

PROJECT MANUAL

Issued for 100% Final Design Package

Volume 1

New Daycare 55 John Street, Toronto

55 John Street, Toronto, Ontario M5V 3C6

Diamond Schmitt Architects and Salter Pilon Architects

Project No. 211018

February 26, 2024

Document Responsibility and Project Directory

1.1 Document Responsibility

- .1 Refer to Project Manual, Section 00 01 10 - Table of Contents, for indication of document responsibility (DR). Abbreviations for entity responsible for document preparation are as follows:
 - .1 A - Denotes documents prepared by Architect.
 - .2 CE - Denotes documents prepared by Communications Engineer.
 - .3 E - Denotes documents prepared by Electrical Engineer.
 - .4 M - Denotes documents prepared by Mechanical Engineer.
 - .5 ES - Denotes documents prepared by Electronic Safety and Security Engineer.
 - .6 O - Denotes documents prepared by Owner.
 - .7 S - Denotes documents prepared by Structural Engineer.
- .2 Professional seals if applied next to company names in the project directory (below) govern only those specification sections and schedules identified by the corresponding document responsibility (DR) abbreviation in Section 00 01 10.

1.2 Project Directory

- .1 Owner:

City of Toronto

Metro Hall – 55 John Street, 2nd Floor
Toronto, Ontario
M5V 3C6

Tel: 416-338-6611

- .2 Architect (the Contract Administrator):

Diamond Schmitt Architects

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

Tel: 416-862-8800

Fax: 416-862-5508

Salter Pilon Architects

151 Ferris Lane, Suite 400
Barrie, Ontario
L4M 6C1

Tel: 705-737-3530

Document Responsibility and Project Directory

.3 Structural Engineer:

Reed Jones Christoffersen Limited

100 University Avenue, North Tower Suite 300
Toronto, Ontario
M5J 1V6

Tel: 416-977-5335

.4 Mechanical Engineer:

The HIDI Group Inc.

155 Gordon Backer Road, Suite 200
Toronto, Ontario
M2H 3N5

Tel: 416-364-2100

.5 Electrical Engineer:

The HIDI Group Inc.

155 Gordon Backer Road, Suite 200
Toronto, Ontario
M2H 3N5

Tel: 416-364-2100

.6 Communications Engineer:

The HIDI Group Inc.

155 Gordon Backer Road, Suite 200
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.7 Electronic Safety and Security Engineer:

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155 Gordon Backer Road, Suite 200
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General Instructions

PART 1 - GENERAL

1.1 The Agreement, Drawings, Schedules, and Specifications

- .1 The Agreement, Drawings, Schedules, and Specifications have been arranged into various divisions, sections, drawings, and schedules for the purpose of presenting the Work in a logical and organized form and to enable ease of reference and interpretation, and are not intended to be an arrangement of precise and independent Subcontractors, or jurisdiction of responsibility for the various parts of the Work. The Contractor shall be solely responsible for coordinating the execution of the Work of this Contract in accordance with the requirements of the Agreement, Drawings, Schedules, and Specifications.
- .2 As a result, the Contract Administrator shall not be required to decide on questions arising with regard to agreements or contracts between the Contractor and Subcontractors or Suppliers, nor to the extent of the parts of the Work assigned thereto.
- .3 Further, no extra will be allowed as a result of the failure to coordinate and allocate the Work such that the Work is Provided in accordance with the Agreement, Drawings, Schedules, and Specifications.
- .4 The Agreement, Drawings, Schedules, and Specifications may specify, indicate, or schedule requirements that exceed the requirements of the building code, other applicable codes, requirements of authorities having jurisdiction, and standards cited in the Agreement, Drawings, Schedules, and Specifications. In such cases, the requirements specified, indicated, or scheduled in the Agreement, Drawings, Schedules, and Specifications shall govern.
- .5 This section coordinates, relates, and governs the work of other sections of the specifications.

1.2 Laws, Notices, Permits and Fees

- .1 The building code - Ontario Regulation 332/12, including amendments, shall govern the Work.
- .2 Comply with codes, by-laws, and regulations of authorities having jurisdiction over the Place of the Work. Codes and regulations form an integral part of the Agreement, Drawings, Schedules, and Specifications.
- .3 Owner shall apply and pay for the building permit. The Contractor shall pick up building permit from the municipal department having jurisdiction at the Place of the Work.
- .4 Arrange for inspection, testing and acceptance of the Work required by the authorities having jurisdiction. Be responsible for necessary preparations, provisions and pay costs.
- .5 Obtain permits required to execute work on municipal rights of way. Obtain damage deposits for sidewalks, roads and services, unless otherwise indicated.

General Instructions

- .6 The Contractor shall provide to the chief building official or the registered code agency, where a registered code agency is appointed under the Ontario Building Code Act in respect of the construction to which the notice relates, the required notices set out in Division C – Part 1 Sentence 1.3.5.1(2) and Sentence 1.3.5.2 of the Ontario Building Code, O. Reg. 332/12 as amended. The Contractor shall be present at each site inspection by an inspector or registered code agency as applicable under Division C – Part 1 Sentence 1.3.5.2 of the building code.

