost point of each link. Operate
    - .3 Acknowledge/Silence switch after reception of each of the three signals. Correct imposed fault after completion of each series of tests.
- 3.3.3 Provide final PROM program re-burn for system incorporating program changes made during construction.

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**3.4 Cleaning**

3.4.1 Progress Cleaning: Clean in accordance with Section 01 74 00 – Cleaning and Waste Management.

.1 Leave Work area clean at end of each day.

3.4.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Management.

.1 Place materials defined as hazardous or toxic waste in designated containers.

**3.5 Protection**

3.5.1 Protect installed products and components from damage during construction.

3.5.2 Repair damage to adjacent materials caused by fire alarm system installation.

**3.6 Closeout Activities**

3.6.1 Provide on-site lectures and demonstration by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.

**3.7 Maintenance**

3.7.1 Provide individual price on tender form for subsequent PROM re-burns. Price shall be good for one years from date of project completion.

3.7.2 Provide individual price on tender form for temporary program changes during construction period, to include zone labels, control functions, system operation.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1 Conform to Section 28 00 03 – General Specifications and Requirements for Electronic Safety and Security.

### **1.2 General**

- 1.2.1 All equipment and materials used shall be standard components that are regularly manufactured and used in the manufacturer's system.
- 1.2.2 All systems and components shall have been thoroughly tested and proven in actual use.
- 1.2.3 All systems and components shall be provided with the availability of a toll-free (U.S. and Canada), 24-hour technical assistance program (TAP) from the manufacturer. The TAP shall allow for immediate technical assistance for either the dealer/installer or the end user at no charge for as long as the product is installed.
- 1.2.4 All systems and components shall be provided with a one-day turnaround repair express and 24-hour parts replacement. The repair and parts express shall be guaranteed by the manufacturer on warranty and non-warranty items.

## **2 PRODUCT**

### **2.1 Manufactures**

- 2.1.1 Acceptable Manufactures are Code Blue and Bosch

### **2.2 General**

- 2.2.1 All equipment shall be rated for continuous operation. Environmental conditions (i.e., temperature, humidity, wind, and seismic activity) shall be taken under consideration at each facility and site location prior to installation of the equipment.
- 2.2.2 All equipment shall operate on 120 or 240 volts alternating current (VAC); 50 hertz (Hz) or 60 Hz Alternating Current (AC) power system unless documented otherwise in subsequent sections listed within this spec. All equipment shall have a battery back-up source of power that will provide 12 hours (hrs.) of run time in the event of a loss of primary power to the security systems until a backup generator comes on-line.
- 2.2.3 The Electronic Personal Protection System (hereafter referred to as "EPPS") shall be designed, installed, and programmed in a manner that will allow for ease of operation, programming, servicing, maintenance, testing, and upgrading of the system.
- 2.2.4 The Electronic Safety and Security Contractor shall provide the Contracting Officer with written verification, that the type of wire/cable being provided is recommended and approved by the OEM.

- 2.2.5 When interfacing with other communications or security subsystems the Electronic Safety and Security Contractor shall utilize interfacing methods that are approved by the Contracting Officer. At a minimum, an acceptable interfacing method requires not only a physical and mechanical connection, but also a matching of signal, voltage, and processing levels with regard to signal quality and impedance. The interface point must adhere to all standards described herein.
- 2.2.6 Systems shall be scalable and allow expansion as required.
- 2.2.7 Wireless systems shall use ultrasonic, infrared or radio frequency waves to link distributed transmitters and receivers. Specific characteristics of particular site will determine best application. The Electronic Safety and Security Contractor is responsible for determining best system using prediction program to determine where readable signals can be obtained and identify "dead spots".
- 2.2.8 All hardwired alarms, switches, and junction boxes shall be protected from tampering and include line supervision.
- 2.2.9 The installation and placement of intercom units and emergency-call boxes in strategic locations shall also require that signage be posted near these devices. The signage shall communicate the location of the device and its unique identification number, and brief instruction on how to access/use the device. The signage may appear on the device, on a pole or wall near the device location and shall be printed in a manner that is easily read during daylight and hours of darkness.

### 2.3 **Equipment**

- 2.3.1 All systems shall be designed to provide continuous electrical and communications supervision of the complete and entire system.
- 2.3.2 Noise filters and surge protectors shall be provided for all intercommunications equipment to ensure protection from primary AC power surges and to ensure noise interference is not induced into low voltage data circuits.
- 2.3.3 All alarm and initiating and signaling circuits shall be supervised for open circuits, short circuits, and system grounds. Main and Uninterrupted Power Supply (UPS) power circuits shall be supervised for any change in operating conditions (e.g., low battery, primary to back up battery, and UPS online). When an open, short, or ground occurs in any system circuit, an audible and visual fault alarm signal shall be initiated at the master control station and all remote locations.
- 2.3.4 Control Unit: Shall consist of the components to constantly monitor and verify alarm activation; identify zone of activation and location of activation.
- 2.3.5 Audible Signal Device for Duress-Panic: Provides alarm activation and audible sound for alarms, as well as supervisory and trouble signals that shall be distinctive.
- 2.3.6 Assessment: This capability shall consist of electronic devices required to verify the validity of alarms visually and audibly. Assessment also includes providing indication of tampering, fail-safe, low battery, and power losses.

- 
- 2.3.7 Alarm Monitoring and Reporting: Shall annunciate information to at least two (2) separate locations. The alarms shall maintain the capability to respond with local and remote visible and audible signals upon activation of an alarm. The alarms shall have the capability of operating in a silent mode, alerting personnel monitoring the system that the device has been activated.
- 2.3.8 The intercom and duress panic alarm systems shall be provided with normally acceptable speech intelligibility, defined as a score of at least 70% in accordance with ANSI S3.2
- 2.4 **Duress-Panic Alarms:**
- 2.4.1 Housing shall be a rugged corrosion-resistant housing of stainless steel or Acrylonitrile Butadiene Styrene (ABS) molded plastic or similar material that is weather and dust proof.
- 2.4.2 Actuating device shall include a minimum of a plunger button whose head is recessed from the face/front edge of the housing and be designed to avoid accidental activation using either a switch guard or two (2) button activation system (Pressing 2 buttons simultaneously).
- 2.4.3 No Wireless stationary devices will meet the same specifications as Personal Duress/Panic Alarms.
- 2.4.4 Alarm switch/button shall lock-in upon activation until manually reset with key or manufacture provided device.
- 2.4.5 The switch shall be a positive-acting double-pole switch.
- 2.4.6 Duress/Panic alarms shall meet UL 305 Standard for Panic Alarms. To reduce the possibility of false alarms and ensure installation functionality UL 636 Standard for Holdup Alarms standards shall be met.
- 2.4.7 Components:
- .1 Transmitter
  - .2 Locator subsystem
  - .3 Receiver
  - .4 Software
- 2.4.8 Wiring will be four (4) conductors #18 American Wire Gauge (AWG).
- 2.4.9 Duress-Panic Alarm Technical Characteristics:
- |                   |  |
|-------------------|--|
| Temperature Range | 0° to 110°F (-17.8°C to 43.3°C)  |
| Operational life  | Rated for 10,000 activations   |
| Actuator          | Wall mounted: Single button with Switch guard OR Dual button with activation lock.<br>Desk mounted: Dual button with activation lock |
| LED               | Bi-color – on and activated  |
- 2.4.10 Shall be capable of being mounted for hand use in a manner that is unable to be viewed by the public.
-

- 2.4.11 They shall also annunciate at the Physical Access Control System and Database Management, monitored by a central station, or direct connect to local police, depending on local ordinance requirements.
- 2.4.12 On activation of an Alarm, the system will send a message to the client paging system, indicating date, time, and location of alarm. This shall be user configurable for future expansion of the system, at no cost to the client.
- 2.4.13 On activation of an Alarm, the system shall send an email to indicate date, time, and location of the alarm. This system shall be capable of sending email to multiple recipients and be user configurable for future expansion of the system, at no cost to the client.

## 2.5 **Code Blue Station**

- 2.5.1 The unit shall be a two-piece construction, with both pieces constructed of 12 gauge, 304 grade stainless steel, with a custom-designed, and microphone/speaker.
- 2.5.2 A 0.187" thick transparent lens formed of clear polycarbonate shall be inserted into the housing behind the opening.
- 2.5.3 Tamper resistant proprietary fasteners shall be used. It shall not be possible to acquire the custom-designed bit from any other source.
- 2.5.4 The unit button and strobe configuration and programming shall be coordinated with Owner.

### .1 Specified Product:

Manufacturer	Model No.	Location	Colour
Code Blue	CB 6-f	Indoors	Stainless

## 3 **EXECUTION**

### 3.1 **Installation**

- 3.1.1 System installation shall be in accordance with manufacturer's instructions and using appropriate installation manual for each type of subsystem designed, engineered, and installed.
- 3.1.2 Concealed duress/panic devices shall be mounted in such a way that their location is only known by the person having knowledge of the activating device location. No wiring shall be exposed to identify the location of the activation device.
- 3.1.3 Subsequent to installation, clean each system component of dust, dirt, grease, or oil incurred during installation in accordance to manufacture instructions.
- 3.1.4 Provisions shall be made for systems in high-noise areas or areas with electrical interference environments.

- 3.1.5 Adjustment/Alignment/Synchronization: Contractor shall prepare for system activation by following manufacturer's recommended procedures for adjustment, alignment, or programming. Prepare each component in accordance with appropriate provisions of the component's installation, operations, and maintenance instructions.

**3.2 Field Quality Control**

- 3.2.1 Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation and supervise pretesting, testing, and adjusting of video surveillance equipment.
- 3.2.2 Inspection: Verify that units and controls are properly installed, connected, and labeled, and that any interconnecting wires and terminals are identified.
- 3.2.3 Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.
- 3.2.4 Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.
- 3.2.5 Remove and replace malfunctioning items and retest as specified above.
- 3.2.6 Record test results for each piece of equipment.
- 3.2.7 Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

**3.3 Protection**

- 3.3.1 Protect installed products until completion of project.
- 3.3.2 Touch-up, repair or replace damaged products before Substantial Completion.

**3.4 Demonstration**

- 3.4.1 Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain EPPS equipment.
- .1 Train Owner's maintenance personnel on procedures and schedules for troubleshooting, servicing, and maintaining equipment.
- .2 Demonstrate methods of determining optimum alignment and adjustment of components and settings for system controls.
- .3 Review equipment list and data in maintenance manuals.
- .4 Conduct a minimum of four (4) x one (1) hour end user training sessions.



**3.5 Commissioning**

- 3.5.1 Provide commissioning documentation in accordance with the requirements of Section 28 08 00 – COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- 3.5.2 Components provided under this section of the specification may be tested as part of a larger system. Refer to Section 28 08 00 – COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS and related sections for contractor responsibilities for system commissioning.

**3.6 Adjusting**

- 3.6.1 Occupancy Adjustments: When requested within 6 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions and to optimize performance of the installed equipment. Tasks shall include, but are not limited to, the following:
  - .1 Check cable connections (where relevant).
  - .5 Check proper operation of all detectors / sensors.
  - .6 Re-locate end-point equipment if necessary.
  - .7 Provide a written report of adjustments and recommendations.

**END OF SECTION**

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## **1 GENERAL**

### **1.1 Work Included**

- 1.1.1 Conform to Section 28 00 03 – General Specifications and Requirements for Electronic Safety and Security.

### **1.2 General**

- 1.2.1 The following systems shall be integrated on a single common IP network via respective servers; controllers and a common data switch to provide integrated functions as described in this specifications document and on Contract Drawings.
  - .1 Access Control
  - .2 Video Surveillance/CCTV
  - .3 Intercom
  - .4 Electronic Personal Protection System
- 1.2.2 Personal computers (Referred to as Central Management Stations) shall be provided at locations indicated on contract drawings. Each personal computer shall be equipped with all required, hardware, client and or server software; software licence and shall facilitate remote administration of all systems as described in the contract documents.
- 1.2.3 These "performance" specifications are to be translated into specific equipment and systems depicting products which the Contractor proposes to use.
- 1.2.4 The functions of each Central Management Stations shall include but not limited to:
  - .1 View, monitor and administer the access control, CCTV, intercom and electronic personal protection systems via interactive graphical map of the facility.
  - .2 Monitor and administer access control, CCTV, intercom and electronic personal protection systems devices via interactive graphical map of the facility.
  - .3 Administration of credentials.
  - .4 View, monitor and administer video streams from each CCTV camera.
  - .5 Display single and/or multiple video streams from multiple CCTV camera simultaneously.
  - .6 Functions described in all sections of this specifications.
  - .7 The systems shall be modular and expandable as herein specified or as the Owner may direct up to full system capacity.
- 1.2.5 All hardware, client and or server software; software licence shall be provided and installed and configured on the Central Management Stations, all servers, and controllers to facilitate the following integrated functions:

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**.1 Access Control and CCTV System**

The access control system shall be integrated with the CCTV system so that upon presentation of an invalid card at a card reader, forced entry at a secured door or door held open beyond pre-set acceptable duration, the access control system shall signal the CCTV System to display the video streams from the CCTV camera with view of the respective door. The video stream shall be displayed immediately on each Central Management Station Monitor following the event. It shall be possible to display the video stream in full screen format or reduces size format.

**.1 Access Control and Intercom System**

The access control system shall be integrated with intercom systems to the so that upon activation of an intercom or duress alarm station the alarm is graphically announced and displayed immediately on each Central Management Station Monitor following the event. Each alarm shall have a unique address indicating the location of the alarm on a graphical map of the facility.

The access control system shall be integrated with intercom systems to facilitate the remote opening of access-controlled doors via the intercom master station.

**.2 Access Control and Electronic Personal Protection System**

The access control system shall be integrated with electronic personal protection systems to the so that upon activation of an electronic personal protection device is graphically announced and displayed immediately on each Central Management Station Monitor following the event. Each alarm shall have a unique address indicating the location of the alarm on a graphical map of the facility.

Integration for Access Control and Electronic Personal Protection system shall be coordinated with Owner.

**.3 Video Surveillance/CCTV and Intercom System with duress alarm functions**

The Video Surveillance/CCTV shall be integrated with the Intercom system so that to upon activation of an intercom or a duress alarm station the intercom system shall signal the CCTV System to display the video streams from the CCTV camera with view of the respective activated intercom or duress alarm station. The video stream shall be displayed immediately on each Central Management Station Monitor following the event. Each alarm shall have a unique address indicating the location of the alarm on a graphical map of the facility.

**.4 Video Surveillance/CCTV and Electronic Personal Protection System**

The Video Surveillance/CCTV shall be integrated with the electronic personal protection system so that to upon activation of an electronic personal protection device the electronic personal protection system shall signal the CCTV System to display the video streams from the CCTV camera with view of the respective activated electronic personal protection device. The video stream shall be displayed immediately on each Central Management Station Monitor following the event. Each alarm shall have a unique address indicating the location of the alarm on a graphical map of the facility. Integration for Video Surveillance/CCTV and Electronic Personal Protection system shall be coordinated with Owner.

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## **2 PRODUCT**

### **2.1 Central Management Station Computer**

2.1.1 The monitoring equipment for video surveillance and access control systems, when installed in the security systems furniture shall be placed on a shelf so that the equipment is not sitting on the floor to avoid any potential water damage due to flooding.

2.1.2 The monitoring computer for video surveillance and access control systems shall have the following minimum specifications:

Processors:	Intel Core i7-5960X 8-Core 3.0GHz Desktop Processor
Memory:	16GB 1600MHz DDR4 Memory
Video Cards	4 x (HDMI with DVI and 2GB RAM)
Optical Drivers	DVD+/-RW Drive
Boot Hard Drives:	1TB 3.5inch SATA
Monitors:	2 x 27" displays complete with stand
USB Ports:	Minimum 4
Security Hardware:	Chassis Intrusion Switch Option
Warranty:	3 Year
Mouse:	USB 2-Button Laser Mouse
Operating System:	Windows 8.1 Pro, 64-bit English
Software:	MS office 2013
Audio Inputs	Two 3.5 mm stereo jacks
Audio Outputs	One 3.5 mm stereo jack
Network Specifications	Interface Gigabit Ethernet RJ-45 port, (1000Base-T)
Form Factor	Desktop
UPS Backup	1500VA UPS

## **3 EXECUTION**

### **3.1 Installation**

3.1.1 Install system in accordance with manufacturer's instructions.

### **3.2 Field Quality Control**

3.2.1 Test in accordance with manufacturer's testing procedures.

### **3.3 Manufacturer's Field Services**

3.3.1 Provide manufacturer's field services for final system checkout and acceptance testing as required.

### **3.4 Protection**

3.4.1 Protect installed products until completion of project.

3.4.2 Repair or replacement damaged products before Substantial Completion.

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**END OF SECTION**

**1. GENERAL****1.1 Summary**

- 1.1.1 Provide labour, materials, products, equipment, and services to complete the excavation, grading and backfill for work in areas within the limits of Construction specified herein.

**1.2 Related Requirements**

- 1.2.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.2.2 Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

**1.3 References**

- 1.3.1 The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- 1.3.2 All reference amendments adopted prior to the Bid Closing date of this Project shall be applicable to this Project.
- 1.3.3 All materials, installation and workmanship shall comply with all applicable requirements and standards.

**1.4 EXISTING CONDITIONS**

- 1.4.1 Examine subsurface investigation reports.
- 1.4.2 Any on-site soils encountered by the Contractor that are suspected as being contaminated shall be brought to the attention of the Consultant for testing, prior to its removal from the site as per Special Provision On-Site and Excess Soil Management, GN133SP.
- 1.4.3 It is the Contractor's responsibility to verify all utilities prior to any site activity. Known underground, surface/overhead utility lines and buried objects are as indicated on Contract Drawings.
- 1.4.4 If upon excavating to the specified elevations, it is found that existing conditions are not fulfilled, adjust the excavations accordingly, but only with the written authorization of the Consultant.

**1.5 SUBMITTALS**

- 1.5.1 A minimum of 14 days prior to imported fill (earth borrow) material being used (if required), a list of intended borrow sources and tonnage that is expected to be used from each source shall be

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provided to the Geotechnical Engineer to allow time for sampling and testing.

1.5.2 Shop drawings:

1.5.3 Submit shop drawings in accordance with Section 01 33 00 indicating:

1.5.4 Adjacent construction, elevations, sections and details, dimensions, and relationship to adjacent construction.

1.5.5 Include shoring design for excavations, design calculations (if requested), design concept, construction method, sequence and means by which existing structures, utilities and equipment will be protected; Location of in-use, maintained, re-routed and abandoned underground lines.

1.5.6 Reports:

1.5.7 Submit written laboratory test reports for each material proposed for backfill. All imported "Soil" must be sampled in accordance with O.Reg. 406/19 sampling frequency, under the supervision of a Qualified Person (Ref. Special Provision).

1.5.8 Submit written field inspection and test report results after each inspection. Submit dewatering methods 30 days in advance for review by Consultant.

1.5.9 Submit Dewatering Plan 30 days in advance for review by Consultant.

1.5.10 The Contractor shall provide the completed Excess Soil Destination Assessment Report (ESDAR) 30 Days after award to the Region. Five Days in advance of any excavation, the report shall be reviewed for acceptance by the Region. See Special Provision On-Site and Excess Soil Management, GN133SP.

1.5.11 Submit to Consultant details of locations where surplus soils and other materials are to be disposed of or reused. Include each disposal/reuse Site and type of surplus soil or other material, location of the disposal/reuse Site, operator's name and business address, type of license under which Site operates, and criteria used by Site to access suitability of surplus material for disposal. See Special Provision On-Site and Excess Soil Management, GN133SP.

1.5.12 Submit to Consultant, within 48 hours of a load of surplus soil or other material leaving the Site, a daily register recording the time and place of disposal/reuse of each load signed by a representative of the disposal site. Such documentation must be submitted before payment for excavation will be made. See Special Provision On-Site and Excess Soil Management, GN133SP.

1.5.13 Within 21 Days of the completion of soil movement, the Contractor's QP shall provide an Excess Soil Implementation Report, as per Special Provision On-Site and Excess Soil Management, GN133SP.

## **1.6 QUALITY ASSURANCE**

1.6.1 All shop drawings to be signed and sealed by a Professional Engineer licensed in Province of Ontario and having experience in design and inspection of shoring, bracing and underpinning required to complete Work.

## **1.7 SITE CONDITIONS**

1.7.1 Cultural heritage resources: If Cultural Heritage Resources (such as archaeological sites, artifacts, building and structural remains, and/or human burials) are encountered during performance of Work, contact Consultant immediately and suspend Work in immediate area until assessment has been completed by Ministry of Tourism, Culture and Sport. Perform required measures to mitigate negative impacts on found resources to acceptance of Consultant.

## **1.8 PROTECTION**

1.8.1 Existing buried utilities and structures:

.1 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are assumed, not guaranteed. The Contractor is responsible for location of all underground utilities, piping, abandoned services, etc.

.2 Prior to construction, the Contractor shall contact all utility companies for the location of their respective plant.

.3 Prior to construction Contractor shall have authorities stake out utility locations to prevent disturbance during Work, establish location and state of use of buried utilities and structures.

.4 During construction, the Contractor shall be responsible for protecting all utilities as per the requirements of the utility. Contractor shall maintain all locates during the duration of work. Repair to any damaged utility plant shall be the Contractor's responsibility and at the Contractor's expense.

.5 Confirm locations of buried utilities by careful test excavations. Hand digs test excavations as necessary.

.6 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered. Obtain permission of Consultant before moving or otherwise disturbing utilities or structures.



- .7 Where utility lines or structures exist in area of excavation obtain direction of Consultant before removing or rerouting.
- .8 Record location of maintained or re-routed and abandoned underground lines for record keeping purposes and transposing to the as-built version of the Contract Drawings.
- .9 Temporarily cover local existing catch basins and maintenance holes to prevent entry of earth or debris in accordance with Section 31 25 00 - Erosion and Sediment Control. Ensure adequate surface drainage in affected area is maintained.
- .10 Protect Work or work of other Contractors/Contracts in progress or completed and protect existing properties, stored Products, services, utilities, trees, landscaping and natural features from damage.
- .11 Protect the Owner's existing property, stored products, services, and utilities.
- .12 Protect excavations against flooding and damage and install and maintain appropriate warning devices during construction and during time when Work is closed down for any cause.
- .13 Protect bottom of excavations that will support foundations, slabs, pavements etc. from frost or freezing.
- .14 Keep access roads clear of debris and dirt resulting from Work of this Section to acceptance of Authorities having jurisdiction.
- .15 Protect trenches or any open excavations, maintaining warning devices during construction and periods of inactivity.

## **2 . PRODUCTS**

### **2.1 MATERIALS**

- 2.1.1 Granular A and Granular B: OPSS.MUNI 1010 – Aggregates – Base, Subbase Select Subgrade, and Backfill Material
- 2.1.2 Clear Stone: OPSS.MUNI 1004 – Aggregates - Miscellaneous
- 2.1.3 Native Fill: Clean (meeting the MECP Table 3 Site Condition Standards for Industrial/commercial/community (ICC) land use), native soil, excavated at *Place of Work*, as selected and approved by Geotechnical Engineer, free of organic material including roots and tree or shrub material, particles larger than 100 mm (4”), foreign or building debris, chemicals, and infectious substances detrimental to plants, free of deleterious matter, and provided moisture content of fill is controlled and provided fill is capable of being compacted to required density.
- 2.1.4 Imported Fill (Earth Borrow): fill material containing no organic material, foreign matter, roots, rocks over 100mm (4”) in diameter,

building debris and toxic material in accordance with OPSS.MUNI 212. Demonstrate that such fill is compactable to a density of 98% Standard Proctor Maximum Dry Density (SPMDD), that it is maintained within 2% of optimum moisture content at time of compaction and meets the MECP Table 3 Site Condition Standards for Industrial/commercial/community (ICC) land use.

### **3 . EXECUTION**

#### **3.1 DEWATERING**

3.1.1 In accordance with OPSS.MUNI 517 and 518 except for the following notes and modifications:

- .1 Do not obstruct flow of surface drainage or natural water courses
- .2 Protect open excavations against flooding and damage due to surface run-off.
- .3 Submit for Consultant's approval details of the proposed dewatering or heave prevention methods such as temporary sumps, pumping, dikes, well points, or any other means.
- .4 Dispose of excess water in a manner not detrimental to public and private property, or any portion of work completed or under construction
- .5 Obtain letter of conditional approval from Authorities Having Jurisdiction to dispose of groundwater into sewer drainage system. Apply for and pay for water disposal permit.
- .6 Keep excavations and trenches free of water throughout construction period.

3.1.2 Groundwater removal:

- .1 Lower groundwater level and maintain at depth below lowest point of excavation to ensure a dry stable surface.
- .2 Dewater to prevent loss of soil and maintain stability of sides and bottom of excavation and of adjacent structures.
- .3 Dispose of water in conformance with applicable by-laws and in a manner not detrimental to public and private property, or portion of Work completed or under construction.
- .4 Supply and install flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to sewers, water courses or drainage areas in accordance with authorities having jurisdiction. Perform testing on settlement tank discharge to confirm that effluent meets sewer bylaw requirements. Locate tanks to acceptable area determined by Consultant.

.5 Should method of dewatering fail to achieve conditions specified above, Consultant reserves right to revise methods and procedures at no cost to Owner.

3.1.3 Surface water removal:

.1 Remove surface run-off in a manner that will prevent loss of soil and maintain stability of sides and bottom of excavation. Obtain Consultant's approval of dewatering method to be used.

.2 Discharge surface water into existing storm drainage system to acceptance of Consultant and local authorities.

**3.2 LINES AND ELEVATIONS**

3.2.1 Establish lines and elevations from Control Points shown on Contract Drawings.

3.2.2 Have lines and elevations established by Registered Ontario Land Surveyor or qualified Civil Engineer Licensed in Province of Ontario.

3.2.3 Protect and maintain Control Points and Benchmark as long as they are required.

**3.3 STRIPPING OF TOPSOIL**

3.3.1 Do not handle topsoil while in wet or frozen condition or in manner in which soil composition is adversely affected.

3.3.2 Commence topsoil stripping of areas as directed by the Consultant after area has been cleared of brush, weeds and grasses. All material cleared shall be removed from site and shall conform to O.Reg. 409/19.

3.3.3 Strip topsoil to depths as directed by the Consultant. Avoid mixing topsoil with subsoil.

3.3.4 Stockpile topsoil in locations directed by Consultant. Stockpile to height not exceeding 3 m.

3.3.5 Dispose of unused topsoil.

**3.4 EXCAVATION**

3.4.1 Completed Excavation in accordance with OPSS.MUNI.206, except to the following notes and modifications:

3.4.2 Remove concrete, masonry, paving, demolished foundations and rubble and other obstructions encountered during excavation Work.

3.4.3 Removal of existing boulders and/or concrete elements up to a size of 1 m<sup>3</sup> encountered below existing grade while excavated are included as part of the Work. Notify Consultant at each time of occurrence when existing boulders and/or concrete elements greater than 1 m<sup>3</sup> are encountered below existing grade, providing detailed record of each occurrence in writing. This record must be

approved by the Consultant before claims for extras will be considered.

- 3.4.4 Do not disturb soil within drip line of trees or shrubs that are to remain. If excavating through roots, excavate by hand and cut roots with sharp axe or saw in a manner acceptable to authorities having jurisdiction.
- 3.4.5 Excavate to required lines and grades shown on Contract Drawings with allowance for subsequent Work including shoring, bracing and formwork. Make excavation clean and clear of loose material and true to size.
- 3.4.6 Protect stockpiles of fill against contamination and moisture absorption.
- 3.4.7 Trim, and remove loose material, debris and organic material from excavations. Where material at bottom of excavation is disturbed, remove disturbed material and re-compact to density equal to or better than undisturbed soil or backfill with lean concrete as directed by Consultant.
- 3.4.8 When excavations are complete, prior to commencement of subsequent Work, request Consultant for inspection of excavation Work.
- 3.4.9 Sub-excavation may be required where soft/loose material and organic matter are encountered, and shall be properly replaced with suitable approved backfill, as approved by the Geotechnical Engineer, compacted to 98% SPMDD. Notify the Geotechnical Engineer of the sub-excavation and record quantities removed.
- 3.4.10 Over-excavation due to Contractor error will be rectified and properly replaced with suitable approved backfill, as approved by the Geotechnical Engineer, compacted to 98% SPMDD without additional compensation.

### **3.5 EXCAVATED MATERIAL DISPOSAL**

- 3.5.1 Except for material to be used as select fill, immediately remove and dispose of excavated material from Site as per Special Provision On-Site and Excess Soil Management – GN133SP
- 3.5.2 Remove and dispose of construction rubble, abandoned gas, water and sewer pipes, valves, valve boxes and fittings, maintenance holes, frames and covers and other material which may be encountered during excavation but not indicated on Contract Drawings.
- 3.5.3 Comply with the waste management plan developed by the Contractor for the Work in accordance with Section 01 74 00. Comply with the directions of the Contract Administrator regarding waste management disposal activities.

- 3.5.4 Dispose of surplus and unsuitable excavated material offsite, as per OPSS.MUNI 180, revision date November 2021 and O. Reg 406/19.
- 3.5.5 Excess material resulting from trenching and excavation may be re-used as select fill provided it meets or exceeds the requirements of select fill and if approved by the Consultant. Any material that is not approved for re-use shall be transported and disposed of at an approved waste disposal facility as per OPSS.MUNI 180, revision date November 2021, and O. Reg 406/19. Special Provision On-Site and Excess Soil Management – GN133SP.

### **3.6 GRADING**

- 3.6.1 Complete Grading in accordance with OPSS.MUNI.206, except to the following notes and modifications:
- 3.6.2 Prior to placing fill over existing ground, scarify surface to depth of 150 mm. Maintain fill and existing surface at approximately same moisture content to facilitate bonding.
- 3.6.3 Place material only on clean unfrozen surface, properly shaped and compacted and free from snow and ice. Ensure no frozen material is used in placing.
- 3.6.4 Grade as necessary to bring Work areas to required elevations. Supply additional material required to obtain new grade levels. Place and compact as specified.
- 3.6.5 Grade drainage ditches to elevations indicated on Contract Drawings.
- 3.6.6 Maintain positive drainage. Slope rough grade away from building 1:50 minimum.
- 3.6.7 Grade materials using methods which do not lead to segregation or degradation of aggregate.
- 3.6.8 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- 3.6.9 Remove and replace that portion of layer in which material becomes segregated during spreading.
- 3.6.10 Make graded areas smooth to profile, free of debris, with local excavations and depressions filled and compacted.
- 3.6.11 Do not disturb soil within branch spread of trees and shrubs remaining.
- 3.6.12 Cultivate entire area which is to receive topsoil to a depth of 100 mm. Repeat cultivation in those areas where equipment used for hauling and spreading has compacted soil.
- 3.6.13 Remove surface debris, roots, vegetation, branches and stones in excess of 50 mm in diameter.

**3.7 Subgrade Compaction**

- 3.7.1 After grading has been completed, scarify and mix subgrade surface to a depth of 300 mm unless otherwise shown on the drawings.
- 3.7.2 Remove unsuitable materials found during work. Replace with material approved by the Engineer.
- 3.7.3 Compact top 300 mm of subgrade soil to at least 98% SPMDD, or as directed by the Geotechnical Consultant.
- 3.7.4 Bring moisture content of soil to level required to achieve specified compaction. Add water or aerate as required.
- 3.7.5 Inspection of subgrade required by Geotechnical Consultant prior to placement of granular materials. The General Contractor is responsible for coordination of inspections with the Geotechnical Consultant.

**3.8 Proof Rolling of Subgrade**

- 3.8.1 Proof roll subgrade using standard roller of 45400 kg gross mass with four pneumatic tires each carrying 11350 kg and inflated to 620 kPa. Four tires arranged abreast with centre to centre spacing of 730 mm.
- 3.8.2 If use of non-standard proof rolling equipment is approved, Geotechnical Engineer to determine level of proof rolling.
- 3.8.3 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.
- 3.8.4 Where proof rolling reveals areas of defective subgrade reconstruct the defective work and repeat proof rolling.

**3.9 EMBANKMENTS**

- 3.9.1 Bench slopes greater than 4(H):1(V) or where shown on the drawings, to ensure proper bond between new materials and existing surfaces. Obtain prior approval from the Engineer of method to be used.
- 3.9.2 Scarify slopes of 4(H):1(V) and flatter 200 mm deep, after topsoil stripping, unless otherwise indicated on the drawings.
- 3.9.3 Break up or scarify existing pavement to sub-grade elevation as indicated.
- 3.9.4 Do not place material which is frozen nor place material on frozen surfaces.
- 3.9.5 Maintain crowned surface during construction to ensure ready run-off of surface water. Do not place material in free standing water.

- 3.9.6 Place and compact to full width in uniform layers not exceeding 200 mm loose thickness. The Engineer may authorize thicker lifts if specified compaction can be achieved.
- 3.9.7 Compact to density of not less than 95% maximum dry density in accordance with ASTM D698.
- 3.9.8 Bring moisture content of soil to level required to achieve specified compaction. Add water or aerate as required.

### **3.10 BACKFILLING**

- 3.10.1 Commence backfilling after areas of Work to be backfilled have been inspected.
- 3.10.2 Areas to be backfilled shall be free of debris, snow, ice, water, or frozen ground. Backfill material shall not be frozen or contain ice, snow or debris.
- 3.10.3 Backfill simultaneously each side of walls and other structures to equalize soil pressures.
- 3.10.4 Obtain Consultant's acceptance prior to placing backfill against foundation walls enclosing interior space.
- 3.10.5 Request reviews by Consultant and Geotechnical Engineer of excavation prior to beginning backfilling.
- 3.10.6 Where temporary unbalanced earth pressures are liable to develop on walls or other structures, erect bracing or shoring to counteract unbalance, and leave in place until removals is approved by Consultant.
- 3.10.7 Place and compact fill materials in continuous horizontal layers not exceeding 200 mm (8") loose depth.
- 3.10.8 Use backfilling methods to prevent disturbing or damaging buried services and site improvements.
- 3.10.9 Concrete Floor Slab: beneath moisture barrier granular lay (20mm clear stone – see section 32 11 16 Base and Subbase Courses), supply and install Granular B, Type 1, backfill compacted to 98% SPMDD.

### **3.11 RESTORATION**

- 3.11.1 Upon completion of Work, remove surplus materials and debris, trim slopes, and correct defects as directed by Consultant.
- 3.11.2 Replace topsoil and reinstate existing pavement, sidewalk, lawns and walks to elevation and condition which existed before excavation.
- 3.11.3 Clean and reinstate areas affected to acceptance of Consultant.
- 3.11.4 Restoration of the pavement structure of driveways as shown on Contract Drawings.

**3.12 TOLERANCES**

3.12.1 Tolerances in accordance with OPSS.MUNI.206.

**3.13 FIELD QUALITY CONTROL**

3.13.1 Conduct quality control in accordance with Section 01 40 00.

3.13.2 Submission of grade checks in accordance with OPSS.MUNI.206. Contract shall complete and submit form OPSF 206-1 to the Consultant.

3.13.3 In-situ tests and inspections:

3.13.4 Allow inspection and testing company to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

3.13.5 Footing subgrade: at footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by the Consultant.

3.13.6 Inspections:

3.13.7 Determine prior to placement of fill that site has been prepared in compliance with requirements.

3.13.8 Determine that fill material and maximum lift thickness comply with requirements.

3.13.9 Determine, at the required frequency, that in-place density of compacted fill complies with requirements.

3.13.10 Testing:

3.13.11 Contractor shall use Method B according to OPSS 501 for quality control of compaction except for the following notes and modifications:

3.13.12 Building slab areas: at subgrade and at each compacted fill and backfill layer, at least one test for every 200 sq.m or less, but in no case fewer than three tests.

3.13.13 Foundation wall backfill: at each compacted backfill layer, at least one test for every 30 m or less of wall length, but no fewer than two tests.

**3.14 WORK WITHIN THE MUNICIPAL RIGHT-OF-WAY**

3.14.1 Obtain a Road Occupancy Permit from the Region of Peel for works within the Dixie Road Right-of-Way.

3.14.2 Obtain a Road Occupancy Permit from the City of Brampton for works within the Dockstader Road Right-of-Way.



- 3.14.3 All work within the Region's Right-of-Way shall be constructed according to the latest Region of Peel Standard Drawings and Specifications. Ontario Provincial Standard Drawings and Specifications may, subject to the approval of the Region of Peel, be used where no Region standard or specification is available.
- 3.14.4 All work within the City's Right-of-Way shall be constructed according to the latest City of Brampton Standard Drawings and Specifications. Ontario Provincial Standard Drawings and Specifications may, subject to the approval of the City, be used where no City standard or specification is available.
- 3.14.5 All work shall be completed according to the current Occupational Health and Safety Act and Regulations for Construction Projects. The General Contractor shall be deemed to be the Constructor as Defined in the Act.
- 3.14.6 All temporary Traffic Control and Signage during construction shall be according to the current Ontario Traffic Manual Book 7: Temporary Conditions Field Edition.
- 3.14.7 All areas disturbed during construction within the City or Region's right-of-way shall be restored to original or better condition and to the satisfaction of the Contract Administrator. Grassed areas shall be treated with 100 mm of topsoil and shall be sodded according to Region of Peel Standard Vol. 2.4.

**END OF SECTION**

## 1. GENERAL

### 1.1 Summary

- 1.1.1 Provide labour, materials, products, equipment and services to complete the for removal of excess materials as required for the work indicated on the Contract Drawings, including the requirements for excavation, backfilling of resulting trenches holes or pits specified herein.

### 1.2 Related Requirements

- 1.2.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.2.2 Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

### 1.3 References

- 1.3.1 The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- 1.3.2 All reference amendments adopted prior to the Bid Closing date of this Project shall be applicable to this Project.
- 1.3.3 All materials, installation and workmanship shall comply with all applicable requirements and standards.

### 1.4 CLEARING AND GRUBBING

- 1.4.1 Clear and grub as necessary to remove trees and roots. Tag and adequately protect trees shown on Reference Design to be preserved.
- 1.4.2 The relocation of trees and shrubs shall be subject to approval by the project Landscape Architect or Consultant.
- 1.4.3 Where an excess material is a mixture of materials managed in compliance with the most stringent conditions associated with any of the constituent excess material.
- 1.4.4 Manage all excess materials so as to prevent their entry to waterbodies and other Environmentally Sensitive Areas except when re-used in accordance with the relevant municipal standards

## 2. PRODUCTS

- 2.1.1 N/A

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**3 . EXECUTION****3.1 Preparation**

- 3.1.1 Contractor to inspect site and verify with Consultant all items designated for removal and items to be preserved.
- 3.1.2 Locate and protect all utility lines. Preserve in operating condition active utilities traversing the site.
- 3.1.3 Notify and obtain approvals from all agencies prior to commencing work.
- 3.1.4 Contractor to maintain vehicle and facility traffic in all stages of work.

**3.2 Protection**

- 3.2.1 All existing buried utilities and structures as well as existing buildings and surface features shall be protected in accordance with Section 31 00 00 – Excavating, Backfilling, and Compacting.

**3.3 Backfill**

- 3.3.1 Backfill in accordance with Section 31 23 33 - Trenching and Backfilling and Section 32 11 16 – Granular Base and Subbase Courses.

**3.4 Disposal of waste and surplus material**

- 3.4.1 Remove excess excavated material from the site, except material approved to be reused, at appropriate on-site locations as per Special Provision On-Site and Excess Soil Management, GN133SP.
- 3.4.2 The excess soil and fill material shall be disposed of at MECP approved soil treatment site, waste disposal site or any other appropriate disposal site meeting applicable regulations for excess soil and fill material disposal. Identify and propose an off-site disposal option or disposal facility meeting all applicable and current regulations for excess soil and fill material disposal.
- 3.4.3 Obtain all regulatory approvals, permits and any other requirements for off-site disposal. This includes requirements for all additional testing, such as any chemical analysis required by the current MECP guideline and Ontario Regulation 347.
- 3.4.4 Comply with the waste management plan developed by the Contractor for the Work in accordance with Section 01 74 00. Comply with the directions of the Contract Administrator regarding waste management and disposal activities.

**3.5 Restoration**

- 3.5.1 Leave site clean upon completion of work.

- 3.5.2 Reinstatement areas and existing works outside areas of demolition to conditions that existed prior to commencement of work or better to the satisfaction of the Region of Peel.

**END OF SECTION**

## 1. **GENERAL**

### 1.1 **Summary**

- 1.1.1 Provide labour, materials, products, equipment and services to complete the protection of trees and shrubs as well as removal if required specified herein.
- 1.1.2 A Tree Removal Permit is required for any street tree or any private tree with a diameter of 30 cm or more and must be obtained from the City of Brampton Urban Forestry.

### 1.2 **Related Requirements**

- 1.2.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.2.2 Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

### 1.3 **References**

- 1.3.1 The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- 1.3.2 All reference amendments adopted prior to the Bid Closing date of this Project shall be applicable to this Project.
- 1.3.3 All materials, installation and workmanship shall comply with all applicable requirements and standards.

### 1.4 **Scheduling**

- 1.4.1 Obtain approval from Consultant of schedule indicating commencement of work.

## 2. **PRODUCTS**

### 2.1 **Materials**

- 2.1.1 Obtain approval from Consultant of schedule indicating commencement of work.
- 2.1.2 Drainage Tile: 100 mm diameter corrugated plastic perforated tubing complete with snap couplings to CGSB 41-GP-31M.
- 2.1.3 Anti-desiccant: Commercial, wax-like emulsion.

- 2.1.4 Stakes: Metal 'T' bars @ 750 mm length for deciduous trees. Galvanized Turnbuckles with 150 mm long eyebolts or approved equal wire tightener. Pine stakes at 2,400 mm length, stained brown, for conifers.
- 2.1.5 Wire: 3 mm galvanized guy wire.
- 2.1.6 2 ply reinforced rubber hose: 12 mm dia.
- 2.1.7 Hoarding: Plastic snow fence and geotextile or as approved by Infrastructure & Development Services.

### **3 . EXECUTION**

#### **3.1 Identification and Protection**

- 3.1.1 Contractor shall protect all existing trees within the work areas. Should any tree conflict with the proposed works, the Consultant shall be notified immediately to determine a course of action. No trees shall be removed without written consent from the City of Brampton.
- 3.1.2 Contractor to install tree protection fencing as per OPSD 220.0010.
- 3.1.3 Protect plant and root systems from damage, compaction and contamination resulting from construction by erecting hoarding fence at the dripline of existing vegetation to be preserved to the satisfaction of Consultant.
- 3.1.4 Install 8' (2400 mm) length metal T-bars and wooden posts as per detail to support hoarding and fasten with wire fasteners.
- 3.1.5 Contractor to provide an on-site Arborist present to oversee the tree preservation measures outlined in this section and related sections. More specifically, the Arborist will supervise all tree cutting and pruning (above grade and below), as well as excavation which occur within the Tree Protection Zone (TPZ).
- 3.1.6 The Arborist must have International Society of Arboriculture (ISA) certification and have a minimum of 5 years arboricultural experience. Proof of certification or training will be submitted upon request.

#### **3.2 Transplanting**

- 3.2.1 Location and quantity of transplanting are to be approved by Consultant on site, prior to transplanting. Transplanted trees and shrubs are to be tagged prior to transplanting.
- 3.2.2 Location and limits of final transplanting location to be approved by Consultant prior to transplanting.

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- 3.2.3 For trees larger than 50 mm caliper transplant mechanically with tree spade approved by Consultant. Do not sever roots greater than 40 mm diameter except at greater than 500 mm below existing grade. Protect roots and cut roots cleanly with sharp disinfected tools.
  - 3.2.4 All roots balls to conform to "Canadian Standards for Nursery Stock", 7th edition, published by Canadian Nursery Landscape Association for size with respect to caliper.
  - 3.2.5 Construct earth saucer, mulch base of tree and guy according to standard horticultural practices.
  - 3.2.6 Backfill pits to 85% Standard Proctor Density. Avoid damage to trunk and roots of adjacent trees.
  - 3.2.7 Water plants immediately after transplanting and fertilize to maintain optimum soil moisture and fertility.
  - 3.2.8 Transplanting of trees is not to take place during the months of July or August, or during extreme weather conditions.

### **3.3 Maintenance during Warranty Period**

- 3.3.1 From time of acceptance by Consultant to end of warranty period, perform following maintenance operations:
  - .1 Water to maintain soil moisture conditions for optimum growth and health of plant material without causing erosion.
  - .2 Apply organic urea fertilizer in early spring at suppliers suggested rate.
  - .3 Remove dead, broken or hazardous branches from plant material.
  - .4 Submit monthly written reports to Consultant identifying:
  - .5 Maintenance work carried out.
  - .6 Development and condition of plant material.
  - .7 Preventative or corrective measures required which are outside Contractor's responsibility.

### **3.4 Pruning**

- 3.4.1 Prune crown to compensate for root loss while maintaining general form and character of plant.
- 3.4.2 All pruning of on-site trees shall be conducted by a qualified tree service contractor who is approved in advanced by the Arborist and Consultant.
- 3.4.3 Tree roots found to be in conflict of the site works will be pruned clearly by the Arborist and undertake those works according to the proper arboricultural practices.

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- 3.4.4 Trees will require interim watering between the time that the tree are root pruned and until elements are constructed as directed by the Arborist and Consultant.

**3.5 Anti-Dessicant**

- 3.5.1 Apply anti-desiccant to foliage where applicable and as directed by Consultant.

**END OF SECTION**



**1. GENERAL****1.1 Summary**

1.1.1 Provide labour, materials, products, equipment and services to complete the placement of engineered fill for grade raise and preloading specified herein.

1.1.2 Section excludes:

.1 Stripping and sub-excavation of topsoil, earth fill, organic soil, and unsuitable fill; see section 31 00 00 Excavating, Backfilling, and Compacting.

**1.2 Related Requirements**

1.2.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2.2 Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

**1.3 References**

1.3.1 The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

1.3.2 All reference amendments adopted prior to the Bid Closing date of this Project shall be applicable to this Project.

1.3.3 All materials, installation and workmanship shall comply with all applicable requirements and standards.

**1.4 Administrative Requirements**

1.4.1 Conduct a pre-installation meeting in accordance with Section 01 31 00.

.1 Independent inspection and testing company shall attend the pre-installation meeting.

**1.5 Submittals**

1.5.1 Submit required submittals in accordance with Section 01 33 00.

1.5.2 A minimum of 14 days prior to imported fill (earth borrow) material being used (if required), a list of intended borrow sources and tonnage that is expected to be used from each source shall be provided to the Geotechnical Engineer and Consultant to allow time for sampling and testing as per Special Provision On-Site and Excess Soil Management, GN133SP.

**1.5.3 Reports:**

1.5.4 Submit written laboratory test reports for each material proposed for fill.

1.5.5 Submit written field inspection and test report results after each inspection.

1.5.6 Survey of subgrade and finished ground elevations on completion of engineered fill, provided in a format compatible with AutoCAD 2023.

**1.6 Quality Assurance**

1.6.1 All shop drawings to be signed and sealed by a Professional Engineer licensed in Province of Ontario and having experience in design and inspection of shoring, bracing and underpinning required to complete Work.

**2 . PRODUCTS****2.1 MATERIALS****2.1.1 Engineered Fill:**

.1 Imported or Native Fill: fill material containing no organic material, foreign matter, roots, rocks over 100mm (4") in diameter, building debris and toxic material in accordance with OPSS.MUNI 212. Drying and careful site management will be required for fill to be compactable to a density of 98% Standard Proctor Maximum Dry Density (SPMDD).

.2 Granular B: OPSS.MUNI 1010 – Aggregates – Base, Subbase Select Subgrade, and Backfill Material

**3 . EXECUTION****3.1 Stockpiling**

3.1.1 Stockpile fill materials in areas to approval of geotechnical engineer. Stockpile granular materials in manner to prevent segregation. Protect stockpiled fill material from freezing.

3.1.2 Protect fill materials from contamination.

3.1.3 Smooth-blade stockpile to promote runoff and/or protect from excessive moisture take up.

**3.2 Surveying**

3.2.1 Survey subgrade ground elevations prior to placing engineered fill.

3.2.2 Survey ground elevations on completion of engineered fill placement.

**3.3 Lines and Elevations**

3.3.1 Boundaries of the engineered fill shall be established by a Registered Ontario Land Surveyor in the Province of Ontario, in consultation with the Geotechnical Engineer and Consultant.

3.3.2 Protect and maintain layout and offset stakes as long as they are required.

**3.4 Stripping of Topsoil**

3.4.1 See section 31 00 00 Excavating, Backfilling, and Compacting

**3.5 Excavation**

3.5.1 See section 31 00 00 Excavating, Backfilling, and Compacting

**3.6 Grading**

3.6.1 See section 31 00 00 Excavating, Backfilling, and Compacting

**3.7 Compaction**

3.7.1 Engineered fill material must be compacted to 98% SPMDD in maximum 150mm lift thicknesses.

3.7.2 After completion of compaction, the surface of engineered fill must be protected from disturbance from construction traffic.

**3.8 Proof Rolling**

3.8.1 Proof roll using standard roller of 45400 kg gross mass with four pneumatic tires each carrying 11350 kg and inflated to 620 kPa. Four tires arranged abreast with centre to centre spacing of 730 mm.

3.8.2 If use of non-standard proof rolling equipment is approved, Geotechnical Engineer to determine level of proof rolling.

3.8.3 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.

3.8.4 Where proof rolling reveals areas of defective fill, reconstruct the defective work and repeat proof rolling.

**3.9 Surcharge Fill and Removal for Preloading**

3.9.1 In areas where the grade is raised for more than 1.5m above the existing ground, a surcharge fill of 1.5m in thickness above the final grade shall be placed to preload the underlying weak soils.

- 3.9.2 The top of the surcharge fill should extend horizontally 6.0m beyond building walls (i.e. extend 6.0m into the building area) and then slope down at 1.5H:1V or flatter.
- 3.9.3 The surcharge fill shall be kept in place until a degree of consolidation of at least 70% is achieved for the underlying soils.
- 3.9.4 After the ground has been consolidated under the surcharge fill for the required preloading period, the surface fill can be removed.

### **3.10 Settlement Monitoring**

- 3.10.1 Settlement monitoring is required to confirm the required duration of preloading with the surcharge fill.
- 3.10.2 Ground settlement monitoring using settlement rods conducted at a minimum of 3 locations shall be installed on the top of native subgrade level or at the bottom of the engineered fill.
- 3.10.3 Initial sets of monitoring readings must be taken prior to the placement of fill above the instrument. During the fill placement preloading period, monitoring readings should be taken weekly, or at intervals as directed by the Geotechnical Engineer.
- 3.10.4 After removal of the surcharge fill, the settlement rods must be properly decommissioned.

### **3.11 Tolerances**

- 3.11.1 Tolerances in accordance with OPSS 206.

### **3.12 Field Quality Control**

- 3.12.1 Conduct quality control in accordance with Section 01 40 00.
- 3.12.2 Submission of grade checks in accordance with OPSS 206. Contract shall complete and submit form OPSF 206-1 to the Consultant.
- 3.12.3 In-situ tests and inspections:
  - .1 Allow inspection and testing company to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- 3.12.4 Inspections:
  - .1 Determine prior to placement of fill that site has been prepared in compliance with requirements.
  - .2 Determine that fill material and maximum lift thickness comply with requirements.
  - .3 Determine, at the required frequency, that in-place density of compacted fill complies with requirements.
- 3.12.5 Testing:

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.1 Contractor shall use Method B according to OPSS 501 for quality control of compaction.

**END OF SECTION**

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## 1. GENERAL

### 1.1 Summary

- 1.1.1 Provide labour, materials, products, equipment and services to complete the trenching, backfill, and compaction to accommodate underground pipes and sewers. For all other utilities, see respective specification sections pertaining to electrical and mechanical.
- 1.1.2 Compaction methods and material specifications for such Work are also detailed in this Section.

### 1.2 Related Requirements

- 1.2.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.2.2 Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

### 1.3 References

- 1.3.1 The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- 1.3.2 All reference amendments adopted prior to the Bid Closing date of this Project shall be applicable to this Project.
- 1.3.3 All materials, installation and workmanship shall comply with all applicable requirements and standards.

### 1.4 Submittals

- 1.4.1 Submit shop drawings for temporary shoring design and erection in accordance with Section 01 33 00.
- 1.4.2 Shop drawings will include material grades, core thicknesses, connections, joints, method of anchorage, number of anchors, supports, details and accessories.
- 1.4.3 Ensure shop drawings are of uniform size and based on field measurements.
- 1.4.4 Shop drawings shall bear the stamp of a qualified professional engineer registered in the Province of Ontario.

### 1.5 Protection

- 1.5.1 The Contractor shall provide protection as per requirements of Section 31 00 00 - Excavating, Grading, and Backfilling

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## 2. PRODUCTS

### 2.1 Materials

#### 2.1.1 Backfill:

- .1 See Section 31 00 00 – Excavating, Grading, and Backfilling

#### 2.1.2 Pipe Bedding:

- .1 Pipe bedding shall be Granular A material conforming to TS 1010 and TS 514, placed beneath and above pipe in accordance with the Contract Documents. Gradation to be within the limits specified when tested to ASTM C136 and ASTM C117. Refer to Section 32 11 16 - Granular Base and Subbase.

#### 2.1.3 Unshrinkable Fill:

- .1 Unshrinkable fill (U-fill), if required, shall be a very weak mixture of Portland Cement, concrete aggregate, and water to 0.4 MPa strength to 0.4 MPa cement stabilized backfill conforming to requirements of OPSS.MUNI 1359, such that the mix resists settlement when placed in trenches, but can be readily excavated if required.

#### 2.1.4 Embankment materials require approval by the Consultant.

#### 2.1.5 Material used for embankment shall not contain organic matter, frozen lumps, weeds, sod, roots, logs, stumps or any other unsuitable material.

### 2.2 Compaction Equipment

#### 2.2.1 Compaction equipment must be capable of obtaining required densities in materials on project.

#### 2.2.2 Compaction equipment not specified herein is to be efficiency proved at no extra cost and written approval must be received from Consultant before use.

## 3. EXECUTION

### 3.1 Preparations And Layout

#### 3.1.1 Establish extent of excavation.

#### 3.1.2 Set out all lines and levels as indicated in Contract Documents or as directed by the Consultant required for proper excavation.

#### 3.1.3 Maintain benchmarks, monuments and other reference points. Re-establish if disturbed or destroyed at no additional cost to the Owner.

#### 3.1.4 Prior to commencement of Site grading works, site alteration plans must be approved and all erosion and sediment control measures

shall be installed and operational. The Contractor shall maintain all erosion and sediment control measures until servicing construction is completed to the satisfaction of the Consultant and authorities having jurisdiction.

3.1.5 Dust control shall be applied by the contractor as required and/or when directed to do so by the Consultant or Authorities having jurisdiction.

3.1.6 Erosion control as specified in Section 31 25 00 – Erosion and Sediment Controls is the responsibility of the Contractor.

### **3.2 Utilities**

3.2.1 Prior to commencement of excavation work, establish location and extent of all underground utilities occurring in work area. Inform consultant immediately of any discrepancy from the information regarding utilities in the drawings provided.

3.2.2 Maintain, re-route or extend as required existing utility lines which pass through work area and which must remain. Pay all costs for this work except costs borne by utility companies.

3.2.3 Protect utility services uncovered by excavation.

3.2.4 Remove abandoned utility service lines encountered from areas of construction. Cap, plug or seal such lines and identify at grade with markers.

3.2.5 Accurately locate and record abandoned and active utility line re-routed or extended on as-built Contract Documents.

### **3.3 Stockpiling**

3.3.1 Temporarily stockpile granular fill materials in areas designated by Consultant. Stockpile granular fill materials in manner to prevent segregation and mixing.

3.3.2 Protect all granular fill materials from contamination.

### **3.4 Dewatering And Heave Prevention**

3.4.1 See Section 31 00 00 – Excavating, Grading, and Backfilling

### **3.5 Excavation**

3.5.1 See Section 31 00 00 – Excavating, Grading, and Backfilling

### **3.6 Trenching**

3.6.1 Trenching shall be carried out in accordance with OPSS 401.

3.6.2 Excavate trenches to lines and grades indicated and to a depth of 75 mm minimum below invert elevation and slope established for



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pipe and backfill to invert elevation of pipe with specified granular material.

- 3.6.3 Unless otherwise authorized by Consultant, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation. Remove unsuitable material from trench bottom to extent and depth as directed by Consultant.
- 3.6.4 If unstable soil conditions are encountered, excavate trenches to depth directed by Consultant and backfill to correct elevation with backfill material.
- 3.6.5 Remove loose material from bottom of trenches to ensure granular material is placed against undisturbed soil.
- 3.6.6 Compact bedding and grade as required for even and uniform support on each length of pipe.
- 3.6.7 Where excavating is required adjacent to and parallel with and below any footing, submit excavation and backfill procedures to Consultant for review prior to start of excavating.
- 3.6.8 Keep width of trenches to a minimum to ensure minimum span for pipe to be supported and minimum loading on buried pipes.
- 3.6.9 Any loose fill or other unsuitable material below pipe invert level must be removed and replaced with select on-site or imported fill as approved by the Geotechnical Engineer and compacted to 98% SPMDD.
- 3.6.10 Over-excavation or sub-excavation shall be properly replaced with granular material and compacted to 98% SPMDD.
- 3.6.11 Dispose of surplus and unsuitable excavated material offsite, as per OPSS.PROV 180, revision date November 2016 and O. Reg 406/19.
- 3.6.12 Excess material resulting from trenching and excavation may be re-used as select fill provided it meets or exceeds the requirements of select fill and if approved by the Consultant. Any material that is not approved for re-use shall be transported and disposed of at an approved waste disposal facility as per OPSS.PROV 180, revision date November 2016, and O. Reg 406/19.

### **3.7 Bedding And Material Surrounding Of Underground Services**

- 3.7.1 See Sections for details:
- 3.7.2 Site Water Utility Distribution Piping – Section 33 11 16
- 3.7.3 Fire Suppression Utility Water Distribution Piping – Section 33 11 19
- 3.7.4 Sanitary Utility Distribution Piping – Section 33 31 13

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3.7.5 Storm Utility Drainage Piping – Section 33 41 00

**3.8 Backfilling And Compaction**

- 3.8.1 Backfilling and compaction shall be carried out in accordance with OPSS 401.
- 3.8.2 Do not proceed with backfilling operations until Consultant has inspected and approved installations.
- 3.8.3 Areas to be backfilled to be free from debris, snow, ice, water and frozen materials.
- 3.8.4 Place backfill material in uniform layers not exceeding 300 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.
- 3.8.5 Backfill shall be with select on-site excavated organic free silty clay fill or imported earth fill as approved by the Geotechnical Engineer and compacted to at least 98% SPMDD.
- 3.8.6 Place backfill uniformly and simultaneously on each side of pipe.
- 3.8.7 Compaction tests shall be conducted by a qualified Geotechnical Consultant to ensure compaction and stability of the fill and test results shall be submitted to the Consultant and the Region of Peel.

**3.9 Restoration**

- 3.9.1 Upon completion of the Work, immediately remove and dispose of waste materials and debris, replace topsoil, trim slopes, and correct defects as directed by Consultant.
- 3.9.2 Clean and reinstate areas affected by work as directed by Consultant.
- 3.9.3 All disturbed grassed areas shall be restored to original condition or better, with sod on minimum of 100 mm topsoil as per Region of Peel Standard Vol. 2.4.
- 3.9.4 Maximum slope for grade shall be 3(H):1(V).