- .1 It is the responsibility of the Contractor to schedule notifications to the chief building official or the registered code agency such that the inspection pertaining to the notifications can be made within the time frame as required under Division C – Part 1 Sentence 1.3.5.3 of the Ontario Building Code, O. Reg. 332/12 as amended, without causing a delay in the Work. The Contractor, at no additional cost to the Owner, shall be solely responsible for any delay in the Work caused by failure to properly schedule required notifications and inspections.

1.3 Examination of the Place of the Work, Documents, Surfaces and Conditions

- .1 Examine the Place of the Work and investigate matters relating to the nature of the Work, means of access and egress, obstacles, rights and interests of other parties which may be interfered with during the execution of the Work, conditions and limitations including obstructions, existing structures or facilities, local conditions, actual levels, character and nature of the Work, and other consideration which may affect performance of the Work.
- .2 Examine the extent of work to be performed and matters which are referred to in the Agreement, Drawings, Schedules, and Specifications prior to start of the Work.
- .3 Examine work to which work is to be applied, anchored or connected, and relevant as-built conditions.
- .4 Each work operation following on a previous work operation of a differing Subcontractor, as in the case of finishing and surfacing work, shall include a thorough examination of the condition of the previous work. Conditions found unacceptable, either for the commencement of the new work or its satisfactory completion, shall be reported in writing to the Contract Administrator.
- .5 Do not commence work until unsatisfactory conditions are corrected. Commencement of work implies acceptance of surfaces, tolerances, and conditions and existing conditions will not be accepted as a contributing factor to subsequent failure or acceptability of the Work.

1.4 Quantity of Items

- .1 Where a component, device, item or part of materials or equipment is referred to in the singular number, such reference shall require the provision of as many components, devices, items or parts of material or equipment necessary to complete the Work.

1.5 Schedule of Values

- .1 The schedule of values specified under GC 5.3.6 shall include line items identifying full costs for the following:
 - .1 Preparation of coordination and interference drawings in accordance with the requirements of Section 01 33 00, with a value not less than 0.5% of the *Contract Price* or \$10,000.00, whichever is greater.

General Instructions

- .2 To Provide mock-ups in accordance with Section 01 45 00.
- .3 Progressive cleaning, specified under Section 01 74 13, as distinct from final cleaning, specified under Section 01 77 00.
- .4 Final cleaning, specified under Section 01 77 00, as distinct from progressive cleaning, specified under Section 01 74 13.
- .5 Preparation and submission of closeout submittals in accordance with the requirements of Section 01 77 00, with a value not less than 0.5% of the *Contract Price* or \$10,000.00, whichever is greater.
- .6 Preparation and submission of the deficiency list in accordance with the requirements of Section 01 77 00.

1.6 Discrepancies and Clarifications

- .1 Advise Contract Administrator of discrepancies discovered in requirements of the Agreement, Drawings, Schedules, and Specifications and request clarification in written form.
- .2 Advise Contract Administrator when clarifications are required pertaining to meaning or intent of requirements of Agreement, Drawings, Schedules, and Specifications and request clarification from Contract Administrator in written form.
- .3 Do not proceed with related work until written clarification is provided by Contract Administrator.
- .4 Failure to notify Contract Administrator shall result in Contractor incurring responsibility for resulting deficiencies and expense at no additional cost to the Owner.
- .5 Written instructions issued by Contract Administrator for the purpose of clarification, implicitly supersede applicable and relevant aspects of the Agreement, Drawings, Schedules, and Specifications irrespective of whether or not these documents are explicitly or specifically cited in clarification requests or clarification instructions.

1.7 Use of Premises and the Place of the Work

- .1 Make good roads, soft landscaping, walkways, curbs, sidewalks, possessions and property, soiled or damaged due to the Work, to requirements of authorities having jurisdiction and requirements of Owner, as applicable.
- .2 Fully protect adjacent site improvements, services, landscaping, and other works using suitable covering and support framing, to prevent damage by construction related activities.

1.8 Work on Public Property

- .1 Include curb cuts and making good of existing property to Provide fully paved and finished approaches to requirements of authorities having jurisdiction.
- .2 Include making good of existing curbs, walks, paving and soft landscaping on adjacent property.

1.9 Setting Out the Work

- .1 Assume full responsibility for and execute complete layout of the Work to required locations, lines and elevations.

General Instructions

- .2 Arrange meeting with Contract Administrator to discuss critical setting out assumptions for the Work and establish limiting conditions for setting out the Work. Contractor shall chair and prepare minutes of the meeting, and prepare and submit sketches recording understanding of key setting out principles.
- .3 Provide devices needed to lay out and construct the Work.
- .4 Preserve bench marks, reference points and stakes.