**3.10 Quality Assurance And Testing**

- 3.10.1 Ensuring proper compaction techniques and adherence to the required densities will be the responsibility of the Contractor. Consultant shall appoint an independent testing company to be put under the cash allowance "Testing & Inspection", for checking and approval of the placement and compaction of granular materials. The Contractor will be responsible for payment of all costs associated with re-testing of materials if corrective actions are required to restore defective areas. The Contractor is required to coordinate with the Consultant and the testing company to ensure at least two (2) business days notice is given prior to placement and compaction of granular materials.

**3.11 Quality Control**

3.11.1 See OPSS 501 for Quality Control requirements.

**3.12 Work Within the Municipal Right-Of-Way**

3.12.1 Obtain a Road Occupancy Permit from the Region of Peel for works within the Dixie Road Right-of-Way.

3.12.2 Obtain a Road Occupancy Permit from the City of Brampton for works within the Docksteader Road Right-of-Way.

3.12.3 All work within the Region's Right-of-Way shall be constructed according to the latest Region of Peel Standard Drawings and Specifications. Ontario Provincial Standard Drawings and Specifications may, subject to the approval of the Region of Peel, be used where no Region standard or specification is available.

3.12.4 All work within the City's Right-of-Way shall be constructed according to the latest City of Brampton Standard Drawings and Specifications. Ontario Provincial Standard Drawings and Specifications may, subject to the approval of the City, be used where no City standard or specification is available.

3.12.5 All work shall be completed according to the current Occupational Health and Safety Act and Regulations for Construction Projects. The General Contractor shall be deemed to be the Constructor as Defined in the Act.

3.12.6 All temporary Traffic Control and Signage during construction shall be according to the current Ontario Traffic Manual Book 7: Temporary Conditions Field Edition.

3.12.7 All areas disturbed during construction within the City or Region's right-of-way shall be restored to original or better condition and to the satisfaction of the Contract Administrator. Grassed areas shall be treated with 100 mm of topsoil and shall be sodded according to Region of Peel Standard Vol. 2.4.

**END OF SECTION**

**1. GENERAL****1.1 Summary**

- 1.1.1 Provide labour, materials, products, equipment and services to complete the requirements for the supply, installation and maintenance of erosion and sediment control measures in accordance with the contract drawings and the guidelines outlined below in areas as necessary prior to commencing excavation operations.

**1.2 Related Requirements**

- 1.2.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.2.2 Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

**1.3 References**

- 1.3.1 The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- 1.3.2 All reference amendments adopted prior to the Bid Closing date of this Project shall be applicable to this Project.
- 1.3.3 All materials, installation and workmanship shall comply with all applicable requirements and standards.

**2. PRODUCTS****2.1 MATERIALS**

- 2.1.1 Silt fence fabric shall be filter fabric geotextile – TerraFix Geosynthetics Inc 270R or Equivalent.
- 2.1.2 The stakes shall be of sufficient strength to satisfy silt fence barrier performance and maintenance requirements. The stakes shall be a minimum of 2.1 metres in length with a maximum spacing of 2 metres between stakes.
- 2.1.3 Using catch basin to match OPSS silt traps – Siltsack or Equivalent

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### **3 . EXECUTION**

#### **3.1 INSTALLATION**

##### **3.1.1 Silt fence barrier:**

- .1 The Contractor shall Install silt fence as necessary to prevent sediment from passing from one side of the barrier to the other.
- .2 Posts shall be spaced a maximum of 2 metres apart and shall be driven vertically into the ground to a minimum of 900 millimetres.
- .3 A trench measuring millimetres approximately 300 millimetres wide by 300 millimetres deep shall be excavated along the entire line of stakes. The trench shall be on the side of the stakes where grading work is to be conducted.
- .4 The geotextile from the silt fence shall extend into the trench a minimum of 300 millimetres. The prefabricated silt fence shall be installed without sags and have an overlap of 450 millimetres wherever its length is extended.
- .5 The trench should be backfilled and tamped to existing grade so as to hold the base of the geotextile firmly in place. The completed silt fence barrier shall have a minimum height of 1200 millimetres above the ground surface.

##### **3.1.2 Using catch basin to match OPSS silt traps:**

- .1 Place Silksack or Equivalent as directed by the manufacturer's recommendations.

#### **3.2 MAINTENANCE**

- 3.2.1 All silt fences shall be inspected immediately after runoff event and at least daily during prolonged rainfall. Any required repairs shall be made immediately. The silt fence barriers shall be maintained in place, without gaps and without undermining, so as to prevent sediment passage through or under barrier. Silt fence barriers shall be maintained vertical without tears and without sagging and maintain a 450 millimetres overlap on seams.
- 3.2.2 Accumulated sediment shall be removed at the direction of the Consultant in a manner that avoids escape to the downstream side of the barriers. Sediment shall be removed to the level of the grade existing at the time of barrier installation and shall conform to the following:
- 3.2.3 Accumulated sediment shall be removed when it reaches a depth of one-half the height of the silt fence barrier.
- 3.2.4 Accumulated sediment shall be removed as necessary to perform maintenance repairs.

3.2.5 Accumulated sediment shall be removed immediately prior to the removal of the silt fence.

3.2.6 All collected sediments to be disposed of at an approved location, in accordance with O Reg 406/19 (On-Site and Excess Soil Management).

### **3.3 REMOVAL**

3.3.1 Silt fence barriers and catch basin cover shall be removed when, in the opinion of the Consultant, the measure is no longer required. Area disturbed by the installation and removal shall be restored to the original grade and to the satisfaction of the Consultant and sodded.

**END OF SECTION**

**1. GENERAL****1.1 Summary**

- 1.1.1 Provide labour, materials, products, equipment and services to complete the supply, placement, and compaction of granular materials.
- 1.1.2 Supply, place, shape, adjust water content and compact granular subbase and base.
- 1.1.3 Subbase shall be the granular course below the granular road/pavement base course and building.

**1.2 Related Requirements**

- 1.2.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.2.2 Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

**1.3 References**

- 1.3.1 The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- 1.3.2 All reference amendments adopted prior to the Bid Closing date of this Project shall be applicable to this Project.
- 1.3.3 All materials, installation and workmanship shall comply with all applicable requirements and standards.

**2. PRODUCTS****2.1 Pavement Subbase**

- 2.1.1 Granular subbase materials shall be Granular 'B' conforming to OPSS.MUNI 1010. Granular 'B' may be either Type I or Type II with the exception that granular materials placed under structural elements be free of any reclaimed asphalt.

**2.2 Pavement Base**

- 2.2.1 Granular 'A', conforming to OPSS.MUNI 1010 with the exception that granular materials placed under structural elements, be free of any reclaimed asphalt (RAP).

**2.3 Concrete Floor Slab Base Course**

- 2.3.1 200 mm of 19 mm clear crushed stone or Granular 'A' conforming to OPSS.MUNI 1004

**3 . EXECUTION****3.1 Placement**

- 3.1.1 Supply, place, shape and compact granular subbase as indicated in the Contract Documents in conformance with OPSS.MUNI 314, except where the following requirements specify otherwise:
- 3.1.2 Supply and place in lifts not exceeding 200 mm compacted thickness.
- 3.1.3 Do not mix granular subbase or base course with underlying materials.
- 3.1.4 Scarify and air-dry excess moisture or add and mix water as required to obtain the specified soil density. Control watering and rolling to prevent pumping of fines to the surface.
- 3.1.5 Compact Granular Subbase to a dense, uniform condition, free from ruts or excess deflection under construction traffic. Compact in accordance with OPSS.MUNI 501, Method A; compact to 100% Standard Proctor Maximum Dry Density (SPMDD).
- 3.1.6 Shape the surface to the lines and grades specified.
- 3.1.7 Supply, place, shape and compact granular base as indicated in the Contract Documents in conformance with OPSS.MUNI 314 and in the above-mentioned specifications, except where the following requirements specify otherwise:
- 3.1.8 Supply and place in lifts not exceeding 150 mm compacted thicknesses.
- 3.1.9 Do not mix granular base course with underlying materials.
- 3.1.10 Scarify and air-dry excess moisture or add and mix water as required to obtain the specified soil density. Watering and rolling must be controlled to prevent pumping of fines to the surface.
- 3.1.11 Shape the surface to the lines and grades specified. Finished surface shall be free of any ruts or irregularities. The finished surface shall be free from depressions exceeding 10 mm as measured in any direction with a 3.0 meter straight edge.
- 3.1.12 To prepare for placement of granular base, the completed subbase shall be shaped and smoothed to within  $\pm 25$  mm of design elevations and shall, on average, meet the lines and grades specified in the Contract Documents.



- 3.1.13 Compact Granular Base to a dense, uniform condition, free from ruts or excess deflection under construction traffic. Compact in accordance with TS 501, Method A; compact to 100% Standard Proctor Maximum Dry Density (SPMDD).
- 3.1.14 The final granular base elevations shall meet the approval of the Consultant prior to placement of the asphalt.
- 3.1.15 Repair failures in compacted granular base course at Contractor's expense.
- 3.1.16 Supply and install minimum 200 mm (8") base course of 20mm clear stone to underside of slab. Vibrate into place to achieve uniform support for concrete slab and place to allow maximum concrete floor slab thickness tolerance of +/- 10 mm (3/8") in accordance with CSA-A23.1-09.

### **3.2 Quality Control**

- 3.2.1 The Contractor shall carry out grade checks to ensure the finished granular courses are built within the specified tolerances as noted in OPSS.MUNI 314 and within this specification. The Contractor shall complete grade checks and submit form OPSF 314-1 to the Consultant.
- 3.2.2 If the finished grade or cross-section is not in accordance to the specifications, the Contractor is required to rectify the Works to the Consultant's approval without additional compensation.

**END OF SECTION**

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## 1. GENERAL

### 1.1 Summary

- 1.1.1 Provide labour, materials, products, equipment, and services to complete the supply, placement and compaction of Hot Mix Asphalt Concrete Pavement to lines, grades and sections indicated in the Contract Documents. Prepare existing surfaces for asphalt placement.

### 1.2 Related Requirements

- 1.2.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.2.2 Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

### 1.3 References

- 1.3.1 The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- 1.3.2 All reference amendments adopted prior to the Bid Closing date of this Project shall be applicable to this Project.
- 1.3.3 All materials, installation and workmanship shall comply with all applicable requirements and standards.

### 1.4 Coordinate With Others

- 1.4.1 Provide the Consultant with 48 hours prior notice before starting Hot Mix Asphalt Concrete Pavement.

### 1.5 Submittals

- 1.5.1 Provide the Consultant asphalt mix designs prior for approval prior to the starting of Hot Mixed Concrete Asphalt Pavement.

## 2. PRODUCTS

### 2.1 Hot Mix Asphalt

- 2.1.1 HL-3 Surface Course and HL-8 Base Course as per OPSS.MUNI 1150.
- 2.1.2 Heavy duty asphalt cement to be PG 58-28 grade and light duty asphalt cement to be PG 58-28 grade, conforming to CAN/CGSB-16.3-M90.

- 2.1.3 The Region of Peel uses performance graded asphalt cement (PGAC) as an asphalt binder.
- 2.1.4 Aggregate shall conform to OPSS.MUNI 1003 for all mixes.
- 2.1.5 Hot Mix Asphalt Concrete mix design shall be the responsibility of the Contractor and shall conform to OPSS.MUNI 1150. Contractor to submit to the Consultant, for review, the mix designs a minimum 10 days prior to commencing with paving operations.

## 2.2 Tack Coat

- 2.2.1 Tack coat to comply with OPSS.MUNI 310.

## 2.3 Joint Sealer

- 2.3.1 Joint sealer shall be rubberized asphalt conforming to ASTM D3405.

## 1.1 Equipment

- 2.3.2 Equipment to comply with OPSS.MUNI 301.
- 2.3.3 Pavers: mechanical, self-powered, pavers capable of spreading mix within specified tolerances, true to line, grade and crown indicated.
- 2.3.4 Rollers: sufficient number of rollers of type and weight to obtain specified density of compacted mix.
- 2.3.5 Equipment employed shall not cause overloading of structures. Temporary support shall be provided where necessary for the proper execution of the work.

## 2.4 PAVEMENT MARKINGS

- 2.4.1 Parking stall lines and hatching:
  - .1 Yellow
  - .2 Low VOC Acrylic Traffic Marking Paint, SetFast or approved equivalent
- 2.4.2 Accessibility parking:
  - .1 International Symbol of Access with blue background
  - .2 Preformed thermoplastic
- 2.4.3 Roadway markings:
  - .1 Including stop bars centreline, and crosswalks within the parking lot
  - .2 Thermoplastic

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**3 . EXECUTION****3.1 General**

- 3.1.1 Pavement structure thickness shall be as directed in the Contract Drawings.
- 3.1.2 Step joints shall be used where proposed asphalt meets existing concrete asphalt as detailed on Contract Drawings.
- 3.1.3 Produce and supply Hot Mixed, Hot Laid Asphaltic Concrete in accordance with OPSS.MUNI 1150.
- 3.1.4 Place and compact Hot Mixed, Hot Laid Asphaltic Concrete in accordance with OPSS.MUNI 310, OPSS.MUNI 1101 and OPSS.MUNI 1151 and should be compacted to a minimum of 91% of the Maximum Relative Density (MDR) for SP 19.0 and 92% MDR for all other mixes.

**3.2 Protection**

- 3.2.1 Keep vehicular traffic off newly paved areas until paving surface temperature has cooled below 60°C. Do not permit stationary loads on pavement until 48 hours after placement.
- 3.2.2 All newly installed joints shall be protected from construction traffic until the joint material has cured.
- 3.2.3 Provide access to buildings as required. Arrange paving schedule so as not to interfere with normal use of premises.

**3.3 Quality Assurance**

- 3.3.1 Quality Assurance to be carried out in accordance with OPSS.MUNI 310.
- 3.3.2 Inspection and testing of asphalt pavement will be carried out on behalf of the Owner by designated Testing Laboratory.
- 3.3.3 The Contractor is required to cooperate with, and to provide access and samples to the Testing Laboratory. The Contractor shall give 48 hours advance notice for inspection and/or testing services.
- 3.3.4 Asphalt concrete will be tested in accordance with the Laboratory Procedures of the MTO. The following shall be tested:
- 3.3.5 In-situ compaction – with a nuclear density gauge.
- 3.3.6 Asphalt cement content – one sample from each mix and each day of production.
- 3.3.7 Gradation - one sample from each mix and each day of production.
- 3.3.8 In addition to the above, for the PG 58-28 (heavy and light duty) asphalt concrete mix, the recovered asphalt cement shall be performance graded. The performance grade of the asphalt cement is to be confirmed in writing by the testing laboratory.

3.3.9 Any work not accepted by the Consultant shall be immediately corrected by the Contractor to the Consultant's satisfaction. Contractor is responsible to reimburse the additional testing and inspection required due to non-conformance by the Contractor.

**3.4 Quality Control**

3.4.1 Quality Control to be carried out in accordance to OPSS.MUNI 310.

**3.5 Cleaning**

3.5.1 Upon completion of work, wash and sweep paving clean.

3.5.2 Remove debris and leave work site clean as to the satisfaction of the Contract Administrator.

**END OF SECTION**

**1. GENERAL****1.1 Summary**

- 1.1.1 Provide labour, materials, products, equipment and services to complete the supply, placement and compaction of Concrete Pavement to lines, grades and sections indicated in the Contract Documents and prepare existing surfaces for concrete placement.

**1.2 Related Requirements**

- 1.2.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.2.2 Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

**1.3 References**

- 1.3.1 The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- 1.3.2 All reference amendments adopted prior to the Bid Closing date of this Project shall be applicable to this Project.
- 1.3.3 All materials, installation and workmanship shall comply with all applicable requirements and standards.

**1.4 Coordinate With Others**

- 1.4.1 Provide the Consultant with 48 hours prior notice before starting Concrete Pavement.

**1.5 Submittals**

- 1.5.1 The requirements for submissions and designs shall comply with the requirements stipulated in the referenced Specifications except as modified herein.
- 1.5.2 Provide the Consultant concrete mix designs prior for approval prior to the starting of Concrete Pavement.
- 1.5.3 Two (2) weeks prior to the start of the work, a complete mix design submission shall be provided for concrete of each specified compressive strength according to CSA A23.1. A separate mix design submission is also required within each strength level for:
- .1 Mixes where material proportions vary outside the tolerance identified below in this clause.

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- .2 Cast-in-place and slip-formed concrete.
  - .3 Mixes with different sources of materials.
  - .4 Mixes with different admixtures.
  - .5 Special purpose or unique mixes.
- 1.5.4 Submission of separate mix designs and separate supporting documentation is not required if concrete with the same mix design is to be supplied by multiple plants with the same sources of materials in the same proportions, however it must be supported in writing prior to use.
- 1.5.5 A new, complete mix design submission shall be provided prior to:
- .1 Changing sources of materials used in the concrete.
  - .2 Substituting a material or product for another from the same source.
  - .3 Adding a material to the concrete that was not on the original mix design (except retarder).
- 1.5.6 Adjusting the quantities of the stated materials in the concrete, outside of the following tolerances stated on Form B:
- .1 Cement: +/- 5% of quantity
  - .2 Supplementary cementing materials: 95% to 100% of quantity
  - .3 Admixtures: Dosage or range of dosage
  - .4 Water: Range
- 1.5.7 Material quantities may be varied within the tolerances identified above, without submission of a new mix design.
- 1.5.8 Removal of a material from the mix requires submission of a new mix design but does not require submission of supporting test data.
- 1.5.9 The submission process for new or modified mix designs is the same as for the original mix design.
- 1.5.10 Prior to starting the work, the Contractor shall supply the Contract Administrator with material safety data sheets (MSDS) for all the materials to be incorporated in the work.
- 1.5.11 The certificate of ready-mix facilities and/or the certificate of mobile mix concrete production facilities along with concrete mix details shall be submitted as required by OPSS 1350.
- 1.5.12 Details of the method of curing and curing materials (including manufacturers' literature, where applicable) shall be submitted to the Contract Administrator.
- 1.5.13 One copy of the concrete delivery ticket shall be submitted to the Contract Administrator for each load of concrete delivered.
- 1.5.14 The Contractor shall submit a Detailed Work Plan to the Contract Administrator a minimum of two (2) weeks or as per the Contract

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Documents, prior to commencement of the work. The Detailed Work Plan shall include the following:

- .1 Health and Safety Plan including the company safety manual and emergency procedures.
  - .2 The Working Area layout.
  - .3 Materials, procedures, methods and schedule to be used to execute the paving work including, but not limited to, details on pavement cross-section, paving details, and pavement markings.
  - .4 Certification from the manufacturer that the supplied product meets the product specifications and is designed to withstand all conditions specific to the site where the materials will be installed and is suitable for the specified application.
  - .5 Product literature consisting of general product brochure, mixing instructions, and installation instructions for all materials in accordance with the Contract Documents.
- 1.5.15 Any concrete mix design and/or Work Plan shall be stamped by a Licensed Professional Engineer with Professional Engineering Experience in concrete design and authorized to perform such work by Professional Engineers Ontario (PEO).

## **2 . PRODUCTS**

### **2.1 General**

- 2.1.1 The materials for and the production of concrete paving shall comply with the requirements stipulated in the referenced Specifications except as modified herein.
- 2.1.2 The concrete pavement structure for this site shall be Plain Jointed Concrete Pavement (JPCP) with dowels as per OPSD 552.010 and OPSD 552.051. The dowels shall be as follows:
  - .1 For contraction/expansion/construction joints the dowels shall be 32 mm diameter glass-fiber reinforced polymer (GFRP), 450 mm long spaced at 300 mm.
  - .2 For longitudinal joint 15 mm diameter epoxy coated tie bar, 760 mm long at 600 mm shall be used.

### **2.2 Joint Filler**

- 2.2.1 Expansion joint filler material shall be bituminous fiberboard and in accordance with ASTM D1751.

### **2.3 Joint Sealant**

- 2.3.1 All joints shall be sealed with hot-poured rubberized asphalt cement.



- 2.3.2 Joints shall be allowed sufficient time to thoroughly dry before the application of the joint sealer

**2.4 Concrete Sealer**

- 2.4.1 Concrete sealer shall conform to NCHRP 244.

**1.2 Pavement Markings**

- 2.4.2 Parking stall lines and hatching shall be in accordance with OPSS.MUNI 710.

**3 . EXECUTION**

**3.1 General**

- 3.1.1 Construction shall comply with the requirements stipulated in the referenced Specifications, CSA 23.1-3 and CSA S413, except as modified herein.
- 3.1.2 Pavement structure thickness shall be as directed in the Contract Drawings.
- 3.1.3 Concrete shall be placed and consolidated according to CSA A23.1. The concrete delivering and spreading operations shall be coordinated as to provide a uniform rate of progress of the paving equipment.
- 3.1.4 The concrete shall be placed to the specified thickness, line and grade. The concrete shall be consolidated by 50 mm vibrators and other suitable tools to eliminate voids, honeycombing and entrapped air, especially against the formwork.
- 3.1.5 The transition between concrete pavement and hot mix asphalt pavement shall be completed in accordance with OPSD 555.010.

**3.2 Protection**

- 3.2.1 Keep vehicular traffic off newly paved areas until paving surface has fully cured. Do not permit stationary loads on pavement until fully cured.
- 3.2.2 Covers shall be used to provide protection to concrete during inclement weather.
- 3.2.3 Concrete road base protection as per OPSS.MUNI 1350.
- 3.2.4 All newly installed joints shall be protected from construction traffic until the joint material has cured.
- 3.2.5 Provide access to buildings as required. Arrange paving schedule so as not to interfere with normal use of premises.

**3.3 Quality Control**

- 3.3.1 Quality Control shall comply with the requirements stipulated in the referenced Specifications, CSA A23.2 and OPSS.MUNI 1350, except as modified herein.
- 3.3.2 Any work not accepted by the Consultant shall be immediately corrected by the Contractor to the Consultant's satisfaction. Contractor is responsible to reimburse the additional testing and inspection required due to non-conformance by the Contractor.
- 3.3.3 Any unacceptable testing, sampling, and/or results shall be re-done by the Contractor at no extra cost to the Region of Peel.

**3.4 Cleaning**

- 3.4.1 Upon completion of work, wash and sweep paving clean.
- 3.4.2 The Contractor shall remove any and all debris and leave the work site clean as to the satisfaction of the Contract Administrator.

**END OF SECTION**

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**1. GENERAL**

**1.1 Scope**

- 1.1.1 Provide all articles, labour, materials, equipment, transportation and incidentals noted, specified or required to complete the work of this Section.

**1.2 Work Included**

- 1.2.1 Precast Concrete Unit Paving at grade.  
1.2.2 Jointing Mortar  
1.2.3 Stabilized Setting Bed  
1.2.4 Base Aggregate

**1.3 Related Sections**

- 1.3.1 Section 32 13 13 – Concrete Paving  
1.3.2 Section 32 37 00 – Site Furnishings

**1.4 References**

- 1.4.1 CAN/CSA A231.2-95 (R2000): Precast Concrete Pavers.  
1.4.2 CAN/CSA A23.2A: Sieve Analysis of Fine and Coarse Aggregates.  
1.4.3 Interlocking Concrete Pavement Institute: ICPI Tech. Spec. No. 9.

**1.5 Submittals**

1.5.1 Precast Concrete Pavers

- .1 The Consultant will be provided with a representative full-size sample of each paver type, thickness, color, finish that indicate the range of color variation and texture expected in the finished installation. Accepted samples become the standard of acceptance for the work.

1.5.2 The Vendor will provide:

- .1 Manufacturer's certification of concrete pavers as having met applicable CSA standards or ICPI product certification.  
.2 Manufacturer's Environmental Product Declaration for Concrete Paver materials.  
.3 Manufacturer's catalogue containing product data, installation instructions, and material safety data sheets for the safe handling of the specified materials and products.  
.4 Manufacturer's product data sheets and installation guides for joint mortar and stabilized setting bed materials.  
.5 Sieve analysis tests for all granular materials.  
.6 Compaction test results for all sub grades, granular bases and sub bases.

- 1.5.3 Paving Installation Vendor:
- 1.5.4 Provide references for a minimum of three project similar in size and complexity, including contact information for the Owner, Client, or General Vendor.

**1.6 Delivery, Storage and Handling of Product**

- 1.6.1 The Vendor shall comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- 1.6.2 Deliveries and paving schedule will be coordinated to minimize interference with normal use of buildings adjacent to paving.
- 1.6.3 Concrete pavers will be delivered to the site in steel-banded, plastic-banded or plastic-wrapped packaging capable of transfer by forklift or clamp lift.
- 1.6.4 Pavers will be unloaded at job site in such a manner that no damage occurs to the product. Materials should be protected such that they are kept free from mud, dirt, and other foreign materials.
- 1.6.5 Bedding and joint materials should be securely covered with waterproof covering if required to prevent exposure to rainfall or removal by wind.

**2 . PRODUCTS**

**2.1 Permeable Granular Base**

- 2.1.1 The granular sub base material shall consist of granular materials conforming to ASTM C 33 and gradation requirements of ASTM D 448 No. 57 in Table 1

Table 1  
Permeable Base Aggregate  
Gradation Requirements

ASTM No. 57	
Sieve Size	Percent Passing
1-1/2 in (37.5 mm)	100
1 in (25 mm)	95 to 100
1/2 in (12.5 mm)	25 to 60
No. 4 (4.75 mm)	0 to 10
No. 8 (2.36 mm)	0 to 5

**2.2 Stabilized Setting Bed**

- 2.2.1 Basis of Design:
  - .1 Rompox Trass Bed Compound and Adhesion Elutriant
  - .2 Available from: Romex North America, 214 - 3993 Henning Drive Burnaby V5C 6P7. Contact David Maxwell, (905) 334-2677.

- 2.2.2 Provide washed, clean, angular aggregates conforming to ASTM C 33 with gradation requirements of 4-8mm.
- 2.2.3 The Vendor will provide bedding and joint mortar that is clean, non-plastic, and free from deleterious or foreign matter, symmetrically shaped, natural or manufactured from crushed rock.
- 2.2.4 Limestone screenings, or stone dust shall not be used for the bedding layer. Mason sand, or sand conforming to CSA A179 shall not be used for the bedding layer.

## **2.3    Pavers**

### **2.3.1    Field Paver**

- .1    Basis of Design:
  - .1    Product: Promenade Ecoterra
  - .2    Size: 100mm x 300mm x 70mm
  - .3    Colour: Light Steel Grey Blend
  - .4    Pattern: Running Bond
  - .5    Available from: Unilock, 287 Armstrong Ave. Georgetown, ON L7G 4X6, 416-646-9000

### **2.3.2    Tactile Warning Paver**

- .1    Basis of Design:
  - .1    Product: Truncated Dome Paver
  - .2    Size: 305mm x 305mm x 70mm
  - .3    Colour: A-90
  - .4    Available from: Inspired By Architecture, Kingston, ON K7M 6N7. Attention: Chris Duncan, (613) 329-7911

### **2.3.3    Tactile Wayfinding Paver**

- .1    Basis of Design:
  - .1    Product: DB-1 Directional Bar
  - .2    Size: 305mm x 305mm x 70mm
  - .3    Colour: A-90
  - .4    Available from: Inspired By Architecture, Kingston, ON K7M 6N7. Attention: Chris Duncan, (613) 329-7911

### **2.3.4    Turfstone**

- .1    Basis of Design
  - .1    Product: Turfstone
  - .2    Size: 400mm x 600mm x 80mm
  - .3    Colour: Natural
  - .4    Available from: Unilock, 287 Armstrong Ave. Georgetown, ON L7G 4X6, 416-646-9000

- 2.3.5 Provide pavers meeting the minimum material and physical properties set forth in ASTM C 936, Standard Specification for Interlocking Concrete Paving Units.
- 2.3.6 Obtain written approval for substitutions if product is not available at the time of installation.

## **2.4 Edge Restraints**

- 2.4.1 Edge restraints shall be non-fastening Perma Loc Geo Edge, natural mill finish, extruded aluminum alloy and shall be installed where interlocking paving areas abut infiltration galleries and planting areas, as manufactured by Perma Loc Corporation, 13505 Barry Street, Holland MI 49424; tel: 800-365-9660; email: info@permaloc.com. Install as per manufacturers' recommendations (or approved equivalent).

## **3 . EXECUTION**

### **3.1 Installation**

- 3.1.1 Precast Unit pavers
  - .1 Interlocking paving stones will be installed by qualified vendors, including, but not limited to:
  - .2 Vendors with a current certificate from the Interlocking Concrete Pavement Institute Concrete Paver Installer Certification program.
  - .3 Vendors able to provide job references from projects of a similar size and complexity.
- 3.1.2 Pavers and bedding should not be installed under the following conditions:
  - .1 During heavy rain or snowfall.
  - .2 Over frozen base materials.
  - .3 Over frozen sand or saturated sand
- 3.1.3 The Vendor shall verify that sub grade and base preparation, compacted density installation and elevations conform to specified requirements:
  - .1 Compaction of the sub grade to a minimum of 95% Modified Proctor Density per ASTM D 1557.
  - .2 Compaction of the granular sub base and base to a minimum of 98% Modified Proctor Density per ASTM D 1557.
- 3.1.4 Mechanical tampers are recommended for compaction of soil sub grade and aggregate base in areas not accessible to large compaction equipment. Such areas can include those around lamp standards, utility structures, building edges, curbs, tree wells and other protrusions.
- 3.1.5 The Vendor shall verify that geotextiles, if applicable, have been placed according to drawings and specifications.
- 3.1.6 Prior to screeding the bedding layer, the recommended base surface tolerance should be  $\pm 3/8$  in. (10 mm) over a 10 ft. (3 m) straight edge.

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See ICPI Tech Spec 2, Construction of Interlocking Concrete Pavements for further guidance on construction practices.

- 3.1.7 Spread bedding evenly over the base course and screed to a nominal 1 in. (25 mm) thickness, not exceeding 1 1/2 in. (40 mm) thickness. Spread bedding evenly over the base course and screed rails, using the rails and/or edge restraints to produce a nominal 1 in. (25 mm) thickness, allowing for specified variation in the base surface.
  - .1 Do not disturb screeded leveling base.
  - .2 Screeded area shall not substantially exceed that which is covered by pavers in one day.
  - .3 Do not use bedding sand or mortar to fill depressions in the base surface.
- 3.1.8 The elevations and surface tolerance of the base determine the final surface elevations of concrete pavers. The paver installation vendor shall not correct deficiencies in the base surface with additional bedding sand, mortar, or by other means. Therefore, the surface elevations of the base should be checked and accepted by the Vendor or designated party, with written certification to the paving subcontractor, prior to placing bedding and concrete pavers.
- 3.1.9 Lay pavers in pattern(s) shown on drawings. Place units hand tight without using hammers. Make horizontal adjustments to placement of laid pavers with rubber hammers as required. Provide joints between pavers between 1/16 in. and 3/16 in. (2 and 5 mm) wide. No more than 5% of the joints shall exceed 1/4 in. (6 mm) wide to achieve straight bond lines.
- 3.1.10 Joint (bond) lines shall not deviate more than  $\pm \frac{1}{2}$  in. (15 mm) over 50 ft. (15 m) from string lines.
- 3.1.11 Fill gaps at the edges of the paved area with cut pavers or edge units. Cut pavers with a wet or dry masonry saw. For vehicular applications, cut pavers should not be less than 1/3 of the original size of the paver. For pedestrian areas and driveways, the cut pieces should be no less than 10 mm wide.
- 3.1.12 All work within 6 ft. (2 m) of the laying face shall be left fully compacted with mortar filled joints at the end of each day or compacted upon acceptance of the work. Cover the laying face or any incomplete areas with plastic sheets overnight if not closed with cut and compacted pavers with joint mortar to prevent exposed bedding from becoming saturated from rainfall.
- 3.1.13 Remove excess joint mortar from surface when installation is complete, except when excess joint mortar should be allowed to remain on surface to protect pavers from damage from other trades. The Vendor will be responsible for removing excess material at the completion of construction or as directed by the Consultant.
- 3.1.14 Surfaces shall be broom clean after removal of excess joint mortar.

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3.1.15 Edge restraints should be installed as per the drawings and manufacturer's recommendations, at the indicated elevations.

**3.2 Field Quality Control**

3.2.1 Surface tolerances on flat slopes should be measured with a rigid straightedge. Tolerances on complex contoured slopes should be measured with a flexible straightedge capable of conforming to the complex curves on the pavement surface.

3.2.2 The final surface tolerance from grade elevations shall not deviate more than  $\pm 3/8$  in. (10 mm) under a 10 ft (3 m) straightedge.

3.2.3 Check final surface elevations for conformance to drawings. For installations on a compacted aggregate base and soil sub grade, the top surface of the pavers shall be from 0 to 5 mm above adjacent hard surfaces, after compaction.

3.2.4 The surface elevation of pavers shall be 3 to 6 mm above adjacent drainage inlets, concrete collars or channels.

3.2.5 Lippage: There shall be no more than 3 mm difference in height between adjacent pavers.

**3.3 Cleaning, Sealing, and Joint Mortar Stabilization**

3.3.1 Precast Unit Pavers only

.1 If specified, special cleaners, sealers or joint stabilization materials shall be applied in accordance with manufacturer's recommendations.

**END OF SECTION**



**1. GENERAL****1.1 Summary**

- 1.1.1 Provide labour, materials, products, equipment and services to complete the installation of granular sub-base, base and concrete sidewalks, islands, curb and gutters as shown on the drawings.
- 1.1.2 For flush concrete curbs within the Landscape areas; see respective Landscape specifications.

**1.2 Related Requirements**

- 1.2.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.2.2 Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

**1.3 References**

- 1.3.1 The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- 1.3.2 All reference amendments adopted prior to the Bid Closing date of this Project shall be applicable to this Project.
- 1.3.3 All materials, installation and workmanship shall comply with all applicable requirements and standards.

**1.4 Submittals**

- 1.4.1 Provide the Consultant concrete mix designs for approval prior to the placement of concrete on site.

**2. PRODUCTS****2.1 Materials**

- 2.1.1 Concrete sidewalks and pavements shall be in accordance with OPSS.MUNI 351 and City of Brampton Drawing 227
- 2.1.2 Concrete curb and gutter shall be in accordance with OPSS.MUNI 353.
- 2.1.3 Joint filler shall be in accordance with:
- 2.1.4 OPSS.MUNI 1308: Joint Filler in Concrete
- 2.1.5 OPSS 1212: Hot-Poured Rubberized Asphalt Joint Sealing Compound

**3 . EXECUTION****3.1 Base Inspection**

- 3.1.1 Obtain Geotechnical testing and inspection agency approval of granular base prior to placing concrete.

**3.2 Granular base**

- 3.2.1 Compact granular base under concrete sidewalk, curbs, and islands to 100% SPMDD.

**3.3 Concrete Pavements, islands, Curbs and Gutters**

- 3.3.1 Concrete sidewalk shall be 150 mm in depth as per City of Brampton Drawing 227 except where crossing laneways, roads and commercial/industrial/institutional driveways where sidewalks shall be 180 mm in depth.
- 3.3.2 All barrier curb within the site shall be constructed as per OPSD 600.110. Height of curb to be 150mm.
- 3.3.3 All curb cuts shall be in accordance with OPSD 600.110.
- 3.3.4 Obtain Geotechnical testing and inspection agency approval of granular base and reinforcing steel prior to placing concrete.
- 3.3.5 Immediately after floating, give sidewalk surface uniform broom finish to produce regular corrugations not exceeding 2 mm deep, by drawing broom in direction normal to centre line.
- 3.3.6 Provide edging as indicated with 10 mm radius edging tool.
- 3.3.7 Concrete islands:
- .1 Minimum width of 1.5 m in accordance with OPSD 504.010.
  - .2 Concrete surfaced islands shall have contraction joints to match adjacent curb joints.
  - .3 Concrete islands to have minimum of 150 mm upstand.

**3.4 Concrete tolerances:**

- 3.4.1 Concrete sidewalk tolerances for subgrade, base, and sidewalk placement to be in accordance with OPSS.MUNI 351.
- 3.4.2 Concrete curb tolerances in accordance with OPSS.MUNI 353.

**3.5 Expansion and Contraction Joints in Concrete:**

- 3.5.1 Install tooled transverse contraction joints after floating, when concrete is stiff, but still plastic, at intervals of 1.5 m.
- 3.5.2 Install joints as required to prevent concrete from cracking:
- 3.5.3 Provide expansion joints where length of concrete placing exceeds 15 m.

3.5.4 Provide expansion joints where the sidewalk abuts a rigid object or changes direction.

3.5.5 When roadway surface and sidewalk is adjacent to curb, make joints of curb, gutters and sidewalk coincide.

**3.6 Isolation Joints in Concrete:**

3.6.1 Install isolation joints around manholes and catch basins and along length adjacent to concrete curbs, catch basins, buildings, or permanent structures.

3.6.2 Install joint filler in isolation joints.

3.6.3 Seal isolation joints with sealant.

**3.7 Concrete Curing**

3.7.1 Curing compound shall be according to OPSS 1315.

3.7.2 Concrete sidewalks shall be cured using a membrane-curing compound applied according to OPSS.MUNI 904; application rate shall be 0.2 L/m<sup>2</sup>.

3.7.3 Concrete curbs shall be cured with one or more of the following methods in accordance to OPSS.MUNI 353:

- .1 Burlap and water
- .2 Moisture vapour barrier
- .3 White pigmented curing compound

**3.8 Surface Texturing**

3.8.1 Use moistened burlap drag or stiff bristled broom to produce nonslip concrete surface finish approved by Consultant, with fine granular texture free from disfigurations.

3.8.2 For large areas provide surface texture by transverse wire comb leaving grooves in surface of plastic concrete as per American Concrete Pavement Association publications.

3.8.3 Texturing to be straight, precise and not damaging to pavement edges.

**3.9 Protection**

3.9.1 Do not open concrete pavement to traffic or construction equipment until concrete reaches a minimum compressive strength of 20 MPa and joints have been sealed.

3.9.2 When placing concrete in lanes adjacent to existing concrete, operate placing equipment on rubber wheels or pads to prevent damage to existing surface.

**3.10 Sealing**

- 3.10.1 Seal joints before allowing vehicular traffic on new pavement.
- 3.10.2 Provide Consultant with copy of sealant manufacturer's instructions for application. Have sealant manufacturer's representative on site during initial sealing operation.
- 3.10.3 Just prior to sealing joint, clean with compressed air or flush with high pressure water to remove laitance, curing compound and protrusions of hardened concrete. Clean and dry by compressed air and vacuum to remove loose and foreign material.
- 3.10.4 Do not apply joint sealant in rainy weather or when ambient temperature is less than 5 degrees C.
- 3.10.5 Insert approved filler and bond breaking material in joint prior to applying sealant, then fill joint from bottom up with sealant to avoid trapping air.
- 3.10.6 Prepare sealant for application using equipment and methods approved by Consultant
- 3.10.7 Apply sealant strictly in accordance with manufacturer's recommendations with special attention to temperature ranges for safe heating and for application of hot poured sealants and cleanliness of concrete to be bonded.
- 3.10.8 On completion of first application of sealant, return and top up any underfilled areas.
- 3.10.9 Replace sealant which fails to bond to concrete or fails to cure properly, as directed by Consultant

**3.11 Defective Concrete**

- 3.11.1 Concrete is defective when:
  - .1 It contains: honeycombing, embedded debris, uncontrolled shrinkage cracking, or other surface defects.
  - .2 It is damaged by freezing.
  - .3 It is placed at too high temperature, without hot weather precautions/protection.
  - .4 Average 28 day strength of any three consecutive strength tests is less than specified minimum 28 day strength.
  - .5 Any 28 day strength test result is more than 3.5 MPa below the specified minimum 28 day strength.

**3.12 Repair/Restoration**

- 3.12.1 Repair of defective concrete work:
  - .1 Where defective concrete is identified by Consultant during plastic condition, repair using methods approved by Consultant.

- .2 Grind off high surface variations where directed by Consultant.
- .3 Remove and replace defective concrete where directed by Consultant.
- .4 Remove minimum 3 m of pavement by sawing through concrete across full lane width.
- .5 Replace with new concrete to this specification.
- .6 Construct contraction joint at boundary between sawn face of existing concrete and new concrete.
- .7 Install new dowel bars and tie bars between old and new concrete as directed.

### **3.13 Cleaning**

- 3.13.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

**END OF SECTION**

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**1. GENERAL**

**1.1 Scope**

- 1.1.1 Provide all articles, labour, materials, equipment, transportation and incidentals noted, specified or required to complete the work of this Section.

**1.2 Work Included**

- 1.2.1 Supply and installation of benches, bollards, bicycle racks, bicycle repair station, bicycle lockers and planters.
- 1.2.2 Maintenance and Warranty.

**1.3 Related Sections**

- 1.3.1 Section 03 30 00 – Cast In Place Concrete
- 1.3.2 Section 32 14 13 – Unit Paving

**1.4 References**

- 1.4.1 ASTM Testing Standards:
- .1 ASTM B 108 – Standard Specification for Aluminum-Alloy Permanent Mold Castings.
  - .2 ASTM B 117 – Standard Practice for Operating Salt Spray (Fog) Apparatus.
  - .3 ASTM B 221 – Standard Specification for Aluminum-Alloy and Aluminum-Alloy Extruded Bars, Rod, Wire, Profiles and Tubes.
  - .4 ASTM D 522 – Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings.
  - .5 ASTM D 523 – Standard Test Method for Specular Gloss.
  - .6 ASTM D 2247 – Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
  - .7 ASTM D 2794 – Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
  - .8 ASTM D 3359 – Standard Test Methods for Measuring Adhesion by Tape Test.
  - .9 ASTM D 3363 – Standard Test Method for Film Hardness by Pencil Test.
  - .10 ASTM G 155 – Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials.
- 1.4.2 ISO Testing Standards:
- .1 ISO 1520 – Paints and Varnishes – Cupping Test.
  - .2 ISO 2815 – Paints and Varnishes – Buchholz Indentation Test.
  - .3 ANSI/BIFMA Testing Standards:

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.4 ANSI/BIFMA X5.5-2008– Standard Test for Desk / Tables.

**1.5 Submittals**

- 1.5.1 Product Data: Supply manufacturer's product data, storage and handling requirements and recommendations, installation methods and available colours, patterns and textures for approval by the Consultant.
- 1.5.2 Shop drawings: Submit manufacturer's shop drawings, including plans and elevations, indicating overall dimensions, for approval by the Consultant.
- 1.5.3 Samples: Submit manufacturer's samples of materials, finishes, colours and anchoring systems for approval by the Consultant.
- 1.5.4 Warranty: Submit Manufacturer's standard warranty.

**1.6 Quality Assurance**

- 1.6.1 Manufacturer's Qualifications: Manufacturer regularly engaged in manufacture of site furnishings for a minimum of 30 years.
- 1.6.2 Product Support: Products are supported with complete engineering drawings and design patents.
- 1.6.3 Production: Orders are filled within a 40-day schedule.
- 1.6.4 Facility Operator: Welders and machine operators are certified.

**1.7 Delivery, Storage, And Handling**

- 1.7.1 Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- 1.7.2 Storage: Store materials in clean, dry area in accordance with manufacturer's instructions. Keep materials in manufacturer's original, unopened containers and packaging until installation.
- 1.7.3 Handling: Protect materials and finish during handling and installation to prevent damage.

**1.8 Warranty**

- 1.8.1 Warranty Information:
  - .1 Products will be free from defects in material and/or workmanship for period of three (3) years from the date of invoice.
  - .2 The warranty does not apply to damage resulting from accident, alteration, misuse, tampering, negligence, or abuse.
  - .3 The Manufacturer shall, at its option, repair, replace, or refund the purchase price of any items found defective upon inspection by an authorized Manufacturer's service representative.

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## 2. PRODUCTS

### 2.1 Bicycle Equipment

#### 2.1.1 Bike Rack

- .1 Product: Flo
- .2 Metal: Stainless Steel
- .3 Quantity: 3.
- .4 Available From: Landscape Forms Inc. 431 Lawndale Ave.  
Kalamazoo, MI. 49048. Attention: Tracy Cook,  
[tracyc@landscapeforms.com](mailto:tracyc@landscapeforms.com).

#### 2.1.2 Bike Repair Station

- .1 Product: Fixit Plus
- .2 Metal: Powdercoat Steel
- .3 Colour: Iron Gray, RAL 7011
- .4 Options: 1 bike capacity with Air Kit 4
- .5 Quantity: 1
- .6 Available from: ABC Recreation. Paris, ON. (519) 442-7900.

#### 2.1.3 Bicycle Storage Locker

- .1 Product: Madlocker Narrow (MLN-1)
- .2 Metal: Powdercoat Steel
- .3 Colour: Storm Metallic
- .4 Options: Full Perforated Door
- .5 Quantity: 17
- .6 Available From: Graber Manufacturing Inc. 1080 Uniek Drive,  
Waunakee WI 53597. Attention: Kaitlyn Ellerman,  
[kellerman@madrax.com](mailto:kellerman@madrax.com).

### 2.2 Benches

#### 2.2.1 Feature Bench

- .1 Basis of Design: Plain Bench
- .2 Wood: Douglas Fir
- .3 Metal Frame: Pre-weathered Steel
- .4 Backrests & Armrests: Stainless Steel
- .5 Quantity: 8 – 4 Backless, 4 with Backrest & Armrests
- .6 Available From: Roburscape. LaSalette, ON Canada, N0E 1H0.  
Attention: John Scharringa, [jonathan@roburscape.com](mailto:jonathan@roburscape.com).

#### 2.2.2 Standard Bench

- .1 Product: MBE-0970-00023
- .2 Metal: Gunmetal Grey Powdercoat Aluminum
- .3 Wood: Thermally Modified Ash



- .4 Options: Backrest, arms at each end.
- .5 Quantity: 2
- .6 Available From: Maglin Site Furniture. 3-468 Innovation Way, Woodstock, ON N4V 0B9. Attention: Jeff Roddick, [jeff.roddick@maglin.com](mailto:jeff.roddick@maglin.com).

## 2.3 **Bollards & Poles**

### 2.3.1 Standard Bollard

- .1 Product: EP 7070
- .2 Metal: Powdercoat Aluminum
- .3 Colour: Meteor Gray, Semi-Gloss
- .4 Quantity: 18
- .5 Available From: Equiparc. 1001 James-Brodie St-Jean-sur-Richelieu, QC. J2X 0C1. Attention: Philippe Tetrault, [philippe.tetrault@equiparc.com](mailto:philippe.tetrault@equiparc.com).

### 2.3.2 Catenary Light Pole

- .1 Product: BEAM-12-6-4-C5-A0-B0-S8-CAT-BC-STD
- .2 Metal: Powdercoat Steel
- .3 Colour: Slate
- .4 Wood: Weathered Grey Accoya
- .5 Quantity: 2
- .6 Available From: Structura, represented by Salex. 435 Finchdene Square, Scarborough ON M1X 1B7.

## 2.4 **Amenity Furnishings**

### 2.4.1 Barbeque

- .1 Product: Weber Summit S-670 6-Burner Propane Gas Grill
- .2 Metal: Stainless Steel
- .3 Quantity: 1

### 2.4.2 Dining Table

- .1 Product: Nardi Tevere 210 Extendable Table
- .2 Colour: Antracite
- .3 Quantity: 1
- .4 Available From: Bum Commercial Furniture. 1-3270 South Service Road West Oakville, ON L6L 0B1.

### 2.4.3 Side Chairs

- .1 Product: Nardi Bit Side Chairs
- .2 Colour: Corallo
- .3 Quantity: 8
- .4 Available From: Bum Commercial Furniture. 1-3270 South Service Road West Oakville, ON L6L 0B1.

2.4.4 Lounge Chairs

- .1 Product: Nardi Doga Relax
- .2 Colour: Menta
- .3 Quantity: 2
- .4 Available From: Bum Commercial Furniture. 1-3270 South Service Road West Oakville, ON L6L 0B1.

2.4.5 Side Table - Nardi Step, 40cm Height.

- .1 Colour: Antracite
- .2 Quantity: 1
- .3 Available From: Bum Commercial Furniture. 1-3270 South Service Road West Oakville, ON L6L 0B1.

**3 .     EXECUTION**

**3.1     Installation**

- 3.1.1 Notify Consultant of source of material at least 7 days in advance of commencement of work to approve materials and layout of site furnishings. No work is to proceed without Consultant's approval.
- 3.1.2 Install furnishings square and plumb as shown on the drawing. All locations to be staked out and approved by the Consultant prior to installation.
- 3.1.3 Use stainless steel vandal proof hardware.
- 3.1.4 Surface Mounted Furnishings
  - .1 Surface Mount onto paving as specified by manufacturer.
- 3.1.5 Embedded Furnishings
  - .1 Installation on Unit Paving: Place threaded rods in stabilized subbase during installation of unit paving. Embed threaded rods 40mm into stabilized subbase by hand. Scribe unit paver the diameter of the threaded rod, plus 6mm. Backfill joint around threaded rod with approved mortar. Refer to Section 32 14 13 – Unit Paving.
  - .1 Do not damage radiant heat piping.
  - .2 Concrete Mounting: Embed as per manufacturer's recommendations.

**END OF SECTION**

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## 1. **GENERAL**

### 1.1 **Related Sections**

- 1.1.1 Section 32 92 20 – Seeding
- 1.1.2 Section 32 92 23 – Sodding
- 1.1.3 Section 32 93 10 - Planting

### 1.2 **References**

- 1.2.1 Ontario Provincial Standard Specification OPSS 802 November 2010.

### 1.3 **Testing**

- 1.3.1 All testing shall only be performed by an OMAFRA accredited commercial lab. Vendor to pay all costs of testing.
- 1.3.2 Test all stockpiled and imported topsoil for N, P, K, Mg, soluble salt content, organic matter and PH value in place and other requirements as noted on the drawings.
  - .1 Perform pH test to determine required lime treatments to bring pH value of soil within 6.0 to 7.5 levels.
- 1.3.3 Submit electronic copy of soil analysis and recommendations for review by the Consultant. Failure to test and provide appropriate documentation of test results may be considered grounds for rejection of a proposed growing medium and removal of such material at the Vendor's expense.
- 1.3.4 If required, adjust fertilizer requirements and other additives to conform to soil testing report recommendations.
- 1.3.5 The Vendor shall guarantee that the soil submitted for the laboratory testing is a representative sample taken (according to the lab recommendations) from the material that will be delivered to the site.

### 1.4 **Stockpiling**

- 1.4.1 Topsoil shall be removed if required, stockpiled and managed according to Contract Documents. Stockpiles shall be constructed neatly with uniform surfaces. When required, the top surface shall be dished.

## 2. **PRODUCTS**

### 2.1 **Materials**

#### 2.1.1 Topsoil

- .1 Topsoil from all sources shall be fertile, friable, topsoil, free of: fragments larger than 75 mm in size; stones over 30 mm in diameter; debris; plants or their roots; sticks; noxious weed plants, stolons, seeds; salts; soil sterilants; chemical contaminants; toxic elements; or other materials detrimental to plant growth.

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- .2 All Topsoil shall have the following characteristics:
    - .1 Textural class of sandy loam based on the Canadian System of Soil Classification, to consist of 40-60% sand, 20-40% silt, and 6-10% clay; pH range of 6.0 – 7.5;
    - .2 Not less than 4% Organic Matter;
    - .3 Salt conductivity, salt less than 2.0 ms/cm (millisiemens/cm) Total Salts.
    - .3 Topsoil not meeting the minimum specification must be amended and retested. Fertilizer and mineral amendments must be made as per soil testing agency recommendations.
    - .4 Topsoil shall not be moved, delivered or worked on while in a frozen, wet, or muddy state or condition.
  - 2.1.2 Growing Medium – Planting Mixes for all planting beds and tree planting
    - .1 Planting Mix: shall be thoroughly combined prior to placement in planting bed areas and tree pits to the following proportions: 4 parts approved topsoil and 1 part organic amendment (compost, manure, peatmoss, etc).
    - .2 Amendments shall have the following characteristics: pH range of 5.5 – 8.0; a minimum of 60% Organic Matter; salt conductivity, salt less than 2.0 ms/cm (millisiemens/cm) Total Salts; maximum moisture content of 35%.
    - .3 Compost and manure shall meet the standards found in the Interim Guidelines for the Production and Use of Aerobic Compost in Ontario published by the Ontario Ministry of Environment and Energy (MOEE), and shall be virtually free from all viable weed seeds, or other plant reproductive parts, pathogens, chemicals or toxic contaminants. Physical contaminants such as rock, plastic, metal or glass shall be less than 0.5%. Total carbon to nitrogen ratio in the resulting growing medium shall not exceed 30:1.
    - .4 Mixes containing a significant amount of peat moss shall not be permitted to dry out. The moisture content of the peat moss at the time of mixing shall be not less than 60% to 75%.
  - 2.1.3 Soil Amendments
    - .1 All Soil Amendments to be applied as per soil test recommendations and Consultant's approval. All Soil Amendments shall be free from clay subsoil, sawdust, commercial wood products, stones, lumps, plants, sticks, weed stolons and seeds, chemical contaminants and other materials harmful to plant life.
    - .2 Organic Components
      - .1 Sphagnum Peat Moss shall be a horticultural grade. Peat Moss suitable for horticultural purposes should be medium to coarse shredded with a texture varying from porous to spongy fibrous and substantially homogeneous with a PH value between 3.4 and 5.5.
      - .2 Commercially prepared compost shall be virtually free from all viable weed seeds. Or other plant reproductive parts, pathogens,
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chemicals or toxic contaminants. Physical contaminants such as rock, plastic, metal or glass shall be less than 0.5%. Total carbon to nitrogen ratio in the growing medium no to exceed 30:1.

- .3 Mushroom compost and/or animal manure and compost are to be pasteurized and leached with fresh water prior to installation (electrical conductivity not to exceed 2.0 mmhos/cm).
- .4 Bonemeal: raw bonemeal, finely ground with a minimum analysis of 4% nitrogen and 20% phosphoric acid.
- .3 Fertilizers
  - .1 All Fertilizers shall be a standard commercial brand, having a guaranteed N-P-K analysis meeting the requirements of the Canada Fertilizer Act and the CFQAP.
  - .2 All Fertilizers shall be granular, pelletized or pill form, and shall be dry and free flowing, unless specified.
  - .3 Fertilizer shall be packed in standard waterproof containers, clearly marked with the name of the manufacturer, weight and analysis.
  - .4 The types, formulations, and rates of application for fertilizers shall be as recommended by the laboratory soil specialist, based on the test results of the growing medium, and as approved by the Consultant.
  - .5 Substitution or variations in fertilizers and methods shall be made only upon pre-approval by the Consultant.
- .4 Lime:
  - .1 Limestone containing not less than 8% of calcium and magnesium carbonates combined, finely ground to pass a 10 mesh sieve with at least one half passing a 100 mesh sieve. Rate of application shall be determined after determining the pH of the topsoil.
- .5 Sand:
  - .1 Sharp, clean sand to OPSS 1002-3.
- .6 Geotextile
  - .1 Woven, polyester reinforcement geotextile: LINQ 300 or approved equal.
  - .7 Granular
    - .1 The drainage material shall be a free draining clear granular material of uniform particle size of 20 mm separated from the retained soil by a geotextile filter.

### **3 . EXECUTION**

#### **3.1 Topsoil and Fine Grading**

- 3.1.1 Submit topsoil testing analysis and recommendations to Consultant prior to hauling to and spreading topsoil on the work site. Failure to obtain

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- topsoil samples and testing and submitting soil analysis report will delay commencement of work until reports are submitted and reviewed by the Owner. Provide proof that specified topsoil amendments were carried out.
- 3.1.2 Obtain approval by the Consultant of prepared subgrades prior to hauling, placing and spreading of topsoil.
- 3.1.3 Topsoil obtained from designated stockpiles shall be amended by mechanical shredder; other methods of blending shall be reviewed and approved only by the Consultant.
- 3.1.4 Spread topsoil to the following minimum depths:
- .1 200 mm for all areas to be sodded;
  - .2 200 mm for areas to be seeded;
  - .3 Depth indicated is compacted depth.
- 3.1.5 Spread growing medium to the following minimum depths:
- .1 600 mm for all planting beds;
  - .2 Tree pits per drawings;
  - .3 Depth indicated is compacted depth.
- 3.1.6 Spread topsoil on prepared subgrade of the work site.
- 3.1.7 Fine grade topsoil to produce a smooth even surface, free debris, sod, stones and roots over 25mm in diameter.
- 3.1.8 Compact to 85% Standard Proctor Density.
- 3.1.9 Meet and match all existing sodded areas, curbs, sidewalks, manholes and catch basin frames, asphalt and other surface areas in a smooth, uniform line to the satisfaction of the Consultant.
- 3.1.10 Install growing medium for tree pits and planting beds as specified in Section 32 93 10 - Planting.
- 3.1.11 Maintain all soils so that they are erosion-free and put in place necessary protection measures as required. Correct all erosion as required prior to proceeding with work.

**END OF SECTION**

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**1. GENERAL**

**1.1 Related Sections**

- 1.1.1 Section 32 91 19 - Topsoil and Fine Grading

**1.2 Submittals**

- 1.2.1 The Consultant will be provided with a representative seed mix of the plant species and percentages, and seeding rates. Accepted seed mixes become the standard of acceptance for the work.

**1.3 Scheduling**

- 1.3.1 March 1 through June 29: Seeding during this period is appropriate but germination of a portion of the seed may not occur until the following season due to lack of cold stratification to break seed dormancy. Cover crop generally germinates within 2 to 3 weeks of seeding operation.
- 1.3.2 June 20 through August 30: Installation of native seed should be suspended unless supplemental watering can be provided, or unseasonably cool conditions persist.
- 1.3.3 October 1 through November 30: Seed on bare, graded surfaces must be protected with specified erosion control blankets on slopes. Seed drilled into existing vegetation or on flat ground not subject to erosion may need only minimal erosion protection. Less cover crop will be observed during the following spring due to frost damage.

**1.4 Delivery And Storage**

- 1.4.1 Deliver seed mixes in original containers showing:
- .1 Analysis of seed mixture.
  - .2 Percentage of pure seed.
  - .3 Year of production.
  - .4 Net weight.
  - .5 Date when tagged and location.

**1.5 Acceptance**

- 1.5.1 Seeded areas will be accepted by the Consultant at the end of the maintenance period provided that:
- .1 Seeded areas are properly established.
  - .2 Seeded areas are free of bare and dead spots and weed growth per the Performance Standards of this Section.
  - .3 Plants are healthy, dense, well-rooted, of good colour and in a vigorous growing condition.

- 1.5.2 Areas seeded in the fall will be accepted in the following spring, one month after the start of the growing season provided that the conditions of section 1.2.1 are fulfilled.

### **1.6 Performance Standards**

- 1.6.1 At least 90% of the seeded area shall be vegetated with cover crop species from the seed mix by July 30 following a spring seeding. If planting occurred in the fall or winter minimum cover crop is expected. Matting shall be reviewed in the spring to ensure that proper erosion control and seed protection is in place.
- 1.6.2 After one (1) full growing season coverage of non-cover crop species shall be at minimum 40%. There shall be no more than 0.25 square-meter of area devoid of vegetation, as measured by aerial visual review.
- 1.6.3 After two (2) full growing seasons, coverage of non-cover crop species shall be at minimum 75%. There shall be no more than 0.25 square-meter of area devoid of vegetation, as measured by aerial visual review.
- 1.6.4 At any time during the contract period no more than 10% (by aerial review) of seeded areas should be dominated by aggressive exotic species which include, but are not limited to, Reed Canary Grass (*Phalaris arundinacea*), Crab Grass (*Digitaria* spp.), Red Clover (*Trifolium* spp.), White or Yellow Sweet Clover (*Melilotus* spp.), Burdock (*Arctium minus*), Teasel (*Dipsacus sylvestris*), Canada Thistle (*Cirsium arvense*).
- 1.6.5 If these standards are not met, the Vendor shall be responsible for repair and supplemental seeding in accordance with the specifications.

## **2. PRODUCTS**

### **2.1 Materials**

#### **2.1.1 Seed**

- .1 Comply with Federal and Provincial seed laws having a minimum germination of 75% and minimum purity of 97%.
- .2 In packages individually labelled in accordance with 'Seeds Regulations' and indicating name of vendor, seed mix content, germination rate, and date bagged.
- .3 Seed to be cleaned and free from stems, chaff, fluff, bracts, leaves and weed seeds.
- .4 Species known to be invasive or potentially invasive by the Province of Ontario and Credit Valley Conservation shall not be used.

#### **2.1.2 Wet Meadow Seed Mix**

- .1 Basis of Design:
- .1 Grassland Bird Habitat Wet Meadow Seed Mix
- .2 Apply seed rate as per nursery recommendations.



- .3 Available from: St. Williams Nursery & Ecology Centre. 885 Norfolk County Highway 24 West, P.O. Box 150, St. Williams, Ontario, CA, N0E 1P0.
- 2.1.3 Dry Meadow Seed Mix
  - .1 Basis of Design:
    - .1 Dry Meadow Seed Mix
    - .2 Apply seed rate as per nursery recommendations.
    - .3 Available from: St. Williams Nursery & Ecology Centre. 885 Norfolk County Highway 24 West, P.O. Box 150, St. Williams, Ontario, CA, N0E 1P0.
- 2.1.4 Nurse Crop:
  - .1 Submit nursery recommended species suitable for each Seed Mix and planting season. Refer to Schedule for seeding windows.
- 2.1.5 Water: Potable, on site.
- 2.1.6 Hydraulic Mulch: Type A, as per OPSS 572.
- 2.1.7 Dry Mulch: Chopped Straw Mulch, as per OPSS 572.
- 2.1.8 Erosion Control Blanket: Terrafix S100B Straw Single Net, or approved equivalent.
- 2.1.9 Seed Drill for seed beds: Tye drill, Truax drill, or John Deere Rangeland drill.

### **3 . EXECUTION**

#### **3.1 Workmanship**

- .1 Do not perform work under adverse field conditions such as frozen soil, excessively wet or dry soil or soil covered with snow, ice or standing water.
- .2 Keep site well drained. Keep excavations dry.
- .3 Clean up immediately any soil or debris spilled onto pavement. Dispose of deleterious material off site.

#### **3.2 Preparation Of Surfaces**

- 3.2.1 Verify finished grades are correct and have been accepted by Consulting Engineer per approved grading plans.
- 3.2.2 Scarify soil surface to a depth of 25mm minimum of area to be seeded.
- 3.2.3 Seed bed surface must be free of all deleterious material and finished grade must be free of humps and hollows. Surface must be chain-harrowed to provide a fine, clump-free seed bed just prior to seeding.
- 3.2.4 Seed beds must receive an organic, pre-emergent herbicide application of Turf Maize, 98% Corn Gluten Meal, pre-emergent weed control per

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manufacturer's recommendations and at least 2 weeks prior to the final cultivation before seeding.

### **3.3 Extent Of Seeding**

- 3.3.1 Areas to be seeded are shown on the drawings or disturbed by construction other than areas to be sodded, paved or installed as planting beds.

### **3.4 Seeding**

- 3.4.1 Seeding must occur when soil moisture is appropriate for seeding operation.
- 3.4.2 Seed shall not receive fertilizer.
- 3.4.3 Wet seed that is moldy or otherwise damaged in transit or storage shall not be used.
- 3.4.4 All drill seeding equipment shall be calibrated to deliver the seed at the rates and proportions specified in subsection 2.0. Equipment shall be operated in such a manner as to ensure complete coverage of the entire area to be seeded, and seed must be placed no deeper than 6 mm into prepared seedbed.
- 3.4.5 Sow one half of the required amount of seed in one direction and follow by sowing the other half at right angles to it. The last pass shall be at right angles to the slope.
- 3.4.6 In the case of late fall seeding, sufficiently protect all seeded areas from damage by erosion, pedestrians and vehicles.
- 3.4.7 After seeding operation is completed, supply and install an erosion control blanket per manufacturers specifications on all slopes exceeding 3:1.

### **3.5 Erosion Control**

- 3.5.1 Install according to manufacturer's specifications.

### **3.6 Maintenance During Establishment Period**

- 3.6.1 Maintain seeded areas from the time of installation until acceptance.
- 3.6.2 Water seeded area to maintain optimum soil moisture level for germination and continued healthy growth of plants. Control watering to avoid washouts.
- 3.6.3 Repair and reseed dead or bare spots to allow establishment of seed.
- 3.6.4 Check the site for broken branches, leaves, paper and similar material to keep the area reasonably clean at all times. Remove all extraneous material from the site. No material shall be burned on the site. Paved areas and lawns shall be kept clean at all times.
- 3.6.5 Maintain all seeded areas weed-free.

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**3.7 Warranty**

- 3.7.1 Seeded areas shall be warrantied for one (1) year after preliminary acceptance.
- 3.7.2 Only seed which is rooted in place and exhibiting vigorous healthy growth at the time of inspection will be deemed to have met the terms of the Warranty.
- 3.7.3 Seeded areas which show deterioration, bare spots, or failure to take root and thrive, shall be re-seeded and maintained for an additional sixty (60) days according to all the requirements as described in this section.
- 3.7.4 Rills and gullies greater than 100mm in width shall be repaired immediately throughout the warranty period.

**END OF SECTION**

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**1 . GENERAL**

**1.1 Work Included**

- 1.1.1 Supply and laying of sod.
- 1.1.2 Fertilizing.
- 1.1.3 Maintenance and clean-up of site.

**1.2 Related Work**

- 1.2.1 Section 32 91 19 – Topsoil and Fine Grading

**1.3 Scheduling**

- 1.3.1 Schedule sod laying to coincide with preparation of soil surface.
- 1.3.2 Schedule sod installation after planting.
- 1.3.3 Coordinate sod laying with work of other trades.

**1.4 Source Quality Control**

- 1.4.1 Source of sod is provided in this specification.
- 1.4.2 Alternate sources will not be accepted without written authorization.

**2 . PRODUCTS**

**2.1 Materials**

- 2.1.1 Number One Turfgrass Nursery Sod: Sod that has been especially sown and cultivated in nursery fields as turfgrass crop and is harvested with a mechanical sod cutter to a thickness of not less than 25 mm and not more than 40 mm, and is supplied in rolls of approximately 0.9 sq m in surface area. Quality and source to comply with standards outlined in Canadian Standards for Nursery Stock, 9th Edition, published by the Canadian Nursery Landscape Association.
  - .1 Number One Sod: Green Horizons Spectrum Sod or approved equivalent, grown solely from seed mixture of cultivars of Kentucky Bluegrass, Turf-Type Tall Fescue, Chewing Fescue, Hard Fescue, Red Fescue, Fine Fescue supplied by Green Horizons Sod Farms Cambridge, 1625 Kossuth Road, Cambridge, ON. (519) 653 7494; greenhorizonssod.com.
- 2.1.2 Sod establishment support: wooden pegs: 17 x 8 x 250 mm.
- 2.1.3 Water: potable, supplied on site.
- 2.1.4 Fertilizer:
  - .1 To Canada 'Fertilizers Act' and 'Fertilizers Regulations'.

- .2 Complete synthetic, slow release with minimum 50% of nitrogen content in ureaformaldehyde form.
- .3 Fertilizer Composition Ratio: 6-12-12.

### **3 . EXECUTION**

#### **3.1 Preparation**

- 3.1.1 Verify that grades are correct and prepared in accordance with Section 32 91 19 – Topsoil and Fine Grading. If discrepancies occur, notify Consultant and do not commence work until instructed.
- 3.1.2 Do not perform work under adverse field conditions such as frozen soil, excessively wet or dry soil or soil covered with snow, ice or standing water.
- 3.1.3 Fine grade surface free of humps and hollows to smooth, even grade, to contours and elevations indicated, surface to drain naturally.
- 3.1.4 Remove and dispose of weeds; debris; stones 50 mm in diameter and larger; and other deleterious materials; off site.
- 3.1.5 Cultivate approved fine grade to 25 mm depth immediately prior to sodding.

#### **3.2 Sod Placement**

- 3.2.1 Lay sod within 24 hours of being lifted.
- 3.2.2 Lay sod sections in rows, longitudinally, along contours of slopes, joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with sharp implements.
- 3.2.3 Provide close contact between sod and soil by light rolling. Use of heavy roller to correct irregularities is not permitted.
- 3.2.4 Water sod no more than 6 mm per hour, beginning no later than 30 minutes after installation.

#### **3.3 Sod Placement On Slopes**

- 3.3.1 Start laying sod at bottom of slopes.
- 3.3.2 Lay sod sections longitudinally, along contours of slopes steeper than 3 horizontal to 1 vertical, and where indicated.
- 3.3.3 Peg sod on slopes to following pattern:
  - .1 100 mm below top edge, using 3 stakes evenly spaced per roll, for first sod sections along contours of slopes.
  - .2 Stake alternate rows.
  - .3 Drive pegs flush, but not below surface of sod sections.

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**3.4 Fertilizing Program**

- 3.4.1 Apply fertilizer uniformly at 0.5 kg N/ha before sodding. 1-2-1 ratio.
- 3.4.2 Additional fertilizer applications may be required to properly establish turf. This is to be determined by Consultant.

**3.5 Maintenance – Installation To Acceptance**

- 3.5.1 Perform following operations from time of installation until acceptance:
- 3.5.2 Water sodded areas no more than 6 mm per hour to depth of 75 to 100mm. Watering should be daily for days 1-7 and every other day for day 8-14 to maintain optimum soil moisture condition until Substantial Performance. Monitor conditions and provide continued watering as required.
- 3.5.3 Cut grass, as many times as required at no additional cost to Owner until Substantial Performance to 60mm height when or prior to it reaching a height of 85mm. A minimum of three (3) mowings are required. Remove clippings which will smother grassed areas. Grass shall not be cut no sooner than 7 days after installation.
- 3.5.4 Maintain sodded areas 95% weed free via mechanical removal.
- 3.5.5 Check the site for broken branches, leaves, paper and similar material to keep the area reasonably clean at all times. Remove all extraneous material from the site. No material shall be burned on the site. Paved areas and lawns shall be kept clean at all times.
- 3.5.6 Damage resulting from erosion, washout, or any other cause shall be repaired immediately by the Contractor at no additional cost to the Owner.
- 3.5.7 Grass areas which show deterioration or bare spots shall be re-sodded within the maintenance period so that at no time does the grass show signs of wear.
- 3.5.8 Fertilize per 3.4 above.

**3.6 Acceptance**

- 3.6.1 Turfgrass Nursery Sod areas will be accepted provided that:
  - .1 Sodded areas are properly established.
  - .2 Sod is free of weeds, bare and dead spots.
  - .3 No surface soil is visible when grass has been cut to height of 60 mm.
  - .4 Sodded areas have been cut a minimum of two (2) times after sod has knit, approximately four (4) weeks after sod laying. Sodded areas must have been cut within 24 h prior to acceptance.
  - .5 Sodded areas have been fertilized. Consultant is to be notified 24 h in advance by the Contractor of when the fertilizer application is to be applied.

- 3.6.2 Areas sodded in fall will be accepted in following spring one month after start of growing season provided acceptance conditions are fulfilled.

**3.7 Maintenance – Warranty Period**

- 3.7.1 Perform following operations during the warranty period:

- .1 Water sodded areas in times of drought to maintain the turf in a healthy growing condition. Assume 5 waterings during the warranty period.
- .2 Replace dead areas of sod as required.
- .3 Fertilize as required.

**3.8 Warranty**

- 3.8.1 Sodded areas shall be warranted for one (1) year from the date of Substantial Performance.
- 3.8.2 Only sod which is rooted in place and exhibiting vigorous healthy growth at the time of inspection will be deemed to have met the terms of the warranty.
- 3.8.3 Sodded areas which show deterioration, bare spots, or failure to take root and thrive, shall be re-seeded and maintained for an additional sixty (60) days of growing season according to all the requirements as described in this section. The additional sixty (60) days shall be carried over into the following growing season where required.

**END OF SECTION**

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**1. GENERAL**

**1.1 Work Included**

- 1.1.1 Preparation of planting beds, spreading of topsoil and planting mix prior to planting operations.
- 1.1.2 Plant material including trees, shrubs, and perennials.
- 1.1.3 Pruning, guying and mulching of trees, shrubs and perennials.
- 1.1.4 Protection of trees, shrubs and surrounding areas.
- 1.1.5 Cleaning and reinstatement of the area of Work.
- 1.1.6 Warranty of plant material.

**1.2 Related Sections**

- 1.2.1 Section 32 91 19 – Topsoil and Fine Grading
- 1.2.2 Section 32 92 20 - Seeding
- 1.2.3 Section 32 92 23 – Sodding

**1.3 References**

- 1.3.1 Canadian Nursery and Landscape Association: Canadian Standards for Nursery Stock 9th Edition, 2017.
- 1.3.2 ANSI Z-133-1; American Standards for Tree Care Operations.
- 1.3.3 ANSI A-300; Tree Pruning Guidelines.
- 1.3.4 Landscape Ontario Horticultural Trades Association, Landscape Standards.

**1.4 Quality Assurance**

- 1.4.1 Soil media (Topsoil; Growing Medium) and organic amendments must be tested prior to supply and installation on site. Refer to Section 32 91 19 – Topsoil and Fine Grading for requirements.
- 1.4.2 The Work shall be carried out by specialist firms engaged in installing and planting landscape products with minimum 5 years' experience performing landscape work and using workers skilled in the various aspects of such work.
- 1.4.3 No substitutions for plant material as indicated on planting plan will be allowed unless written approval has been obtained from the Consultant as to type, variety and size. Proposed substitutions must be of similar species and of equal size as those originally specified.

**1.5 Delivery**

- 1.5.1 Plant material should be protected during delivery to prevent damage to branches, root ball or desiccation of leaves.



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- 1.5.2 Adequate protection and spacing shall be placed between trees so that trunks are not scarred, and branches are not broken.
  - 1.5.3 Plants should be transported in enclosed trucks or covered with a tarpaulin. For large material transported in open trucks, the trees shall be wrapped to prevent damage and windburn.
  - 1.5.4 Movement of container grown, ball and burlap (B&B) and wire-basketed (WB) plants should be restricted to closed van or well-covered trucks with mesh tarpaulin or similar material to protect the leaves or needles from windburn or desiccation.
  - 1.5.5 Dormant plants
    - .1 Deciduous – bare roots (only in dormant period or condition): Adequate protection shall be given to preserve the moisture around the root system. For short transit periods of 4 hours or less, the maximum temperature in the truck should not exceed 20° Celsius. In all cases and at all times, roots should be protected from frost, wind and sun, by such means as a closed van or tarped vehicle with wet straw or other suitable moisture-holding materials placed over the roots. The temperature shall be maintained as uniformly as possible at all times by mechanical or other means.
    - .2 Evergreens: It is recommended that rootballs not be subjected to freezing temperatures below -5 degrees Celsius for a period longer than 4 hours and that adequate protection from wind and sun be given to prevent desiccation.
  - 1.5.6 Non-Dormant Plants: Deciduous and Evergreens:
    - .1 Movement of container grown, ball and burlap (B&B) and wire-basketed (WB) plants should be restricted to closed van or well-covered truck with mesh tarpaulin or similar material to protect the leaves or needles from windburn or desiccation. If plants will be in transit for more than one day, they should be unloaded at interim points and stored away from direct sun for 24 hours at each interim point to avoid burning. When plants may be subject to wind during transportation and storage, tarpaulins and other protective measures may be supplemented by spraying the foliage with an antidesiccant prior to shipping.
  - 1.5.7 Unloading Procedures:
    - .1 BR (Bare Root): Roots should be covered and protected from frost, freezing, sun, and wind.
    - .2 Pots / Containers: Should be handled by the container only in order to reduce breakage of branches or leaves. Container plants shall not be held by the tops, stems or trunks.
    - .3 Ball & Burlap: Should be handled with caution to maintain the firmness of the root balls. Protect against damage to trunk, stems and branches.
    - .4 Trees should not be lifted by the trunk. Lift by attachments to the basket at three to four points or by supporting the tree below the rootball. Support the trunk as necessary to hold it in relation to the rootball to
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prevent tearing of roots or loosening of the rootball. Support shall be such that the cambium is not damaged.

.5 All plants should be unloaded and checked immediately upon arrival and watered if necessary. The Contractor should be notified immediately both verbally and in writing of any plant damage.

.6 Plant material shall not be dropped, thrown or handled roughly.

#### **1.6 Handling and Storage**

1.6.1 Plants and roots shall be kept in a moist condition at all times. All plants shall be well protected against damage, extreme temperatures, desiccation and theft.

##### **1.6.2 Protection Against Stem and Branch Damage**

.1 During loading and unloading, transportation and planting, all trees should be protected against damage to the stems and branches. This is applicable especially to large wire-basketed trees.

.2 The bark should be protected against chafing from chains, cables, equipment or other trees by a wrapping of cardboard or burlap.

.3 Sudden or rapid movement of trees in transit or off-loading should be avoided. If the tree's branches are entangled with those of other trees, care shall be taken to separate them without damage to branches.

.4 If damage occurs, it shall be reported to the Consultant immediately. If the Consultant determines that the plant is acceptable despite the damage, proposed corrective measures should be carried out in accordance with arboricultural practices recognized by the International Society of Arboriculture. Shattered bark should be removed and broken branches should be pruned back to the appropriate branch collar or bud, with care to avoid the tearing of the stem bark.

##### **1.6.3 During Growing Season**

.1 All plants in Containers, Balled & Burlapped, or Wire Basket, if not planted immediately, shall be stored in a secure upright position. Care should be taken to provide enough space between plants so that light reaches all around to the bottom of the plant in order to avoid sunscald or burning when the plants are planted out.

.2 Balled & Burlapped Plants: Special attention should be given to the rootball, and unless weather is rainy or cool, rootballs shall be protected by heeling-in into material suitable (examples: straw, peat moss, topsoil) to protect them from drying out. Plants intended to be planted in the open shall not be kept stored in a building or any area of low light intensity for a prolonged period. All plants shall be kept well-watered and protected from extreme temperatures.

.3 Containerized plants shall be covered in a protective medium such as straw, peat moss or topsoil in extreme weather such as freezing or high dry heat. Plants shall not be kept stored in a building, truck, or any area of low light intensity for a prolonged period during the growing season.

.4 Plants shall not be taken directly from the greenhouse and planted in a drastically different environment. Such plants shall be acclimatized or "hardened off" against the environmental conditions of their final planting location (including plants originating from different geographical sources).

.5 Preparation for the new environment should include an appropriate period of storage in an intermediate environment, managing fertilizer applications to avoid excessive growth, and a graduated watering program.

1.6.4 During Dormant Period

.1 Plants shall be cared for according to the species requirements for winter protection, geographic location and hardiness.

**1.7 Acceptance**

- 1.7.1 Growing medium, fertility levels, depths and surface grading are as specified.
- 1.7.2 Plant quantities, species, sizes, quality and locations are as shown in the contract documents or as otherwise specified. All approved substitutions shall be noted. An approved list of substitutions shall be provided to the Consultant at the time of acceptance.
- 1.7.3 Install all plants properly, vertical and at the correct level relative to finished grade.
- 1.7.4 Trees are to be staked as shown on drawings, and otherwise as and where site conditions require.
- 1.7.5 Pruning is completed where required. All pruning cuts shall be made with a sharp tool.
- 1.7.6 Mulch is in place to the proper depth as required. Un-mulched areas are cultivated to leave a loose, friable, water-permeable surface. All planted areas are free of visible weeds, and substantially free of underground weed parts.
- 1.7.7 Garbage, paper, construction debris, broken branches and similar materials have been removed from all planting areas.
- 1.7.8 Only plant material that exhibits healthy growth, good leafing and branching habit, and are true to the botanical name, size and condition indicated on the plan, and are free from pests, disease, or damage shall be accepted.

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### **1.8Warranty**

- 1.8.1 The Contractor shall warranty all plant materials for two (2) full growing seasons from date of Substantial Performance. The Consultant reserves the right to review all plant material any time during the warranty period and require replacements at that time, at the sole discretion of the Owner/Consultant.
- 1.8.2 All new plant materials used as replacement for unacceptable plant materials shall be of the same species, quality, size and requirements prescribed in the contract documents.
- 1.8.3 A plant shall be assumed to be acceptable when it is structurally sound, when it is well furnished with living foliage, when it has normal colour, when it shows adequate annual growth and formation of buds and when it is free from blight of any description. Plant material which exhibits die back of more than 10% of its branch area or has regrown from a bud or shoot shall be considered dead and unacceptable.
- 1.8.4 Plants which have died during the period of warranty shall be replaced at no cost to the Owner. Dead plant material replaced under warranty shall be removed from the Work site at the Contractor's expense.
- 1.8.5 Plant material replaced under warranty shall conform to all requirements of the original contract including the warranty of 24 months from the date of Substantial Performance.
- 1.8.6 Replacement of materials removed, broken or damaged due to circumstances beyond the Contractor's control after completion shall not be an obligation under this warranty.

### **1.9Required Tasks During Warranty Period**

- 1.9.1 Refer to Section 32 93 40 – Planting Maintenance.

## **2 . PRODUCTS**

### **2.1Plant Material**

- 2.1.1 Plant material: comply with Canadian Nursery and Landscape Association: Canadian Standards for Nursery Stock (2017), referring to:
  - .1 Standard container sizes.
  - .2 Digging standards.
  - .3 Rootball diameters, depths, weights.
  - .4 Recommended container sizes by plant type.
  - .5 Height relationship to caliper by type size and development of plant material and root ball.
  - .6 Age of plant.

- 2.1.2 All trees, shrubs and perennials to be No. 1 Grade. Plant material obtained from areas with milder climatic conditions from those of the site are only acceptable when used for spring planting.

## **2.2Topsoil And Growing Medium**

- 2.2.1 Topsoil and growing medium – refer to Section 32 91 19 – Topsoil and Fine Grading.

## **2.3Fertilizer And Amendments**

- 2.3.1 Organic components and fertilizers per Section 32 91 19 – Topsoil and Fine Grading.

## **2.4Fastening Accessories**

- 2.4.1 Tree supports
- .1 Steel Stakes: T-rail iron stakes 38 x 38 x 5 mm, 2000 mm high, primed with 1 brush coat of black zinc rich paint, to CGSB 1-GP-181M.
  - .2 Wood Stakes: 2400 or 600 x 50 x 50mm spruce survey stakes pointed at bottom end.
  - .3 Anchors: For support of large trees over 100 mm in caliper use “Duckbill” anchors, #68 or 88 as required.
- 2.4.2 Wire: new and free from bends or kinks, No. 10 galvanized steel wire for guying of trees. Wire shall not be used in conjunction with any tree ties that require the wire to encircle the trunk (encased or otherwise).
- 2.4.3 Turnbuckle: appropriate wire tightener by Spannfix, Langer or an accepted alternate, for use when guying.
- 2.4.4 Tree Fasteners: two-ply reinforced 13 mm diameter rubber garden hose, folded burlap strips or proprietary devices that do not encircle the trunk with wire.

## **2.5Maintenance Materials**

- 2.5.1 Tree Wrapping: Dewitt Tree Wrap (white polypropylene fabric).
- 2.5.2 Anti-Desiccant: wax-like emulsion to provide film over plant surfaces reducing evaporation but permeable enough to permit transpiration.
- 2.5.3 Wound dressing: horticulturally accepted non-toxic, non-hardening emulsion.
- 2.5.4 Organic Mulch: “Gro-Bark” Classic Cedar shredded bark mulch or accepted alternate.
- 2.5.5 Water: potable; on site.
- 2.5.6 Rodent Protection: ArborGuard Tree Protector.

## **2.6Source Quality Control**

- 2.6.1 General

- .1 Notify Consultant of source of material at least 7 days in advance of commencement of work and arrange plant material to be inspected, approved and tagged by the Consultant at the source. No work is to proceed without Consultant's approval.
- .2 Plant material must be approved by Consultant prior to planting.
- .3 Acceptance of plant material at its source does not prevent rejection on site prior to or after planting operations.

#### 2.6.2 Plant Material

- .1 Measure plants when branches are in their natural position. Height and spread dimensions refer to main body of plant and from branch tip to branch tip. Measure caliper 150 mm above ground level. Use trees and shrubs of No. 1 grade.
- .2 Label each plant as to type, grade and size.
- .3 All plant material shall be true to type and structurally sound. It shall be structurally sound, well- branched, healthy, vigorous, have a strong fibrous root system and be free of disease, insect infestation, rodent damage, sun scald, frost cracks, defects or injuries. Use trees with straight stems well and characteristically branched for species. Plants must have been transplanted or root pruned regularly but not later than 9 months prior to arrival on site.
- .4 Collected material dug from native stands or established wood lots shall not be accepted unless prior approval has been granted by the Consultant.
- .5 Trees of 3000mm height and larger and all conifers shall be delivered balled and burlapped or in wire baskets. Deciduous trees up to 3000 mm height and all shrubs shall not be supplied bare root unless noted on the plant material list. Plants which have been cut back from larger sizes to meet these specifications will not be accepted.
- .6 Plant material that has come out of dormant stage and is too far advanced will not be accepted unless due to special circumstances and Consultant's approval has been obtained.
- .7 The use of plant material that has been held in "cold storage" requires prior approval of the Consultant.
- .8 Plant material grown in more moderate hardiness zones than those in this contract will not be accepted.

#### 2.6.3 Bare Root Stock

- .1 Dig and move all bare root stock while dormant with the major portion of the fibrous root system provided.
- .2 All material shall be suitably packed for shipment to ensure that injury and drying out does not occur. Roots shall be packed in moist straw or another suitable material and wrapped with burlap or heavy paper.
- .3 Bare root material shall not be stored anywhere in excess of 24 hours unless properly "heeled in" and kept moist. All deciduous material which

has started to "leaf out" shall be sprayed with an approved anti-desiccant according to manufacturer's instructions.

2.6.4 Root Balled Stock

.1 All conifer, broad leaf evergreens and trees in excess of 3 metres height must have been dug with large firm ball. Base size of root ball for trees on caliper taken at 300 mm above ground level. A tree with 75 mm caliper requires root ball of 1 meter diameter. Increase diameter of root ball by 250 mm with each increase of 25 mm in caliper.

.2 Root balls of proper size must include 75 percent of fibrous and feeder root system. This excludes use of native trees grown in light sandy or rocky soil.

.3 Secure root balls with burlap, heavy twine and rope. Use 5 oz. Hessian burlap.

.4 Frozen root balls will be permitted, provided root balls are sufficiently protected to prevent breakage. Protect root balls against sudden changes in temperatures and exposure to heavy rainfall.

.5 Dig trees at their original location with root ball dimensions as specified, and to a depth to include 75 percent of the roots. Cleanly cut all roots at the outer edge of the root ball. Double burlap root balls in excess of 920 mm and drum-lace with 13mm rope at 200mm spacing. Wire baskets are an acceptable alternative.

.6 Root balls, trunks and branches of all trees and shrubs shall be protected from sun and wind while in transit and until planted.

.7 Thoroughly spray all deciduous trees which have broken into bud and all coniferous trees with an approved anti-desiccant to requirements of the manufacturer's instructions immediately upon delivery to the job site.

.8 Balled and burlapped material, or material in wire baskets shall NOT be stored on the site in excess of forty-eight hours without prior permission of the Consultant. If such storage is necessary, the plant material shall be protected with soil or a similar material to prevent drying out and shall be kept moist until it is planted.

2.6.5 Container Grown Stock

.1 Container grown stock is acceptable if containers were large enough for root development. Trees and shrubs must have grown in container for minimum of one growing season but not longer than two. Root system must be able to "hold" soil when removed from container. Plants that have become root bound are not acceptable.

.2 Container stock must have been fertilized with slow-release fertilizer. Soil mixture in container must consist of 6 parts loam soil, 3 parts peat moss and 1 part sand.

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### 3 . **EXECUTION**

#### **3.1 Examination**

- 3.1.1 Verify field conditions are ready to receive work.
- 3.1.2 Contractor is responsible for all locates and related costs.
- 3.1.3 Clearly identify all plant material upon delivery to the site, using labels indicating species, size and supplier.
- 3.1.4 Beginning of installation implies acceptance of existing conditions.
- 3.1.5 Co-ordinate operations with appropriate trades and work.
- 3.1.6 Keep site clean and planting holes drained.
- 3.1.7 Erect physical protection barriers, silt fences, shade or erosion protection at the edge of the protection boundaries before any work occurs on site.
- 3.1.8 Physical protection barriers shall meet all applicable municipal by laws and regulatory requirements.
- 3.1.9 Protect adjacent walls, walks and utilities from damage or staining. Use 1/2" plywood to protect adjacent existing elements. Remove soil and debris spilled onto pavement immediately.

#### **3.2 Planting Time**

- 3.2.1 Perform planting during periods suitable with respect to weather conditions and locally accepted practice. Do not plant bare root plant material until all evidence of frost has left the ground site. Bareroot material shall not be planted between May 15 and October 15. Plant material imported from region with warmer climatic conditions may only be planted in early spring.
- 3.2.2 When permission has been obtained to plant deciduous plant material after buds have broken, spray plants with anti-desiccant to slow down transpiration.
- 3.2.3 Planting of coniferous evergreens with root balls may start after middle of August if interference with contract completion is not anticipated. Apply anti-desiccant to all evergreens before digging, where specified.
- 3.2.4 When permission has been obtained, trees and shrubs growing in containers may be planted throughout growing season.
- 3.2.5 Ensure that watering facilities are available. Take particular care and use anti-desiccant when planting during heat of summer.
- 3.2.6 Plant only under conditions that are conducive to health and physical conditions of plants.
- 3.2.7 Plant material noted by Consultant for spring planting only must be planted in dormant period.
- 3.2.8 Provide Consultant with planting schedule. Extending planting operations over long period using limited crew will not be acceptable.



- 3.2.9 Plant material specified, but not available at the time of Contract execution shall be ordered and planted in the fall or in the spring of the following year. Substitutions will only be considered by the Consultant if it is determined that the specified material will not be available at these later dates.

### **3.3Preparation – Layout And Staking**

- 3.3.1 Stake out locations of trees and outlines of areas to be planted with shrubs and perennials.
- 3.3.2 Do not commence excavation until staked locations have been reviewed and accepted by the Consultant.
- 3.3.3 Verify location of all underground utilities and services prior to any excavation. Pay for cost of repairs to any damaged utility or service caused by work of this Section, at no additional cost to Owner.

### **3.4Digging Of Plants**

- 3.4.1 Coniferous material shall not be dug bare root.
- 3.4.2 Plants specified or approved as "BR" (Bare Root) shall be dug and moved while dormant and in accordance with Canadian Nursery and Landscape Association Canadian Standards for Nursery Stock.
- 3.4.3 Plants specified or approved as "B&B" (Ball & Burlap) shall be dug and planted in accordance with Canadian Nursery and Landscape Association Canadian Standards for Nursery Stock.
- 3.4.4 Plants specified or approved as "Machine Dug into Wire Basket" shall be dug and planted in accordance with Canadian Nursery and Landscape Association Canadian Standards for Nursery Stock.

### **3.5Preparing Of Roots**

- 3.5.1 Before removing plants from containers for planting, the plants shall be well watered.
- 3.5.2 Roots have a tendency to grow in a circular pattern within plastic pots. When this is apparent outside roots should be gently loosened or vertically cut with a sharp knife in one or two places.

### **3.6Preparation For Planting**

- 3.6.1 Excavate planting beds to a depth of 600mm.
- 3.6.2 Preparation and depth of growing medium for trees shall follow drawings.
- 3.6.3 The transition of each tree planting area to shallower growing medium shall have a shallow angle.
- 3.6.4 Excavation of the subgrade below the root balls of trees shall be only as necessary to permit the bottom of the rootball to sit on undisturbed material or compacted fill such that the top of the rootball remains at the proper finished grade. Disturbed subgrade or fill below the rootball shall

be compacted to prevent settlement of the tree after planting. Excess excavated material shall be removed from the site.

- 3.6.5 Poor drainage or percolation should be reported to the Consultant. Planting pits or areas shall be tested by filling with water. If planting pits or areas do not drain adequately, measures such as penetrating the impervious layers, raising the planting grade, tree wells or adding drain lines should be employed.
- 3.6.6 Planting pits or areas excavated in fine soils or by mechanical means shall have all bottoms and sides scarified to ensure that they do not have glazed surfaces. Where the growing medium in a planting pit or area is different in texture, structure or organic content from the surrounding soil, the sides and bottom shall be scarified and the two materials thoroughly mixed to avoid an abrupt interface. Growing medium shall be free from interfaces or textural differences that could impede root development.

### **3.7 Planting**

- 3.7.1 Planting shall not be performed during weather conditions that may adversely affect material.
- 3.7.2 Plants shall be planted so that after settlement the level of the adjacent growing medium surface matches the level of the original growing medium surface in the nursery. The soil mark on the stem or container soil level is an indication of this, and it shall be maintained on the finished level, allowing for settling of the growing medium after planting. The total depth of the root ball shall be planted in growing medium.
- 3.7.3 Plants shall be set plumb in the planting beds or in the centre of the pits, except where the plant's character requires variation from this.
- 3.7.4 Root balls shall be placed on the undisturbed subgrade to prevent settling.
- 3.7.5 If no other factors come into play, the plant should be oriented in the same direction that it was grown in the nursery. Face the lowest branch away from the greatest traffic (pedestrian and vehicular); and position the plant for best viewing.
- 3.7.6 Growing medium shall be placed preferably by hand in layers around the roots or ball. Each layer shall be carefully tamped so as to avoid injuring the roots or ball, or disturbing the position of the plant. The hole should be backfilled and gently tamped so that no air pockets are left around the ball.
- 3.7.7 When growing medium is up to about two-thirds of the rootball height, all ties shall be cut and the top one- third of burlap on B&B, plants shall be cut off or folded back carefully, so as not to disturb the rootball integrity. No burlap shall show above grade.
- 3.7.8 Growing medium should be moist in tree pits and beds at this stage. After the water has been absorbed, the backfilling shall be completed and tamped lightly. Any settling shall be brought up to the intended grade with growing medium.

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- 3.7.9 The trunk flare should be partially visible after the tree has been planted.
  - 3.7.10 All non-biodegradable containers and tying materials shall be removed. Biodegradable containers such as fibre tubs should be removed where possible, but trees dug BR and planted in tubs for summer planting (if not fully established at time of planting) can be planted with the fibre tub if the rim is removed below grade and large holes cut out on the sides.
  - 3.7.11 All string, rope, burlap and other restricting elements shall be cut and removed out to the perimeter of the rootball. For jute burlapped root balls, cut away top one half of wrapping and wire basket without damaging root ball. Do not fold burlap or wire basket into the whole. Contractor to photograph tree planting and have the Consultant inspect planting prior to backfilling.
  - 3.7.12 Top lacing shall not be left in place at the time of planting.
  - 3.7.13 A 100 mm raised saucer should be constructed over the rootball to enhance water infiltration into the rootball.
  - 3.7.14 All planting hole depths should only be dug deep enough to accommodate the root system or root mass at the desired depth relative to the surrounding grade. Plant tree with the root collar at the same level as the surrounding ground.
  - 3.7.15 The planting hole width should be at least 200cm in diameter for all trees and 30 cm wider than the perimeter of the rootball or root system for all shrubs.

### **3.8 Poorly Drained Soils**

- 3.8.1 Planting holes should only be dug deep enough to accommodate the root system or root mass at the desired depth relative to the surrounding ground. The tree should be planted with the root collar positioned 75 to 100 mm above the surrounding ground level as settlement may occur.
- 3.8.2 When planting where drainage correction is impractical or impossible, the root collar should be planted higher in relationship to the surrounding soil surface by 75-100 mm.
- 3.8.3 Planting Hole Depth: the width of the actual hole should be at least 30 cm wider around the perimeter of the root ball or root system.

### **3.9 Bare Root Planting – While Dormant Only**

- 3.9.1 Damaged or broken roots should be cut back to healthy remaining tissue. Roots should be spread evenly in the planting pit.
- 3.9.2 Growing medium shall be placed around the roots, gently shaking the tree so all the soil particles sift into the root system to ensure close contact with all roots and to prevent air pockets. Ensure adequate watering occurs immediately after planting.

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**3.10 Watering**

3.10.1 Watering shall be carried out when required and with sufficient quantities relative to specific plant needs to prevent plants and the underlying growing medium from drying out. Plants shall be thoroughly watered at the time of planting and continue throughout the warranty period as required for plant establishment and vigor.

**3.11 Pruning**

3.11.1 Pruning at the time of planting, shall be limited to the minimum necessary to remove dead, diseased, broken or injured branches.

3.11.2 Any corrective pruning (double leader) shall be done in such a manner as to preserve the natural character of the plants.

3.11.3 Only clean, sharp tools shall be used. Tools should be sterilized between cuts of different plants.

3.11.4 All cuts shall be clean and cut to the branch collar, leaving no stubs.

**3.12 Tree Guards**

3.12.1 Supply and install tree guards per manufacturer's instructions. Only guards well secured into the soil will be accepted.

**3.13 Mulching**

3.13.1 Shrub and perennial planting beds to have 100mm depth of approved mulch supplied and installed continuous across entire planting bed.

3.13.2 Trees installed in lawn areas:

3.13.3 Mulched ring to be 2.0 m in diameter with 100mm mulch depth.

3.13.4 Avoid placing wood chip mulch directly in contact with the trunk. Do not under any circumstances mound mulch up against trunk.

3.13.5 Trees installed in existing turf/meadow areas:

3.13.6 Existing herbaceous and woody plant material to be removed from site, and existing soils to be loosened to 100 mm depth within diameter of mulched ring.

3.13.7 Mulched ring to be 2.0 m in diameter with 100mm mulch depth.

3.13.8 Avoid placing wood chip mulch directly in contact with the trunk. Do not under any circumstances mound mulch up against trunk.

**3.14 Stabilizing Trees**

3.14.1 Immediately following planting, trees shall be stabilized (when required or specified) using appropriate methods such that the crown of each tree is permitted free movement but normal forces such as wind, snow loading or forces applied by human hands will not disturb the buttress root system or cause the rootball to shift in the growing medium. Securing methods

include staking, guying, soil anchors, deadmen, and attachments to fixed elements.

- 3.14.2 A tree may not need to be stabilized if the subsoil and growing medium are stable and can hold the rootball in place and if the rootball is solid, contained in a wire basket, and shaped such that it can resist shifting.
- 3.14.3 All tree stabilization methods shall be such that they do not damage the tree.
- 3.14.4 Attachment to the tree shall be no higher than necessary to stabilize the rootball while permitting free movement of the tree's crown.
- 3.14.5 Ties shall be secured in position in accordance with manufacturer recommendations. Ties shall form a loose loop around the stake and loop in a figure "8" around the trunk of the tree. Guys shall be sufficiently tight to transfer support from the stake to the tree and to permit some movement for the development of proper trunk taper.
- 3.14.6 Stakes and anchoring devices shall be set deep enough that they will not move in the soil when subjected to wind and other normal forces. Stakes should be driven a minimum of 300 mm into undisturbed soil.
- 3.14.7 Stakes or anchors for guy wires shall be set below or flush with the soil surface so that they do not present a hazard, and guy wires shall be used only where they do not present a hazard. Guy wires shall be marked with flagging tape for visibility.
- 3.14.8 Stakes shall not be driven through or penetrate the rootball of the plant.
- 3.14.9 The following methods are recommended for staking and guying:
- 3.14.10 Deciduous trees up to 12-cm caliper and coniferous trees up to 3m height: two stakes per tree.
- 3.14.11 Deciduous trees larger than 12-cm caliper and coniferous trees larger than 3m height: three guy wires spaced equally around each tree.
- 3.14.12 Trees installed on roof decks or in planters may require special stabilization methods.
- 3.14.13 Except where stabilization of plants is directed to remain in place for longer periods due to special considerations, tree ties, stakes, guys etc. shall be removed one year after installation. In some cases (e.g., street trees), stakes might be left in place to protect the trees, but ties shall be removed.

### **3.15 Winter Wrapping**

- 3.15.1 Install Burlap wrap on conifers deemed susceptible to wind stresses between mid-November and mid-December and remove by mid-April.

**END OF SECTION**

**1 . GENERAL**

**1.1 Scope Of Work**

- 1.1.1 Provide all equipment, material and labour for the maintenance of trees, shrubs, and perennials to fulfil the requirements for the plant material warranty.
- 1.1.2 Work includes supply and install of plant replacements, weeding, watering, organic pest and disease control, growth control, organic fertilizing, cultivation, pruning, plant protection and mulching. This shall include all planted materials and replacement plant materials.
- 1.1.3 Prepare a maintenance schedule.
- 1.1.4 Prepare and submit monthly Maintenance Reports.

**1.2 Workmanship**

- 1.2.1 All work shall at least conform to the rules and custom of best trade practices; to be executed by skilled tradesmen well equipped and adequately supervised and performed in accordance with these guidelines.

**1.3 Supervision**

- 1.3.1 Supervisors shall have practical experience and knowledge of plant material, organic pest and disease control.

**1.4 Related Sections**

- 1.4.1 Section 32 93 10 – Planting

**1.5 References**

- 1.5.1 ANSI Z-133-1; American Standards for Tree Care Operations.
- 1.5.2 ANSI A-300; International Society of Arboriculture Best Management Practices - Tree Pruning Guidelines.
- 1.5.3 Landscape Ontario Horticultural Trades Association, Landscape Standards.

**1.6 Duration**

- 1.6.1 Landscape maintenance shall commence upon date of substantial completion and continue for two (2) full years following that date. Contractor is responsible for completion of all warranty deficiencies beyond the warranty end date if needed.

**1.7 Notification**

- 1.7.1 Notify the Consultant/Owner before undertaking pruning, and if any disease or insect problems arise.

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## **2 . MAINTENANCE OF PLANTED AREAS**

### **2.1 Warranty Maintenance**

- 2.1.1 Provide all necessary maintenance to ensure the establishment and vigor of the plant material. This includes additional watering, watering at freeze up, treatments of disease or infestations within the City of Guelph pesticide use regulations, installing additional mulch to meet specified depths, maintaining all stakes, guys and rodent protection, and any other measures necessary to achieve the required plant health.
- 2.1.2 Remove all stakes, guards, guy wires, etc., remaining on plant material at end of warranty period, (the Consultant to inform the Contractor in writing if conditions warrant an extension on staking). If stakes are deemed necessary beyond the 2-year warranty period the Contractor will not be responsible for their removal.
- 2.1.3 Rodent guards are to remain in place at the end of the warranty period
- 2.1.4 Restore the site to original conditions from damage arising out of all replacement operations at no cost to the Owner.

### **2.2 Plant Replacements**

- 2.2.1 All plants that are dead, or not in a healthy, satisfactory growing condition, or which in any way do not meet the requirements of the specifications, shall be replaced by the Contractor at the Contractor's expense. All required replacements shall be as originally specified. Where plant material is replaced, the warranty period for the replacement shall be for two (2) years following the acceptance date of the replacement plant material. The Consultant or Owner reserves the right to extend Contractor's warranty responsibilities for an additional year if, at end of initial warranty period, plant condition is not sufficient to ensure future health. Such warranty shall not limit the Contractor's liability for defects that may arise beyond the warranty period.
- 2.2.2 All plant materials shall be reviewed at the beginning of each month from May to September in each year of warranty. Replacements shall be completed within 30 days of receipt of review reports outlining deficiencies.

### **2.3 Watering**

- 2.3.1 Regular and adequate watering shall be provided in order to promote healthy plant growth. Watering shall be such that the water penetrates the full depth of the growing medium.
- 2.3.2 It will be assumed that all plant materials shall be surface watered weekly, dependent on the occurrence of rainfall events and amounts. The Contractor is to provide a weekly watering schedule to the Consultant at the beginning of each week for coordination purposes. Scheduled applications of water shall be skipped only when rainfall has penetrated the soil fully as required and is to be communicated to the Consultant by

the Contractor for confirmation. Moisture shall be monitored to avoid overwatering or under-watering. It is the responsibility of the Contractor to ensure that the plant material does not become stressed in dry periods. Should plant materials die due to these dry conditions, the Contractor will be responsible for replacement, per the warranty obligations.

- 2.3.3 During extended periods of high temperatures and drought, additional watering may be required to promote plant establishment and healthy plant growth. It is the responsibility of the Contractor to ensure plant material does not become stressed in dry periods.

## **2.4 MAINTENANCE OF Planted Areas and Weed Control**

- 2.4.1 All planted areas including the base of all trees, shall have weeds removed on a regular basis. Frequency is expected to be at least once per month through the growing season.
- 2.4.2 Where and when applicable, bark mulch should be replaced, repaired or increased to the specified depth when required by erosion, decay, cultivation or vandalism.
- 2.4.3 Tree soil saucers shall be maintained to proper shape and depth.

## **2.5 Insect, Pest and Disease Control**

- 2.5.1 Contractor shall be responsible for detection, recognition and timely control of plant pests and diseases. Contractor shall have an up-to-date knowledge of the most effective integrated pest management practices, together with the ability to diagnose ailments. All equipment shall be in first class operating condition, completely free of any chemical residual from previous use.

## **2.6 Fertilizing**

- 2.6.1 It shall be the responsibility of the Contractor to maintain an adequate level of soil fertility through the application of suitable certified organic complete formulae fertilizers, together with control of soil acidity where and as required. Lime shall be applied to plant areas where acidity is excessive (i.e. below pH 4.5). No lime shall be applied where specific planting requires an acid condition.
- 2.6.2 Adding fertilizer to newly planted trees that are subjected to transplanting and drought stress may be ineffective for root production and can promote soft growth. If transplanted trees are fertilized, only slow-release fertilizer with  $\geq 50$  % water-insoluble nitrogen should be used. Fertilizer shall only be applied in order to correct nutrient deficiencies as required and included under this Item. Fertilizer application shall be subject to approval by the Consultant and shall be applied as per manufacturer's specifications.



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**2.7     Protection of Trees**

2.7.1 All trees shall be protected against wind and snow damage by adequate staking, guying, tying or wrapping as conditions require. Guys, wire ties and stakes shall be examined at frequent intervals, and adjustments or renewals made to prevent abrasions or other damage to plants.

**2.8     Pruning**

2.8.1 Pruning shall be carried out in order to mitigate hazards, remove dead or broken branches or to ensure proper plant form, structure, vigour and restriction of disease.

2.8.2 Pruning shall be carried out in accordance with current International Society of Arboriculture Best Management Practices (ANSI A300).

2.8.3 Tools shall be sterilized after use on each plant to avoid transmission of disease from one plant to another

**3 .     EXECUTION**

**3.1     Schedule And Maintenance Records**

3.1.1 Work Schedule:

.1 Provide a preliminary schedule to the Consultant for review and approval outlining the maintenance tasks outlined in this Section to be undertaken through each year of the warranty period. These shall include as a minimum: fall/spring clean-up, garbage clean-up, pruning, weeding and watering. It is understood that disease/pest control and fertilizing cannot be scheduled.

3.1.2 Maintenance Reports:

.1 The Contractor shall prepare and provide to the Consultant and Owner monthly maintenance reports. Reports to be submitted within five (5) days after month's end.

.2 Submit a sample format of the monthly maintenance report to the Consultant at the beginning of project construction for review and approval.

.3 Each report shall indicate at minimum project name, date of site visits, areas of work, description of tasks completed, materials used, and outline of future work required, to indicate compliance with these specifications. Lack of information shall infer non-compliance and where there is no evidence of recorded work, this shall have a direct bearing on responsibilities.

**END OF SECTION**

**1. GENERAL****1.1 Summary**

- 1.1.1 Provide labour, materials, products, equipment and services to complete the installation of domestic watermain and appurtenances including inspection and testing.

**1.2 Related Requirements**

- 1.2.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.2.2 Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

**1.3 References**

- 1.3.1 The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- 1.3.2 All reference amendments adopted prior to the Bid Closing date of this Project shall be applicable to this Project.
- 1.3.3 All materials, installation and workmanship shall comply with all applicable requirements and standards.

**1.4 Waste Management and Disposal**

- 1.4.1 Comply with the waste management plan developed by the Contractor for the Work in accordance with Section 01 74 00. Comply with the directions of the Contract Administrator regarding waste management and disposal activities.
- 1.4.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- 1.4.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- 1.4.4 Separate for reuse and recycling and place in designated containers Steel, Metal, Plastic waste in accordance with Waste Management Plan.
- 1.4.5 Place materials defined as hazardous or toxic in designated containers.
- 1.4.6 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.

- 1.4.7 Ensure emptied containers are sealed and stored safely.
- 1.4.8 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Consultant.
- 1.4.9 Divert unused concrete materials from landfill in accordance with Waste Management Plan.
- 1.4.10 Dispose of unused asbestos cement pipe in accordance with regulations governing disposal of hazardous materials.
- 1.4.11 Divert unused aggregate materials from landfill in accordance with Waste Management Plan.
- 1.4.12 Dispose of unused disinfection material at official hazardous material collections site in accordance with Waste Management Plan
- 1.4.13 Do not dispose of unused disinfection material into sewer system, into streams, lakes, onto ground or in other location where they will pose health or environmental hazard.
- 1.4.14 Fold up metal banding, flatten and place in designated area for recycling.

## **2 . PRODUCTS**

### **2.1 Materials**

- 2.1.1 All material for watermain, hydrants and appurtenances, shall be according to the Region of Peel material/manufacture specifications as required by Section 3, Materials from Standard Specifications for Watermains.
- 2.1.2 PVC watermains shall be minimum DR 18 Class 235 (AWWA) C900-07 or Molecularly Oriented Polyvinyl Chloride (PVCO) pipes ranging in size from 100 mm to 300 mm in diameter pressure class 235 AWWA C909-09. PVC pipes ranging in size from 350 mm through 600 mm in diameter, shall be pressure rating 235, DR 18, according to AWWA C905-10.
- 2.1.3 Embedment material for flexible pipe shall be according to OPSD 802.010 and using Granular A according to OPSS.MUNI 1010 and compacted to minimum 98% of maximum dry density.
- 2.1.4 Minimum cover on watermains shall be 1.7 m.
- 2.1.5 All hydrants shall be constructed according to Section W.4.11 of the Region of Peel Standard Specifications for Watermains.
- 2.1.6 Hydrant Leads shall be minimum DR 18 Class 235 (AWWA) C900-07 or pressure Class 235 AWWA C909-09.

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- 2.1.7 All service connections shall be constructed according to W.4.13, W.4.15, W.4.16 of the Region of Peel Standard Specifications for Watermains.
  - 2.1.8 All curb and valve boxes to be located at street line.
  - 2.1.9 Mechanical thrust restraints shall be installed at all fittings, bends, tees, crosses, reducers and valves for all watermain sizes. Mechanical restraints at joints shall be installed at every pipe joint 6.1 m of either side of the valve for watermains 100 mm diameter or larger.
  - 2.1.10 All tees, plugs, horizontal, vertical bends, reducers and hydrants to have concrete thrust blocks according to W.4.6 of the Region of Peel Standard Specifications for Watermains and Region of Peel STD DWG 1-5-4 thru 1-5-7.
  - 2.1.11 Watermains must follow the Ontario Ministry of the Environment Procedure F-6-1 that governs the separation of sewers and watermains. A minimum vertical clearance of 0.30 m when crossing over and 0.5 m when crossing under sewers and all other utilities is required. Must also maintain 2.5 m horizontal separation with sewers.
  - 2.1.12 All valves less than 400 mm will be in a valve box according to Section W.4.10 of the Region of Peel Standard Specifications for Watermains. All valves 400 mm and larger shall be in a chamber.
  - 2.1.13 Corrosion protection systems shall be installed on all metallic pipes and appurtenances, water services and fittings according to Section W.3.1 of the Region of Peel Standard Specifications for Watermains
  - 2.1.14 Tracer wire installation shall be according to Section W.4.7 of the Region of Peel Standard Specifications for Watermains.
  - 2.1.15 Hydrostatic pressure test and leakage testing of the watermain shall be according to Section W.5.11 of the Region of Peel Standard Specifications for Watermains.
  - 2.1.16 The new watermain shall be isolated until bacteriological tests are satisfactory completed.
  - 2.1.17 Watermains 50mm in diameter are to be flushed and sampled only and do not require chlorination per Section W.5.3 of the Region of Peel Standard Specifications for Watermains.
  - 2.1.18 Disinfection of the watermain shall be according to Section W.5.3 of the Region of Peel Standard Specifications for Watermains and shall include all new water services larger than 50 mm diameter and larger.
  - 2.1.19 Regional in-service water valves, curb stops, fire hydrants can only be operated by Region of Peel staff.

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- 2.1.20 Tracer wire shall be installed on all PVC watermain per Section W.4.7 of the Region of Peel Standard Specifications for Watermains and shall be RWU90, AWG N0 10 single or seven strand, insulated copper wire with 60 mil of black, cross-linked polyethylene (XLPE) insulation specifically manufactured for direct burial applications.
- 2.1.21 All valve boxes on watermains less than 400 mm in diameter will be 130 mm regular style, sliding type box with guide plate and with 184 mm diameter cover. Valve boxes shall be Mueller Canada MVB – Bottom section only, or Bibby-Ste-Croix VB2200.
- 2.1.22 All valve boxes on watermains less than or equal to 300 mm in diameter will be 105 mm regular style, sliding type box with guide plate and with 149 mm diameter cover. Valve boxes shall be Mueller Canada MVB – Bottom section only, or Bibby-Ste-Croix VB1200.
- 2.1.23 Hydrants shall be; AVK Model 2780, Canada Valve Century, Clow-McAvery Brigadier M67, Mueller Modern Centurion. All hydrants shall be according to AWWA C502-05 and NSF/ANSI 61 for dry barrel hydrants and open counter clockwise. Hydrants will have tapped drain ports, 150 mm mechanical joint inlet with brass-to-brass fittings on the main valve seat, two 63.5 mm hose nozzles spread 180 degrees apart and a 114.3 mm pumper nozzle with a 100 mm ULC S543 approved Storz connection. Hydrants will be connected to the watermain using a 150 mm lead, 150 mm gate valve and anchor tee. Hydrants will be supplied for a minimum bury depth of 1.7 metres. Hydrant extensions required to adjust the length of the hydrant barrel are to be obtained from the hydrant manufacturer or approved supplier. Hydrant anti-tamper devices shall be manufactured according to Region specifications, as approved by the engineer. Hydrant paint will be high gloss exterior chrome yellow and shall be applied over a quality dry red oxide primer. Storz nozzles shall be painted black.
- 2.1.24 Watermain to be tested, flushed and disinfected in accordance with Region of Peel Standards and Specifications.

## **2.2 Watermain In Fill Areas**

- 2.2.1 Pipes are not to be laid on fill until the field density test reports have been submitted and approved by the Engineer.
- 2.2.2 Fill to be placed to a minimum of 600 mm above the watermain grades and to 3 m minimum on each side prior to watermain laying compacted to a minimum of 100% of maximum dry density in 300 mm lifts.
- 2.2.3 Soil Density shall be taken along centerline of the watermain and on lines 1.5 m on either side of the same at a maximum interval of 30 m. Tests to be taken at each 600 mm lift.

- 2.2.4 All hydrants, tees, valves, bends, plugs and each pipe joint are to be mechanically restrained.
- 2.2.5 Pipe joint deflections are not allowed.

### **3 . EXECUTION**

#### **3.1 Watermain Construction**

- 3.1.1 Install 200 mm diameter PVC watermain and connect to existing watermain as shown on the Contract Drawings.
- 3.1.2 All watermain bedding and backfill shall be in accordance with Section W.3.3, W.4.2 and W.4.3 of the Region of Peel Standard Specifications for Watermains.
- 3.1.3 The Contractor is advised that pursuant to an order issued by the Ontario Ministry of the Environment and Climate Change, all wet taps performed on Region watermains must be performed by, or under the supervision of, a Certified Operator in accordance with Ontario Regulation 128/04. The Region of Peel Standards respecting the performance and verification of wet taps shall be followed.

#### **3.2 Separation and Depth**

- 3.2.1 The top of all watermains shall be a minimum of 1.7 m below the finished grade.
- 3.2.2 Utility separation shall be according to Section 2.6 of the Region of Peel Watermain Design Criteria.
- 3.2.3 At all locations where the proposed watermain crosses under or above the existing sewers, or utilities, granular A bedding material is to extend from the lower pipe to the top of the upper pipe. Granular A to be compacted to minimum 98% of Maximum Dry Density.
- 3.2.4 Contractor to provide adequate support during construction between the new watermain and existing gas mains. Maintain 300 mm minimum vertical clearance between the new watermain and existing gas mains less than 300 mm in diameter. Maintain 600 mm minimum vertical clearance between the new watermain and existing gas mains equal to or greater than 300 mm in diameter.

#### **3.3 Testing On New Mains and Services**

- 3.3.1 All testing of new and existing watermains and service connections including cleaning, disinfection, hydro-static testing and sampling shall be carried out in accordance with the Region of Peel testing procedures described in section W.5.1 of the Region of Peel Standard Specifications for Watermains.

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**3.4 Management of Excess Material**

- 3.4.1 Management of excess material shall be according to the Contract Documents.
- 3.4.2 All chlorinated water used for testing, flushing, or disinfecting watermains shall be disposed of safely.
- 3.4.3 The method of disposal of chlorinated water is subject to the approval of the Consultant.

**3.5 Work Within the Municipal Right Of Way**

- 3.5.1 Obtain a Road Occupancy Permit from the Region of Peel for works within the Dixie Road Right-of-Way.
- 3.5.2 Obtain a Road Occupancy Permit from the City of Brampton for works within the Dockstader Road Right-of-Way.
- 3.5.3 During the construction of watermain / services or sewer/ laterals close to an existing transmission watermain, Contractor to notify the Region of Peel at 905-791-7800 at Least 48 Hours Prior to Construction.
- 3.5.4 All work within the Region's Right-of-Way shall be constructed according to the latest Region of Peel Standard Drawings and Specifications. Ontario Provincial Standard Drawings and Specifications may, subject to the approval of the Region of Peel, be used where no Region standard or specification is available.
- 3.5.5 All work within the City's Right-of-Way shall be constructed according to the latest City of Brampton Standard Drawings and Specifications. Ontario Provincial Standard Drawings and Specifications may, subject to the approval of the City, be used where no City standard or specification is available.
- 3.5.6 All work shall be completed according to the current Occupational Health and Safety Act and Regulations for Construction Projects. The General Contractor shall be deemed to be the Constructor as Defined in the Act.
- 3.5.7 All temporary Traffic Control and Signage during construction shall be according to the current Ontario Traffic Manual Book 7: Temporary Conditions Field Edition.

**END OF SECTION**

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## 1. GENERAL

### 1.1 Summary

- 1.1.1 Provide labour, materials, products, equipment and services to complete the construction of 200 mm diameter firemain and disinfection.

### 1.2 Related Requirements

- 1.2.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.2.2 Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

### 1.3 References

- 1.3.1 The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- 1.3.2 All reference amendments adopted prior to the Bid Closing date of this Project shall be applicable to this Project.
- 1.3.3 All materials, installation and workmanship shall comply with all applicable requirements and standards.

### 1.4 Waste Management and Disposal

- 1.4.1 Comply with the waste management plan developed by the Contractor for the Work in accordance with Section 01 74 00. Comply with the directions of the Contract Administrator regarding waste management and disposal activities.
- 1.4.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- 1.4.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- 1.4.4 Separate for reuse and recycling and place in designated containers Steel, Metal, Plastic waste in accordance with Waste Management Plan.
- 1.4.5 Place materials defined as hazardous or toxic in designated containers.
- 1.4.6 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.



- 1.4.7 Ensure emptied containers are sealed and stored safely.
- 1.4.8 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Consultant.
- 1.4.9 Divert unused concrete materials from landfill in accordance with Waste Management Plan.
- 1.4.10 Dispose of unused asbestos cement pipe in accordance with regulations governing disposal of hazardous materials.
- 1.4.11 Divert unused aggregate materials from landfill in accordance with Waste Management Plan.
- 1.4.12 Dispose of unused disinfection material at official hazardous material collections site in accordance with Waste Management Plan
- 1.4.13 Do not dispose of unused disinfection material into sewer system, into streams, lakes, onto ground or in other location where they will pose health or environmental hazard.
- 1.4.14 Fold up metal banding, flatten and place in designated area for recycling.

## 2 . **PRODUCTS**

### 2.1 **Materials**

- 2.1.1 All material for watermain, hydrants and appurtenances, shall be according to the Region of Peel material/manufacture specifications as required by Section 3, Materials from Standard Specifications for Watermains.
- 2.1.2 Minimum 300 mm diameter firemain shall be polyvinyl chloride (PVC) SDR 18.
- 2.1.3 Hydrants shall be; AVK Model 2780, Canada Valve Century, Clow-McAvity Brigadier M67, Mueller Modern Centurion. All hydrants shall be according to AWWA C502-05 and NSF/ANSI 61 for dry barrel hydrants and open counter clockwise. Hydrants will have tapped drain ports, 150 mm mechanical joint inlet with brass-to-brass fittings on the main valve seat, two 63.5 mm hose nozzles spread 180 degrees apart and a 114.3 mm pumper nozzle with a 100 mm ULC S543 approved Storz connection. Hydrants will be connected to the watermain using a 150 mm lead, 150 mm gate valve and anchor tee. Hydrants will be supplied for a minimum bury depth of 1.8 metres. Hydrant extensions required to adjust the length of the hydrant barrel are to be obtained from the hydrant manufacturer or approved supplier. Hydrant anti-tamper devices shall be manufactured according to Region specifications, as

approved by the engineer. Hydrant paint will be high gloss exterior chrome yellow and shall be applied over a quality dry red oxide primer. Storz nozzles shall be painted black.

- 2.1.4 PVC watermains shall be minimum DR 18 Class 235 (AWWA) C900-07 or Molecularly Oriented Polyvinyl Chloride (PVCO) pipes ranging in size from 100 mm to 300 mm in diameter pressure class 235 AWWA C909-09. PVC pipes ranging in size from 350 mm through 600 mm in diameter, shall be pressure rating 235, DR 18, according to AWWA C905-10.
- 2.1.5 Embedment material for flexible pipe shall be according to OPSD 802.010 and using Granular A according to OPSS.MUNI 1010 and compacted to minimum 98% of maximum dry density.
- 2.1.6 Minimum cover on watermains shall be 1.7 m.
- 2.1.7 All hydrants shall be constructed according to Section W.4.11 of the Region of Peel Standard Specifications for Watermains.
- 2.1.8 Hydrant Leads shall be minimum DR 18 Class 235 (AWWA) C900-07 or pressure Class 235 AWWA C909-09.
- 2.1.9 All service connections shall be constructed according to W.4.13, W.4.15, W.4.16 of the Region of Peel Standard Specifications for Watermains.
- 2.1.10 All curb and valve boxes to be located at street line.
- 2.1.11 Mechanical thrust restraints shall be installed at all fittings, bends, tees, crosses, reducers and valves for all watermain sizes. Mechanical restraints at joints shall be installed at every pipe joint 6.1 m of either side of the valve for watermains 100 mm diameter or larger.
- 2.1.12 All tees, plugs, horizontal, vertical bends, reducers and hydrants to have concrete thrust blocks according to W.4.6 of the Region of Peel Standard Specifications for Watermains and Region of Peel STD DWG 1-5-4 thru 1-5-7.
- 2.1.13 Watermains must follow the Ontario Ministry of the Environment Procedure F-6-1 that governs the separation of sewers and watermains. A minimum vertical clearance of 0.30 m when crossing over and 0.5 m when crossing under sewers and all other utilities is required. Must also maintain 2.5 m horizontal separation with sewers.
- 2.1.14 All valves less than 400 mm will be in a valve box according to Section W.4.10 of the Region of Peel Standard Specifications for Watermains. All valves 400 mm and larger shall be in a chamber.
- 2.1.15 Corrosion protection systems shall be installed on all metallic pipes and appurtenances, water services and fittings according to

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Section W.3.1 of the Region of Peel Standard Specifications for Watermains

- 2.1.16 Tracer wire installation shall be according to Section W.4.7 of the Region of Peel Standard Specifications for Watermains.
- 2.1.17 Hydrostatic pressure test and leakage testing of the watermain shall be according to Section W.5.11 of the Region of Peel Standard Specifications for Watermains.
- 2.1.18 The new watermain shall be isolated until bacteriological tests are satisfactory completed.
- 2.1.19 Watermains 50mm in diameter are to be flushed and sampled only and do not require chlorination per Section W.5.3 of the Region of Peel Standard Specifications for Watermains.
- 2.1.20 Disinfection of the watermain shall be according to Section W.5.3 of the Region of Peel Standard Specifications for Watermains and shall include all new water services larger than 50 mm diameter and larger.
- 2.1.21 Regional in-service water valves, curb stops, fire hydrants can only be operated by Region of Peel staff.
- 2.1.22 Tracer wire shall be installed on all PVC watermain per Section W.4.7 of the Region of Peel Standard Specifications for Watermains and shall be RWU90, AWG N0 10 single or seven strand, insulated copper wire with 60 mil of black, cross-linked polyethylene (XLPE) insulation specifically manufactured for direct burial applications.
- 2.1.23 All valve boxes on watermains less than 400 mm in diameter will be 130 mm regular style, sliding type box with guide plate and with 184 mm diameter cover. Valve boxes shall be Mueller Canada MVB – Bottom section only, or Bibby-Ste-Croix VB2200.
- 2.1.24 All valve boxes on watermains less than or equal to 300 mm in diameter will be 105 mm regular style, sliding type box with guide plate and with 149 mm diameter cover. Valve boxes shall be Mueller Canada MVB – Bottom section only, or Bibby-Ste-Croix VB1200.
- 2.1.25 Watermain to be tested, flushed and disinfected in accordance with Region of Peel Standards and Specifications.

## **2.2 Watermain in Fill Areas**

- 2.2.1 Pipes are not to be laid on fill until the field density test reports have been submitted and approved by the Engineer.
- 2.2.2 Fill to be placed to a minimum of 600 mm above the watermain grades and to 3 m minimum on each side prior to watermain laying

compacted to a minimum of 100% of maximum dry density in 300 mm lifts.

2.2.3 Soil Density shall be taken along centerline of the watermain and on lines 1.5 m on either side of the same at a maximum interval of 30 m. Tests to be taken at each 600 mm lift.

2.2.4 All hydrants, tees, valves, bends, plugs and each pipe joint are to be mechanically restrained.

2.2.5 Pipe joint deflections are not allowed.

### **3 . EXECUTION**

#### **3.1 Firemain Construction**

3.1.1 Install 200 mm diameter PVC firemain and connect to main as shown on the Contract Drawings.

3.1.2 All watermain bedding and backfill shall be in accordance with Section W.3.3, W.4.2 and W.4.3 of the Region of Peel Standard Specifications for Watermains.

3.1.3 The Contractor is advised that pursuant to an order issued by the Ontario Ministry of the Environment and Climate Change, all wet taps performed on Region watermains must be performed by, or under the supervision of, a Certified Operator in accordance with Ontario Regulation 128/04. The Region of Peel Standards respecting the performance and verification of wet taps shall be followed.

#### **3.2 Separation and Depth**

3.2.1 The top of all firemains shall be a minimum of 1.7 m below the finished grade.

3.2.2 Utility separation shall be according to Section 2.6 of the Region of Peel Watermain Design Criteria.

3.2.3 At all locations where the proposed watermain crosses under or above the existing sewers, or utilities, granular A bedding material is to extend from the lower pipe to the top of the upper pipe. Granular A to be compacted to minimum 98% of Maximum Dry Density.

3.2.4 Contractor to provide adequate support during construction between the new watermain and existing gas mains. Maintain 300 mm minimum vertical clearance between the new watermain and existing gas mains less than 300 mm in diameter. Maintain 600 mm minimum vertical clearance between the new watermain and existing gas mains equal to or greater than 300 mm in diameter.

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**3.3 Testing On New Mains and Services**

3.3.1 See section 33 11 16 Site Water Utility Distribution Piping.

**3.4 Work Within the Municipal Right Of Way**

3.4.1 Obtain a Road Occupancy Permit from the Region of Peel for works within the Dixie Road Right-of-Way.

3.4.2 Obtain a Road Occupancy Permit from the City of Brampton for works within the Docksteader Road Right-of-Way.

3.4.3 During the construction of watermain / services or sewer/ laterals close to an existing transmission watermain, Contractor to notify the Region of Peel at 905-791-7800 at Least 48 Hours Prior to Construction.

3.4.4 All work within the Region's Right-of-Way shall be constructed according to the latest Region of Peel Standard Drawings and Specifications. Ontario Provincial Standard Drawings and Specifications may, subject to the approval of the Region of Peel, be used where no Region standard or specification is available.

3.4.5 All work within the City's Right-of-Way shall be constructed according to the latest City of Brampton Standard Drawings and Specifications. Ontario Provincial Standard Drawings and Specifications may, subject to the approval of the City, be used where no City standard or specification is available.

3.4.6 All work shall be completed according to the current Occupational Health and Safety Act and Regulations for Construction Projects. The General Contractor shall be deemed to be the Constructor as Defined in the Act.

3.4.7 All temporary Traffic Control and Signage during construction shall be according to the current Ontario Traffic Manual Book 7: Temporary Conditions Field Edition.

**END OF SECTION**

## 1. **GENERAL**

### 1.1 **Summary**

- 1.1.1 Provide labour, materials, products, equipment and services to complete the installation, inspection and testing of gravity sanitary sewers and appurtenances.
- 1.1.2 Also included in this Section are closed circuit video inspections of as-constructed sewers as per OPSS.MUNI 409.

### 1.2 **Related Requirements**

- 1.2.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.2.2 Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

### 1.3 **References**

- 1.3.1 The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- 1.3.2 All reference amendments adopted prior to the Bid Closing date of this Project shall be applicable to this Project.
- 1.3.3 All materials, installation and workmanship shall comply with all applicable requirements and standards.

### 1.4 **Submittals**

- 1.4.1 Upon completion, submit a Certificate of Conformance sealed by a Qualification Verification Engineer to confirm that the following is in general conformance with the requirements of the Contract Documents:
  - .1 Work
  - .2 Material and Installations
  - .3 Inspection, testing, and test results

### 1.5 **Waste Management and Disposal**

- 1.5.1 Comply with the waste management plan developed by the Contractor for the Work in accordance with Section 01 74 00. Comply with the directions of the Contract Administrator regarding waste management and disposal activities.
- 1.5.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

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- 1.5.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
  - 1.5.4 Separate for reuse and recycling and place in designated containers Steel, Metal, Plastic waste in accordance with Waste Management Plan.
  - 1.5.5 Place materials defined as hazardous or toxic in designated containers.
  - 1.5.6 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.
  - 1.5.7 Ensure emptied containers are sealed and stored safely.
  - 1.5.8 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Consultant.
  - 1.5.9 Divert unused concrete materials from landfill in accordance with Waste Management Plan.
  - 1.5.10 Dispose of unused asbestos cement pipe in accordance with regulations governing disposal of hazardous materials.
  - 1.5.11 Divert unused aggregate materials from landfill in accordance with Waste Management Plan.
  - 1.5.12 Dispose of unused disinfection material at official hazardous material collections site in accordance with Waste Management Plan
  - 1.5.13 Do not dispose of unused disinfection material into sewer system, into streams, lakes, onto ground or in other location where they will pose health or environmental hazard.
  - 1.5.14 Fold up metal banding, flatten and place in designated area for recycling.

## **2 . PRODUCTS**

### **2.1 Materials**

- 2.1.1 All material for sewer and appurtenances shall be according to Region of Peel material/manufacture specifications as required by Section S.3, Standard Specifications for Sanitary Sewers.
- 2.1.2 All polyvinyl chloride (PVC) sanitary sewer pipes and fittings shall conform to CSA B182.1 or CSA B182.2. All PVC sanitary sewer pipe shall have a maximum standard dimension ratio of 35 (SDR-35) and a minimum pipe stiffness of 320 kPa and shall be green in colour or any other color, but not white or blue.
- 2.1.3 Embedment material for flexible pipe shall be according to OPSD 802.010 and using Granular A native or Granular A RCM according

to OPSS 1010 and compacted to minimum 98% of maximum dry density.

- 2.1.4 Bedding for rigid pipe shall be class B bedding material according to OPSD 802.031 and using Granular A native or Granular A RCM bedding material according to TS 1010 and compacted to minimum 98% of maximum dry density.
- 2.1.5 Ultra-rib pipe is not permitted within the municipal right-of-way.
- 2.1.6 Maintenance holes shall be according to OPSD 701.010 (1200 mm), OPSD 701.011 (1500 mm), OPSD 701.012-1 (1800 mm) or OPSD 701.013 (2400 mm). Frame and cover shall be according to OPSD 401.010 Type A closed.
- 2.1.7 Maintenance hole chamber openings must be located on the upstream side of the maintenance hole.
- 2.1.8 Benching details shall be according to OPSD 701.021 or as shown on the drawings.
- 2.1.9 Sanitary maintenance holes shall have watertight frames and covers in ponding areas according to OPSD 401.030.
- 2.1.10 Reinforced concrete pipe shall be minimum 65-D, Height of fill to be verified using OPSD tables 807.010 and 807.030.
- 2.1.11 Non-reinforced concrete pipe 150 mm to 250 mm shall be Class 3. Height of fill to be verified using OPSD tables 807.040.
- 2.1.12 Connection detail for sewer pipe at maintenance holes shall be according to OPSD 708.020.
- 2.1.13 The minimum pipe size for sanitary sewer pipes shall be 200 mm diameter
- 2.1.14 Precast maintenance holes to comply with OPSS.MUNI 1351.
- 2.1.15 All manhole steps shall be in accordance with OPSD 405.010.
- 2.1.16 Ontario Concrete Pipe Association (OCPA) pre-benched manhole bases shall be used, where possible.
- 2.1.17 All sanitary manholes serving 200 mm diameter sewer pipes shall be provided with minimum 250 mm benching throughout and conform to OPSD 701.021. For manholes serving greater than 200 mm diameter sewer pipes, benching shall be to obvert.

### **3 . EXECUTION**

#### **3.1 Sanitary Sewer Construction**

- 3.1.1 Frames and covers shall be in accordance with OPSS.MUNI 1850.
- 3.1.2 Any loose fill or other unsuitable material below the pipe invert level must be removed and replaced with inorganic material compacted



to at least 95% Standard Proctor Maximum Dry Density (SPMDD) and to 98% SPMDD within 0.5m below the pipe invert level.

- 3.1.3 Minimum thickness of granular bedding below the invert of the pipes is 150mm, compacted to 98% SPMDD.
- 3.1.4 After installing the pipe on the bedding, a granular surround of approved cover material shall extend at least 300mm above the obvert of the pipe compacted to 98% SPMDD.
- 3.1.5 All sanitary manhole excavations shall be backfilled with Granular 'B' compacted to 98% Standard Proctor Maximum Dry Density (SPMDD).
- 3.1.6 All sanitary sewer excavations shall be backfilled with select on-site excavated organic free silty clay fill as approved by the Geotechnical Engineer, Granular 'B', or approved equivalent. Select on-site fill shall be placed in maximum 300mm thick layers at or near optimum moisture content (2%) to at least 98% SPMDD.
- 3.1.7 The sanitary sewer installation to be in V-trench and supported excavation.
- 3.1.8 Sanitary sewer service connections from the proposed building shall be installed at a minimum of 0.5% positive grade to the mainline storm sewer. Sanitary service connection pipe to be fitted with approved rubber gasket joints.
- 3.1.9 Where water bearing sand or silt occur, the sanitary sewer bedding shall consist of 20 mm crusher run limestone and the sanitary sewer joints shall be leak-proof, or wrapped with a water-proof membrane to prevent subgrade migration through leaky joints resulting from inadvertent faulty installation. The necessity for implementing these measures shall be assessed by the Geotechnical Engineer at the time of trench excavation.
- 3.1.10 Utility separation shall be according to Section 3.4.2 of the Region of Peel Linear Wastewater Standards.

### **3.2 Manhole Adjustment**

- 3.2.1 Install and adjust manhole frames and grates of the existing and proposed manholes to match the proposed grading design, in accordance with OPSD 704.010.

### **3.3 Inspection And Testing**

- 3.3.1 All proposed sanitary sewer pipes will be inspected by the Consultant upon delivery. Those pieces not conforming to the requirements of the Specification will be rejected and must be immediately removed by the Contractor, who shall furnish all labour necessary to assist the Consultant or inspectors in inspecting the material.

- 3.3.2 All PVC sanitary sewer pipes shall pass a mandrel test (ring test) to confirm the proper pipe installation after the completion of backfilling on the pipe to the proposed finished grade or road elevation, prior to road or parking construction.
- 3.3.3 Video camera inspection of sanitary sewer is required as a condition of Substantial Performance and again at the end of the maintenance period, in accordance with OPSS.MUNI 409.

### **3.4 Coordination With City of Brampton**

- 3.4.1 The City's 250 mm sanitary sewer shall be exposed by hydro vac prior to installation of the proposed sewer connection.
- 3.4.2 A Region's construction administrator must be present on site to witness works related to the crossing of the Regional or City of Brampton Sewer sewer. Provide advance notice of 48 hours.

### **3.5 Work Within The Municipal Right-Of-Way**

- 3.5.1 Obtain a Road Occupancy Permit from the Region of Peel for works within the Dixie Road Right-of-Way.
- 3.5.2 Obtain a Road Occupancy Permit from the City of Brampton for works within the Dockstader Road Right-of-Way.
- 3.5.3 During the construction of watermain / services or sewer/ laterals close to an existing transmission watermain, Contractor to notify the Region of Peel at 905-791-7800 at Least 48 Hours Prior to Construction.
- 3.5.4 All work within the Region's Right-of-Way shall be constructed according to the latest Region of Peel Standard Drawings and Specifications. Ontario Provincial Standard Drawings and Specifications may, subject to the approval of the Region of Peel, be used where no Region standard or specification is available.
- 3.5.5 All work within the City's Right-of-Way shall be constructed according to the latest City of Brampton Standard Drawings and Specifications. Ontario Provincial Standard Drawings and Specifications may, subject to the approval of the City, be used where no City standard or specification is available.
- 3.5.6 All work shall be completed according to the current Occupational Health and Safety Act and Regulations for Construction Projects. The General Contractor shall be deemed to be the Constructor as Defined in the Act.
- 3.5.7 All temporary Traffic Control and Signage during construction shall be according to the current Ontario Traffic Manual Book 7: Temporary Conditions Field Edition.

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**END OF SECTION**

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## 1. GENERAL

### 1.1 Summary

- 1.1.1 Provide labour, materials, products, equipment and services to complete the installation and testing necessary for the installation of gravity storm sewers, fittings, drain connections, manholes, frame and covers, safety grates catchbasins, oil grit separators, appurtenances, and connection with the existing storm sewer system.
- 1.1.2 Also included in this Section are closed circuit video inspections of as-constructed sewers as per OPSS.MUNI 409.

### 1.2 Related Requirements

- 1.2.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.2.2 Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

### 1.3 References

- 1.3.1 The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- 1.3.2 All reference amendments adopted prior to the Bid Closing date of this Project shall be applicable to this Project.
- 1.3.3 All materials, installation and workmanship shall comply with all applicable requirements and standards.

### 1.4 Submittals

- 1.4.1 Contractor shall provide shop drawings for all manholes over 3600 mm diameter and all cast-in-place manholes.
- 1.4.2 Oil grit separators:
  - .1 Calculation for average annual total suspended solids (TSS) removal. Supporting calculations shall be stamped by a Professional Engineer licensed in the Province of Ontario.
  - .2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

.3 Hydraulic report that verifies the system weir is sized correctly for the treatment flow rate and in addition, indicates the effect the OGS has on the hydraulic grade line.

.4 Manufacturer report estimating the OGS' maintenance frequency

## **1.5 Waste Management and Disposal**

- 1.5.1 Comply with the waste management plan developed by the Contractor for the Work in accordance with Section 01 74 00. Comply with the directions of the Contractor Administrator regarding waste management and disposal activities.
- 1.5.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- 1.5.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- 1.5.4 Separate for reuse and recycling and place in designated containers Steel, Metal, Plastic waste in accordance with Waste Management Plan.
- 1.5.5 Place materials defined as hazardous or toxic in designated containers.
- 1.5.6 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.
- 1.5.7 Ensure emptied containers are sealed and stored safely.
- 1.5.8 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Consultant.
- 1.5.9 Divert unused concrete materials from landfill in accordance with Waste Management Plan.
- 1.5.10 Dispose of unused asbestos cement pipe in accordance with regulations governing disposal of hazardous materials.
- 1.5.11 Divert unused aggregate materials from landfill in accordance with Waste Management Plan.
- 1.5.12 Dispose of unused disinfection material at official hazardous material collections site in accordance with Waste Management Plan.
- 1.5.13 Do not dispose of unused disinfection material into sewer system, into streams, lakes, onto ground or in other location where they will pose health or environmental hazard.
- 1.5.14 Fold up metal banding, flatten and place in designated area for recycling.

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**2 .            PRODUCTS****2.1        Materials**

- 2.1.1 All material for sewer and appurtenances shall be according to Region of Peel material/manufacture specifications as required by Section S.3, Standard Specifications for Sanitary Sewers.
- 2.1.2 All polyvinyl chloride (PVC) storm sewer pipes and fittings shall conform to CSA B182.1 or CSA B182.2. All PVC storm sewer pipe shall have a maximum standard dimension ratio of 35 (SDR-35) and a minimum pipe stiffness of 320 kPa. Storm sewers (mainline pipe) shall be green in colour while service connection pipe shall be white in colour.
- 2.1.3 Embedment material for flexible pipe shall be according to OPSD 802.010 and using Granular A native or Granular A RCM according to TS 1010 and compacted to minimum 98% of maximum dry density.
- 2.1.4 Bedding for rigid pipe shall be class B bedding material according to OPSD 802.031 and using Granular A native or Granular A RCM bedding material according to TS 1010 and compacted to minimum 98% of maximum dry density.
- 2.1.5 Ultra-rib pipe is not permitted within the municipal right-of-way.
- 2.1.6 Maintenance holes shall be according to OPSD 701.010 (1200 mm), OPSD 701.011 (1500 mm), OPSD 701.012-1 (1800 mm) or OPSD 701.013 (2400 mm). Frame and cover shall be according to OPSD 401.010 Type A closed.
- 2.1.7 Maintenance hole chamber openings must be located on the upstream side of the maintenance hole.
- 2.1.8 Benching details shall be according to OPSD 701.021 or as shown on the drawings.
- 2.1.9 Reinforced concrete pipe shall be minimum 65-D, Height of fill to be verified using OPSD tables 807.010 and 807.030.
- 2.1.10 Non-reinforced concrete pipe 150 mm to 250 mm shall be Class 3. Height of fill to be verified using OPSD tables 807.040.
- 2.1.11 Single Catchbasins shall be according to OPSD 705.010 complete with goss trap, where specified. Frame and cover shall be according to OPSD 400.070.
- 2.1.12 Double Catchbasin shall be according to OPSD 705.020 complete with goss trap, where specified.
- 2.1.13 Catchbasin leads to be 250 mm PVC DR 35 for single catchbasins and 300 mm PVC DR 35 for Double Catchbasins.
- 2.1.14 Connection detail for sewer pipe at catchbasins and maintenance holes shall be according to OPSD 708.020.

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- 2.1.15 All existing watermain and sewer pipes larger than 300 mm diameter shall be supported according to drawing OPSD 1007.01-4.
- 2.1.16 All manhole steps shall be in accordance with OPSD 405.010.
- 2.1.17 Ontario Concrete Pipe Association (OCPA) pre-benched manhole bases shall be used, where possible.
- 2.1.18 External drop structures shall be used in accordance with OPSD 1003.010 and 1003.020. Drop pipe diameter shall be one size less than sewer to a minimum pipe size of 450 mm diameter and shall be connected to the mainline storm sewer with tee or wye connection.
- 2.1.19 OGS 1 - Stormceptor EFO8 or approved equivalent.
- 2.1.20 Design Parameters:
- .1 Area of the site drainage into the unit is 0.76 hectares
  - .2 Imperviousness of the site is 90%
  - .3 Maximum Treatment Flow Rate 1700 L/s
  - .4 Total storage volume 12090L
  - .5 Hydrocarbon storage capacity 1070 L
  - .6 Maximum sediment capacity 8780 L

### **3 . EXECUTION**

#### **3.1 Sequencing of Construction**

- 3.1.1 Any components of the storm sewer and stormwater management system located within the site where the proposed grade is raised more than 1.5m in comparison to existing grade must be installed following the 'preload' process to allow for consolidation settlement of the weak underlying soils.
- 3.1.2 Components include all sewers, manholes, catchbasins, oil grit separators, and stormwater management facilities.

#### **3.2 Storm Sewer Construction**

- 3.2.1 During construction, all catch basins shall be equipped with temporary sediment control devices. All sediment control devices shall be removed once construction is completed.
- 3.2.2 All concrete storm sewer pipes attached to manholes shall be concrete encased from the manhole to the first pipe joint.
- 3.2.3 Any loose fill or other unsuitable material below the pipe invert level must be removed and replaced with inorganic material compacted to at least 95% Standard Proctor Maximum Dry

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Density (SPMDD) and to 98% SPMDD within 0.5m below the pipe invert level.

- 3.2.4 Minimum thickness of granular bedding below the invert of the pipes is 150mm, compacted to 98% SPMDD.
- 3.2.5 After installing the pipe on the bedding, a granular surround of approved cover material shall extend at least 300mm above the obvert of the pipe, compacted to 98% SPMDD.
- 3.2.6 All manhole and catch basin excavations shall be backfilled with Granular 'B' compacted to 98% SPMDD.
- 3.2.7 All storm sewer excavations shall be backfilled with select on-site excavated organic free silty clay fill as approved by the Geotechnical Engineer, Granular 'B', or approved equivalent. Select on-site fill shall be placed in maximum 300mm thick layers at or near optimum moisture content (2%) to at least 98% SPMDD.
- 3.2.8 On-site excavated soils shall not be used in confined areas (around catch basins and laterals) where heavy compaction equipment cannot be operated.
- 3.2.9 All storm sewers and catch basin installation to be in V-trench and supported excavation. All services and structures located in trench cut shall be supported by compacted granular to undisturbed or structurally compacted ground.
- 3.2.10 Storm sewer service connections from the proposed building shall be installed at a minimum of 0.5% positive grade to the mainline storm sewer. Storm service connection pipe to be fitted with approved rubber gasket joints.
- 3.2.11 Where water bearing sand or silt occur, the storm sewer bedding shall consist of 20 mm crusher run limestone and the storm sewer joints shall be leak-proof or wrapped with a water-proof membrane to prevent subgrade migration through leaky joints resulting from inadvertent faulty installation. The necessity for implementing these measures shall be assessed by the Geotechnical Engineer at the time of trench excavation.
- 3.2.12 Utility separation shall be according to Section 3.4.2 of the Region of Peel Linear Wastewater Standards.

### **3.3 Manhole and Catch Basin Installation**

- 3.3.1 Install catch basins and manholes at locations indicated on the Drawings or as adjusted by the Consultant in the field prior to installation.
- 3.3.2 Construct units in accordance with details indicated, plumb and true to alignment and grade.



- 3.3.3 Pump excavation free of standing water and remove soft and foreign material before placing concrete base.
- 3.3.4 Set bottom section of precast unit in bed of cement mortar and bond to concrete slab or base. Make each successive joint watertight with the Consultant's approved rubber ring gaskets, bituminous compound, cement mortar, epoxy resin cement, or combination thereof.
- 3.3.5 Clean surplus mortar and joint compounds from interior surface of unit as work progresses.
- 3.3.6 Plug lifting holes with precast concrete plugs set in cement mortar or mastic compound.

### **3.4 Adjust Manhole and Catch Basin Adjustment**

- 3.4.1 Adjust manhole frames and grates of the existing and proposed manholes and catch basins to match the proposed grading design in accordance with OPSD 704.010.

### **3.5 OGS Installation**

- 3.5.1 Supply, place and compact 150 mm depth of 19 mm crusher run limestone base.
- 3.5.2 Supply and install oil and grit separator according to this specification.
- 3.5.3 Provide steps according to OPSD 405.020.
- 3.5.4 Provide safety platforms according to OPSD 404.020, where required.
- 3.5.5 Supply, place and compact 300 mm wide Granular B backfill all around structure, full height, above granular base material.
- 3.5.6 Backfill with Select Native Materials outside the Granular B envelope, and compact.

### **3.6 Inspection and Testing**

- 3.6.1 All proposed storm sewer pipes and catch basins will be inspected by the Consultant upon delivery. Those pieces not conforming to the requirements of the Specification will be rejected and must be immediately removed by the Contractor, who shall furnish all labour necessary to assist the Consultant or inspectors in inspecting the material.
- 3.6.2 All PVC storm sewer pipes shall pass a mandrel test (ring test) to confirm the proper pipe installation after the completion of backfilling on the pipe to the proposed finished grade or road elevation, prior to road or parking construction.

3.6.3 Video camera inspection of storm sewer is required as a condition of Substantial Performance and again at the end of the maintenance period, in accordance with OPSS.MUNI 409.

3.6.4 Quality Control requirements for compaction shall conform to OPSS.MUNI 501 Compacting.

### **3.7 Maintenance**

3.7.1 Contractor is responsible for performing maintenance on the oil and grit separators during warranty period following the recommendations of the supplier.

### **3.8 Work Within the Municipal Right-Of-Way**

3.8.1 Obtain a Road Occupancy Permit from the Region of Peel for works within the Dixie Road Right-of-Way.

3.8.2 Obtain a Road Occupancy Permit from the City of Brampton for works within the Dockstader Road Right-of-Way.

3.8.3 During the construction of watermain / services or sewer/ laterals close to an existing transmission watermain, Contractor to notify the Region of Peel at 905-791-7800 at Least 48 Hours Prior to Construction.

3.8.4 All work within the Region's Right-of-Way shall be constructed according to the latest Region of Peel Standard Drawings and Specifications. Ontario Provincial Standard Drawings and Specifications may, subject to the approval of the Region of Peel, be used where no Region standard or specification is available.

3.8.5 All work within the City's Right-of-Way shall be constructed according to the latest City of Brampton Standard Drawings and Specifications. Ontario Provincial Standard Drawings and Specifications may, subject to the approval of the City, be used where no City standard or specification is available.

3.8.6 All work shall be completed according to the current Occupational Health and Safety Act and Regulations for Construction Projects. The General Contractor shall be deemed to be the Constructor as Defined in the Act.

3.8.7 All temporary Traffic Control and Signage during construction shall be according to the current Ontario Traffic Manual Book 7: Temporary Conditions Field Edition.

**END OF SECTION**

**1. GENERAL****1.1 Summary**

- 1.1.1 Provide labour, materials, products, equipment and services to complete installation of Oil Grit Separator (OGS) device. Work includes supply and installation of concrete bases, precast sections, and the appropriate precast section with all internal components completely and correctly installed within the OGS device, water tight seals prior to arrival to the project site.

**1.2 Related Requirements**

- 1.2.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.2.2 Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

**1.3 References**

- 1.3.1 The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- 1.3.2 All reference amendments adopted prior to the Bid Closing date of this Project shall be applicable to this Project.
- 1.3.3 All materials, installation and workmanship shall comply with all applicable requirements and standards.

**1.4 Shop drawings**

- 1.4.1 Shop drawings shall be submitted upon request with each order to the contractor then forwarded to the consulting engineer for review and acceptance. Shop drawings shall detail the precast concrete components and the precast concrete component detailing all OGS internal components pre-installed and watertight sealed at the precast facility prior to shipment, including the sequence for installation.

**1.5 Handling and Storage**

- 1.5.1 Prevent damage to materials during storage and handling.
- 1.5.2 Internal OGS device materials supplied by the Manufacturer for connection to the precast concrete shall be pre-fabricated and bolted to the precast and watertight sealed to the precast surface

prior to delivery to the project site to ensure Manufacturer's internal assembly process and quality control processes are fully adhered to, and to prevent damage to the materials on site. No exceptions will be accepted.

- 1.5.3 Follow all instructions labeled on precast concrete components during installation.

## **2. PRODUCTS**

### **2.1 General**

- 2.1.1 The separator shall be circular and constructed from the pre-cast concrete circular riser and slab components.
- 2.1.2 The concrete separator shall include a fiberglass insert bolted and sealed, watertight inside the concrete precast chamber, prior to delivery to the project site. The fiberglass insert must provide a lining for oil storage and retention as a secondary containment system within the OGS.
- 2.1.3 The separator shall be allowed to be specified as a bend or junction structure in the stormwater drainage system.
- 2.1.4 The OGS design parameters:

<b>OGS ID</b>	<b>Area (ha)</b>	<b>%- Impervious</b>	<b>OGS Type</b>	<b>OGS Model</b>
OGS 1	0.76	90%	Stormceptor STC or other accepted OGS	EFO8 or Equivalent

### **2.2 Precast Concrete Sections**

- 2.2.1 All precast concrete components shall be manufactured to a minimum live load of HS-20 truck loading or greater based on local regulatory specifications.
- 2.2.2 All precast concrete components shall be manufactured by a plant certified through the Ontario Plant Prequalification Program for the appropriate concrete products. In addition, the product must be approved through the OPS New Products Committee and listed as such with the Road Authority.
- 2.2.3 Precast bases shall be manufactured to the OPSD 701 series of specifications in accordance with its internal diameter.

**2.3 Gaskets**

- 2.3.1 Only profile neoprene or nitrile rubber gaskets in accordance to CSA A257.3-M92 will be accepted. Mastic sealants, butyl tape or Conseal CS-101 are not acceptable gasket materials.

**2.4 Frame and Cover**

- 2.4.1 Frame and covers shall be manufactured in accordance with OPSD 401.01 and shall be clearly embossed with manufacturer's product name.

**2.5 Concrete**

- 2.5.1 All concrete components shall conform to the appropriate CSA, OPSD, or ASTM specifications and shall be listed within the approved products to manufacture with the Ontario Plant Prequalification Certificate.

**2.6 Fiberglass**

- 2.6.1 The fiberglass portion of the water treatment device shall be constructed in accordance with the following standard: ASTM D-4097: Contact Molded Glass Fiber Reinforced Chemical Resistant Tanks.

**2.7 Ladders**

- 2.7.1 Ladder rungs to be provided upon request.

**2.8 Safety Grate**

- 2.8.1 A safety grate shall be installed within the chamber of the unit.

**2.9 Inspection**

- 2.9.1 All precast concrete sections shall be inspected to ensure dimensions, appearance, integrity of internal components, and quality of the product meets local municipal specifications and associated standards.

**3 . PERFORMANCE & DESIGN****3.1 General**

- 3.1.1 The OGS device shall remove oil and sediment from stormwater during frequent wet weather events and retain these pollutants within the device for later removal.

**3.2 Runoff Volume**

3.2.1 The OGS device shall be engineered, designed and sized to treat a minimum of 90 percent of the annual runoff volume determined from use of a minimum 15-year rainfall data set. Computations shall derive from widely accepted continuous simulation runoff models.

**3.3 Total Suspended Solids (TSS)**

3.3.1 The OGS device shall be capable of removing the Engineer-specified total suspended solids (TSS) load, without scouring previously captured pollutants.

**3.4 Sizing Methodology**

3.4.1 The OGS device shall be engineered, designed and sized to treat a minimum of 90 percent of the annual runoff volume using a widely accepted continuous simulation runoff model which uses rainfall data records which includes antecedent conditions as well as rainfall periods. Rainfall records should be comprised of 15-years of rainfall data or a longer continuous period if available for a given location, but in all cases at least a minimum of 5-years continuous rainfall. The Peclet Number is not an approved method or model for calculating TSS removal, sizing, or scaling OGS devices.

**1.2 Particle Size Distribution (PSD) for Sizing**

3.4.2 The OGS device shall be sized to remove the Engineer-specified total suspended sediment (TSS) load using the particle size distribution (PSD) in Table 3.5, in addition to adhering to section 3.2 of this specification. No alternative PSDs or deviations from Table 3.5 shall be accepted.

<b>1 Table 3.5 – Particle Size Distribution</b>		
<b>Particle Size Distribution to be used to size OGS</b>		
<b>Particle Diameter (Micron)</b>	<b>% by Mass of All Particles</b>	<b>Specific Gravity</b>
1000	5%	2.65
500	5%	2.65
250	15%	2.65
150	15%	2.65
100	10%	2.65
75	5%	2.65
50	10%	2.65
20	15%	2.65
8	10%	2.65
5	5%	2.65

2	5%	2.65
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### 3.5 Verified Scour Testing

- 3.5.1 The OGS device shall have New Jersey Corporation for Advanced Technology (NJCAT) verification that the device is acceptable for on-line installation based on full-scale third-party scour testing performed with the device pre-loaded with the particle size distribution (PSD) illustrated in **TABLE 1 - Scour Test Particle Size Distribution**. Alternatively, the OGS device shall have Toronto and Region Conservation Authority (TRCA) verification of third-party scour testing performed in accordance with the Canadian ETV "Procedure for Laboratory Testing of Oil-Grit Separators."
- 3.5.2 Scour testing data from laboratory scour testing performed with the OGS device pre-loaded with a coarser PSD than the PSD shown in TABLE 1 (i.e. the coarser PSD has no particles in the 1 – 50 micron size range) shall not be acceptable for the determination of the device's suitability for on-line installation.

<b>TABLE 1 - Scour Test Particle Size Distribution<sup>1</sup></b>	
<b>Particle Size (Microns)</b>	<b>Percent by Mass of All Particles</b>
500 – 1000	5%
250 – 500	5%
100 – 250	30%
50 – 100	15%
8 – 50	25%
2 – 8	15%
1 – 2	5%
1. The Materials shall be hard, firm and inorganic with a specific gravity of 2.65. The various particle sizes shall be uniformly distributed throughout the material prior to use.	

### 3.6 Sediment Storage Capacity

- 3.6.1 Manufacturer's sediment storage capacity guidelines for the OGS device shall be confirmed by the Engineer to be adequate for the anticipated sediment loadings. Sediment loadings shall be determined by land-use and defined as a minimum of 450 kg of sediment (TSS) per impervious hectare of drainage area per year or greater as noted in the "Typical Urban Areas and Pollutant Yields (Sediment)" table below. The OGS device shall be specified as to

not require maintenance (sediment removal) more frequently than once per year.

**Typical Urban Areas and Pollutant Yields (Sediment) (Burton and Pitt, 2002)**

Pollutant	Pollutant Load by Land Use (Kg/ha/year)							
	Commercial	Parking Lot	Residential Density			Highways	Industrial	Shopping Centers
			High	Med.	Low			
TSS	1000	400	400	250	10	880	500	440

**Source: U.S. EPA Stormwater Best Management Practice Design Guide, Volume 1, Appendix D, Table D-1**

NOTE: to determine volume of adequate sediment storage capacity a bulk density of 1602 kg/m<sup>3</sup> (100 lbs/ft<sup>3</sup>) shall be applied.

**3.7 Petroleum Hydrocarbon Capture and Storage**

- 3.7.1 Petroleum hydrocarbon storage capacity in the OGS device shall be a minimum 35 gallons, or more as specified.
- 3.7.2 The OGS device internal hydrocarbon storage area shall include a minimum of 12 inches (305 mm) of double wall containment for the full circumference of the device to provide safe oil and other hydrocarbon material storage and ground water protection.

**3.8 Surface Loading Rate Scaling of Different Model Sizes**

- 3.8.1 The reference device for scaling shall be an OGS device that has been third-party laboratory tested and verified by NJCAT or TRCA. Other model sizes of the tested device shall be scaled such that the claimed TSS removal efficiency of the scaled device shall be no greater than the TSS removal efficiency of the tested device at identical **surface loading rate** (flow rate divided by settling surface area). Alternative scaling methodologies shall not be accepted without providing a minimum of three (3) full-scale third-party laboratory performance and scour testing of differing OGS model sizes. The Peclet Number is not an approved method for scaling OGS devices.



**4 . INSPECTION AND MAINTENANCE****4.1 General**

- 4.1.1 The OGS manufacturer shall provide an Owner's Manual upon request.
- 4.1.2 A Quality Assurance Plan that covers inspection and maintenance for up to 5 years shall be included with the OGS, and written into the COA.
- 4.1.3 Inspection of the OGS device, which includes determination of sediment depth and presence of petroleum hydrocarbons, shall be easily conducted from finished grade.
- 4.1.4 Sediment removal from the OGS shall be conducted using a standard maintenance truck and vacuum apparatus.
- 4.1.5 No confined space for sediment removal or inspection of screens or other internal components shall be required for normal annual inspection or maintenance activity.

**5 . EXECUTION****5.1 Concrete Installation**

- 5.1.1 The installation of the concrete OGS device should conform to state highway, provincial, or local specifications for the construction of manholes. Selected sections of a general specification that are applicable are summarized below.

**5.2 Excavation**

- 5.2.1 Excavation for the installation of the stormwater quality treatment device should conform to state highway, municipal or local specifications. Topsoil that is removed during the excavation for the stormwater quality treatment device should be stockpiled in designated areas and should not be mixed with subsoil or other materials. Topsoil stockpiles and the general site preparation for the installation of the water quality device should conform to state highway, provincial or local specifications.
- 5.2.2 The OGS device should not be installed on frozen ground. Excavation should extend a minimum of 12 inch (300 mm) from the precast concrete surfaces plus an allowance for shoring and bracing where required. If the bottom of the excavation provides an unsuitable foundation additional excavation may be required.
- 5.2.3 In areas with a high water table, continuous dewatering should be provided to ensure that the excavation is stable and free of water.

**5.3 Backfilling**

- 5.3.1 Backfill material should conform to state highway, municipal or local specifications. Backfill material should be placed in uniform layers not exceeding 12 inches (300 mm) in depth and compacted to state highway, provincial or local specifications.

**1.3 Water Quality Device (OGS) Construction Sequence**

- 5.3.2 The concrete water quality device is installed in sections in the following sequence:

- .1 aggregate base
- .2 base slab
- .3 treatment chamber section(s); shall include the internals bolted/secured to the precast walls and water tight sealed prior to arrival to the project site to ensure quality control
- .4 transition slab (if required)
- .5 bypass section
- .6 connect inlet and outlet pipes
- .7 riser section and/or transition slab (if required)
- .8 maintenance riser section(s) (if required)
- .9 frame and access cover
- .10 The precast base should be placed level at the specified grade. The entire base should be in contact with the underlying compacted granular material. Subsequent sections, complete with joint seals, should be installed in accordance with the precast concrete manufacturer's recommendations.
- .11 Adjustment of the stormwater quality treatment device can be performed by lifting the upper sections free of the excavated area, re-leveling the base, and re-installing the sections. Damaged sections and gaskets should be repaired or replaced as necessary. Once the stormwater quality treatment (OGS) device has been constructed, any lift holes must be plugged with mortar.

**5.4 Drop Pipe, Riser Pipe, And Oil Port**

- 5.4.1 Once the upper chamber has been attached to the lower chamber, the inlet drop tee, and riser pipe must be attached. If an oil port is included, this must be attached as well. Pipe installation instructions and required materials shall be provided with the insert.

**5.5 Inlet and Outlet Pipes**

- 5.5.1 Inlet and outlet pipes should be securely set into the upper chamber using grout or approved pipe seals (flexible boot connections, where

applicable) so that the structure is watertight. Non-secure inlets and outlets will result in improper performance.

**5.6 Frame and Cover or Frame and Grate Installation**

- 5.6.1 Precast concrete adjustment units should be installed to set the frame and cover at the required elevation. The adjustment units should be laid in a full bed of mortar with successive units being joined using sealant recommended by the manufacturer. Frames for the cover should be set in a full bed of mortar at the elevation specified.

**END OF SECTION**

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## 1. GENERAL

### 1.1 Summary

- 1.1.1 Provide labour, materials, products, equipment and services to complete the installation of surface rain garden, underground storage tank, inlet structures, manholes, and outlet structures.
- 1.1.2 SWMF-1 (underground storage tank complete with outlet control structure as specified in the Contract Drawings)

### 1.2 Related Requirements

- 1.2.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.2.2 Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

### 1.3 References

- 1.3.1 The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- 1.3.2 All reference amendments adopted prior to the Bid Closing date of this Project shall be applicable to this Project.
- 1.3.3 All materials, installation and workmanship shall comply with all applicable requirements and standards.

### 1.4 Abbreviations

- 1.4.1 SWMF – Stormwater Management Facilities
- 1.4.2 PP – Polypropylene
- 1.4.3 HDPE – High Density Polyethylene
- 1.4.4 PE – Polyethylene
- 1.4.5 PVC – Polyvinyl Chloride
- 1.4.6 ASTM – American Society for Testing and Materials
- 1.4.7 AASHTO – American Association of State Highway and Transportation Officials
- 1.4.8 TSS – Total Suspending Solids

### 1.5 Administrative Requirements

- 1.5.1 Preinstallation Meetings

.1 A preinstallation meeting between the general contractor and supplier representatives for both of the underground storage tanks is recommended to discuss the installation process and site constraints.

#### 1.5.2 Sequencing

.1 Any stormwater management facilities and their respective components located within the site where the proposed grade is raised more than 1.5m in comparison to existing grade must be installed following the 'preload' process to allow for consolidation settlement of the weak underlying soils. See section 31 23 23 Grade Raise and Preloading.

.2 Contractor is responsible for coordinating the installation of the subsurface drainage system with the installation of permanent structures on site.

.3 Construction loads for permanent structures may require the subsurface chamber system to be installed after the permanent structure(s) on site.

.4 Coordinate SWMF connections to on-site storm sewers

.5 Coordinate with building roof drainage systems

.6 Coordinate with other utility work.

### 1.6 **Submittals**

1.6.1 The following shall be submitted by the contractor in accordance with Section 01 33 00 Submittal Procedures:

1.6.2 Shop drawings for the underground storage tank, stamped by an Engineer, including:

.1 Access openings

.2 Ladder

.3 Watertight joints between precast units

1.6.3 Product Specifications for the following:

1.6.4

1.6.5 Infiltration chambers and end caps

1.6.6 PE pipe

1.6.7 Product Installation Instructions for the following:

1.6.8

1.6.9 Chambers and end caps

1.6.10 PE pipe

### 1.7 **Quality Assurance**

1.7.1 Qualifications

- .1 Manufacturers
- .2 Contractor to use a pre-cast box culvert
- .3 Chamber to be adequate for H-20 Highway Loading
- .4 Chamber to meet storage capacity of at least 447000 L
- .5 Chamber to include an ant-buoyancy collar

## **1.8 Delivery, Storage, and Handling**

- 1.8.1 Contractor shall check all materials upon delivery to assure that the proper culvert size and plastic pipe and pipe fittings have been received.
- 1.8.2 Contractor shall check the culverts for shipping damage prior to installation. Units that have been damaged must not be installed. Contractor shall contact culvert manufacturer immediately upon discovery of any damage. Culverts may be left palletized until the units are ready to be installed.
- 1.8.3 All culverts, pipe and pipe fittings shall be delivered to the site and unloaded with handling that conforms to the manufacturer's instructions for reasonable care.
- 1.8.4 Protect culvert and chamber fittings from dirt and damage.
- 1.8.5 All pipe and culvert shall be protected against impact, shock and free fall, and only equipment of sufficient capacity and proper design shall be used in the handling of the pipe. Storage of the pipe on the job shall be in accordance with the pipe manufacturer's recommendations.
- 1.8.6 Contractor shall refer to the fabric manufacturer's guidance handling and storage of fabric products on site.

## **2 . PRODUCTS**

### **2.1 Underground Storage Tank (SWMF1)**

- 2.1.1 SWMF1 shall be watertight and include an impermeable liner to prevent interactions with groundwater.
- 2.1.2 SWMF1 shall be installed with appropriate counter-buoyancy measures to withstand high groundwater conditions.

### **2.2 Infiltration Chamber System**

- 2.2.1 Chamber Options
  - .1 Only stormwater chamber systems evaluated by a licensed design engineer and found to meet AASHTO section 12.12 safety factors are allowed.

.2 The structural design of the chambers, the structural backfill, and the installation requirements shall ensure that the load factors specified in the AASHTO LFRD bridge design specifications, section 12.12, are met for: 1) Long-duration dead loads and 2) Short-duration live loads, based on the AASHTO design truck with consideration for impact and multiple vehicle presences.

.3 Infiltration chambers shall be designed, tested and allowable load configurations determined in accordance with ASTM F 2787, "Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chambers". Load configurations shall include: 1) Instantaneous (<1 min) AASHTO design truck live load on minimum cover 2) Maximum permanent (75-yr) cover load and 3) Allowable cover with parked (1-week) AASHTO design truck.

#### 2.2.2 Performance

.1 Only chambers that are approved by the site design engineer will be allowed. Upon request by the site design engineer or owner, the chamber manufacturer shall submit a structural evaluation for approval before delivering chambers to the project site as follows:

.1 The structural evaluation shall be sealed by a registered professional engineer.

.2 The structural evaluation shall demonstrate that the safety factors are greater than or equal to 1.95 for dead load and 1.75 for live load, the minimum required by ASTM F 2787 and by sections 3 and 12.12 of the AASHTO LFRD bridge design specifications for thermoplastic pipe.

### 3. **EXECUTION**

#### 3.1 **Preparations**

##### 3.1.1 General (underground storage tank)

.1 Installing contractors are required to use and understand the latest manufacturer's installation instructions prior to beginning system installation.

.1 Chamber products must be designed and installed in accordance with the manufacturer's minimum requirements. Failure to do so will void the manufacturer's limited warranty.

.2 The contractor shall install all drainage structures, pipe and chambers in the locations shown on the design engineer's drawings. Pipe shall be of the type and sizes specified on the

drawings and shall be laid accurately to line and grade. Structures shall be accurately located and properly oriented.

.3 Chambers, pipe and drainage structures shall be inspected prior to installation and any defective or damaged product shall be replaced accordingly.

.4 Contact local underground utility companies prior to construction.

.5 The contractor must apply erosion and sediment control measures to protect the stormwater system during all phases of site construction per local codes and design engineer's specifications.

.6 Contractor to meet all manufacturer's requirements.

#### 3.1.2 Site Preparation

.1 Excavation must be free of standing water. Dewatering measures must be taken if required.

.1 When groundwater is present in the work area, dewater to maintain stability of in-situ and imported materials. Maintain water level below pipe bedding and foundation to provide a stable trench bottom.

.2 Prepare the underground storage tank and chamber bed's subgrade soil as outlined in the geotechnical engineering report. Requirement for subgrade soil bearing capacity should meet or exceed the chamber manufacturer's required allowable subgrade soil bearing capacity. The contractor must report any discrepancies with subgrade soil's bearing capacity to the geotechnical engineer.

.3 Contractor to meet all manufacturer's requirements.

### 3.2 Installation and Backfilling

3.2.1 Install chamber system flat or at constant slope between points an elevations indicated.

3.2.2 Construct fabric and stone foundation per chamber manufacturer's installation instructions.

3.2.3 See pipe manufacturer's installation instructions for pipe assembly.

3.2.4 The contractor must refer to the chamber manufacturer's installation instructions for a table of acceptable vehicle loads at various depths of cover. The contractor is responsible for preventing vehicles that exceed the chamber manufacturer's requirements from traveling across or parking over the chamber system. Temporary fencing, warning tape and appropriately located signs are commonly used to prevent unauthorized vehicles from entering sensitive construction areas.



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- 3.2.5 Refer to the chamber manufacturer's installation instructions for minimum requirements for backfill material above the stormwater chamber system.
  - 3.2.6 See pipe manufacturer's installation instructions for guidance on installing the plastic pipe fittings to the chamber system.
  - 3.2.7 Contractor to meet all underground tank manufacturer's requirements.

### **3.3 Protection**

- 3.3.1 Protect all inlets to the stormwater chamber system during construction.
- 3.3.2 All inlet and outlet structures should be protected against construction sediments.

### **3.4 Inspection and Maintenance**

- 3.4.1 Contractor is required to inspect and maintain the stormwater management facilities during the warranty period. Refer to the chamber manufacturer's Isolator Row Operation and Maintenance manual for guidance on inspection intervals during normal system operation.

**END OF SECTION**

**1. GENERAL****1.1 Summary**

- 1.1.1 Provide labour, materials, products, equipment, and services to complete the installation of corrugated steel pipe (CSP) culverts to grades as indicated in the Contract Documents.

**1.2 Related Requirements**

- 1.2.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.2.2 Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

**1.3 References**

- 1.3.1 The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- 1.3.2 All reference amendments adopted prior to the Bid Closing date of this Project shall be applicable to this Project.
- 1.3.3 All materials, installation and workmanship shall comply with all applicable requirements and standards.
- 1.3.4 OPSS.MUNI 421, November 2018
- 1.3.5 OPSS.MUNI 1801, November 2019

**1.4 Waste Management and Disposal**

- 1.4.1 Comply with the waste management plan developed by the Contractor for the Work in accordance with Section 01 74 00. Comply with the directions of the Contract Administrator regarding waste management and disposal activities.
- 1.4.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- 1.4.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- 1.4.4 Separate for reuse and recycling and place in designated containers Steel, Metal, Plastic waste in accordance with Waste Management Plan.
- 1.4.5 Place materials defined as hazardous or toxic in designated containers.

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- 1.4.6 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.
  - 1.4.7 Ensure emptied containers are sealed and stored safely.
  - 1.4.8 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Consultant.
  - 1.4.9 Divert unused concrete materials from landfill in accordance with Waste Management Plan.
  - 1.4.10 Dispose of unused asbestos cement pipe in accordance with regulations governing disposal of hazardous materials.
  - 1.4.11 Divert unused aggregate materials from landfill in accordance with Waste Management Plan.
  - 1.4.12 Dispose of unused disinfection material at official hazardous material collections site in accordance with Waste Management Plan
  - 1.4.13 Do not dispose of unused disinfection material into sewer system, into streams, lakes, onto ground or in other location where they will pose health or environmental hazard.
  - 1.4.14 Fold up metal banding, flatten and place in designated area for recycling.

## **2 . PRODUCTS**

### **2.1 Materials**

- 2.1.1 Corrugated steel pipe per the standards described in OPSS.MUNI 421

## **3 . EXECUTION**

### **3.1 Installation**

- 3.1.1 Carry out the installation of the subdrainage system indicated in the Contract Documents in general conformance with OPSS.MUNI 421 and OPSS.MUNI 1801, except where the following requirements specify otherwise.
- 3.1.2 Subsection OPSS.MUNI 421.09 of OPSS.MUNI 421 shall also be amended by the addition by the following: Payment for the pipe culvert in metres shall also include the cost of supply, placement and compaction of bedding, backfill material, and existing pavement as specified.
- 3.1.3 Subsection OPSS.MUNI 421.10 of OPSS.MUNI 421 shall also be amended by the addition by the following: Payment for the pipe culvert in metres shall also include the cost of supply, placement

and compaction of bedding, backfill material, and existing pavement as specified.

**END OF SECTION**

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## 1. GENERAL

### 1.1 Summary

- 1.1.1 Provide labour, materials, products, equipment, and services to complete the installation of perforated subdrainage pipe and fittings with granular filter and geotextile filter material to lines and grades as indicated in the Contract Documents.

### 1.2 Related Requirements

- 1.2.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.2.2 Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

### 1.3 References

- 1.3.1 The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- 1.3.2 All reference amendments adopted prior to the Bid Closing date of this Project shall be applicable to this Project.
- 1.3.3 All materials, installation and workmanship shall comply with all applicable requirements and standards.

### 1.4 Waste Management and Disposal

- 1.4.1 Comply with the waste management plan developed by the Contractor for the Work in accordance with Section 01 74 00. Comply with the directions of the Contract Administrator regarding waste management and disposal activities.
- 1.4.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- 1.4.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- 1.4.4 Separate for reuse and recycling and place in designated containers Steel, Metal, Plastic waste in accordance with Waste Management Plan.
- 1.4.5 Place materials defined as hazardous or toxic in designated containers.
- 1.4.6 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.

- 1.4.7 Ensure emptied containers are sealed and stored safely.
- 1.4.8 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Consultant.
- 1.4.9 Divert unused concrete materials from landfill in accordance with Waste Management Plan.
- 1.4.10 Dispose of unused asbestos cement pipe in accordance with regulations governing disposal of hazardous materials.
- 1.4.11 Divert unused aggregate materials from landfill in accordance with Waste Management Plan.
- 1.4.12 Dispose of unused disinfection material at official hazardous material collections site in accordance with Waste Management Plan
- 1.4.13 Do not dispose of unused disinfection material into sewer system, into streams, lakes, onto ground or in other location where they will pose health or environmental hazard.
- 1.4.14 Fold up metal banding, flatten and place in designated area for recycling.

## **2 . PRODUCTS**

### **2.1 Materials**

- 2.1.1 Perforated subdrainage pipe, 150 mm diameter single wall corrugated (rigid) HDPE sub-drain coupled with geotextile sock shall be installed continuously under all curb and gutter.
- 2.1.2 Subdrainage pipe to be installed surrounded by 300mm of 19 mm clear stone.
- 2.1.3 Non-woven geotextile fabric, Terrafix 270R or equivalent, Class I, conforming to OPSS.MUNI 1860.

## **3 . EXECUTION**

### **3.1 Installation**

- 3.1.1 Carry out the installation of the subdrainage system indicated in the Contract Documents in general conformance with OPSS.MUNI 405, except where the following requirements specify otherwise.
- 3.1.2 Excavate trenches where shown on the Contract Drawings or where directed to do so by the Consultant.
- 3.1.3 Excavate subdrainage connector trenches to proposed catch basins. Break into and connect subdrain pipes to the catch basins

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with good connections ensuring no exfiltration can occur. Grades must ensure drainage of perforated pipe into the catch basins.

- 3.1.4 Obtain approval of Consultant before placing geotextile fabric.
- 3.1.5 Install geotextile fabric into the trench, prior to installing any crushed rock. Fabric to be installed without folds and in close contact with sides and bottom of trench. Leave enough fabric projecting from the top of each side of the trench to be folded over the full width of the trench.
- 3.1.6 Supply, place, shape and compacted Granular base material at the bottom of subdrains followed by crushed rock layer to the top of the sub-base of the asphalt pavement as shown on details on Contract Drawings.
- 3.1.7 Supply and install perforated PVC pipe to lines and grades specified, complete with factory produced connectors as required.
- 3.1.8 Fold over the geotextile fabric projecting from each side of the trench onto the top of the crushed rock so as to create a double layer of fabric over the full width of the top of the trench.
- 3.1.9 Do not mix or contaminate the subdrainage granular material with soil or other material.
- 3.1.10 Do not excessively rut prepared subgrade surface while placing or shaping subdrainage granular material or subdrainage system. Reshape and re-compact rutted sections as required.

**END OF SECTION**