1.10 Documents at the Place of the Work

- .1 In addition to the documents listed in Schedule D – General Conditions 3.10, maintain at the Place of the Work, one copy of each of following:
 - .1 'Reviewed' or 'Reviewed as Noted shop drawings.
 - .2 Construction and submittal schedules.
 - .3 Supplemental Instructions, Proposed Changes, Change Orders, and Change Directives.
 - .4 RFI responses.
 - .5 Field Test Reports.
 - .6 Contract Administrator's field review reports and deficiency reports.
 - .7 Reports by authorities having jurisdiction.
 - .8 Building and other applicable permits, and related permit documents.
 - .9 Daily log including:
 - .1 Number of workers actively working at the Place of the Work by each subcontract.
 - .2 Subcontractors working at the Place of the Work.
 - .3 Parts of the Work being worked on.
 - .4 Working hours worked at the Place of the Work.
 - .5 Activities with intermittent progress.
 - .6 Time lost and explanation for such time lost.
 - .7 Difficulties (work scheduled to start but did not with the reason why, delays, labour inefficiencies, labour shortage).
 - .8 Products and materials delivered.
 - .9 Equipment mobilized and/or demobilized.
 - .10 Excavation conditions.
 - .11 Demolition conditions.
 - .12 Start and finish date of each part of the Work.
 - .13 Erection and removal dates of formwork.
 - .14 Date, quantities and particulars of each concrete pour.

General Instructions

- .10 As-built drawings recording as-built conditions, instructions, changes for structure, equipment, wiring, plumbing, and the like, as called for in Section 01 77 00 and Divisions 21, 22, and 23 and Divisions 26, 27, and 28, prior to being concealed.

- .2 Make above material available to Contract Administrator upon request.

1.11 Concealed Services

- .1 Conceal wiring, conduit, pipes and ductwork in finished areas, unless otherwise indicated.

1.12 Trademark and Labels

- .1 Trademarks and labels, including applied labels, shall not be visible in finished work in finished areas, unless otherwise accepted or indicated by Contract Administrator.
- .2 The exceptions to this requirement are trademarks and labels which are essential to identify materials, systems, assemblies, and equipment for maintenance and replacement purposes, and for life safety, fire resistance and temperature rise ratings.

1.13 Survey Location Devices

- .1 Replace, at no additional cost to the Owner, any iron pins and survey bars, monuments, geodetic datum and similar reference markers, which are disturbed, moved, or lost in course of construction.

1.14 Waste Audits/Plans for Waste Reduction

- .1 Comply with requirements of authorities having jurisdiction.
- .2 Deliver to nearest appropriate depot materials accepted for recycling by region or municipality having jurisdiction over the Place of the Work, including but not limited to cardboard, paper, plastic, aluminum, steel, and glass. Deliver to nearest appropriate depot scrap and excess gypsum wallboard for recycling of this material. Costs for this work are included in the Contract Price.

1.15 Interferences

- .1 Coordinate placement of equipment to ensure that components will be properly accommodated within spaces provided prior to commencement of the Work.
- .2 Take complete responsibility for remedial work that results from failure to coordinate aspects of work prior to its fabrication/installation.
- .3 Ensure that accesses and clearance required by jurisdictional authorities and/or for easy maintenance of equipment are provided in layout of equipment and services; notify Contract Administrator if indicated clearances are in conflict.
- .4 Prepare coordination and interference drawings in accordance with Section 01 33 00.

1.16 Not In Contract Items and Items Supplied by Owner

- .1 NIC (Not In Contract) shall be used to designate various items of equipment that require coordination for installation although are not Provided as part of the Work.
- .2 Owner supplied material shall be used to designate various items of equipment that will be supplied by the Owner for installation by the Contractor as part of the Work.

General Instructions

- .1 Install items indicated as supplied by Owner during the Work. Coordinate shipping and delivery with the Owner. Store items supplied by Owner at the Place of the Work and protect from damage. Install completely, and leave in full operating condition, in accordance with manufacturer's directions.

1.17 Publicity Releases and Photographs

- .1 No press or publicity releases will be permitted without prior written approval of the Owner.
- .2 No photographs of the Place of the Work or of any portion of the Work will be permitted without written approval of the Owner, except as provided by the Agreement, Drawings, Schedules, and Specifications.

1.18 Electronic Files

- .1 The Contractor shall be provided with 1 set of Issued for Construction digital files in IFC file formats from the Contract Administrator free of charge.
 - .1 Subcontractors and Suppliers requiring Issued for Construction digital files in native file formats shall make arrangements with the Contractor. The Contract Administrator will not provide digital files directly to Subcontractors or Suppliers.
- .2 Prior to delivery of digital files, a BIM data disclaimer shall be signed by the Contractor and any entity requesting digital files.
 - .1 Form of disclaimer shall be provided by the Contract Administrator. An example disclaimer is appended to this section for reference.
- .3 The Contract Administrator or other Contract Administrator /subconsultants may charge a fee for providing the electronic files at the Contract Administrator's or other consultant's/subconsultant's discretion.
 - .1 Payment, where required, shall be made directly to the other Contract Administrator /subconsultant, and not through the Contract Administrator.
- .4 Management of electronic files shall be done using the Contract Administrator's document management system (Newforma):
 - .1 The Contract Administrator shall use, for the digital management of all construction documents, the document management system Newforma.
 - .2 Newforma, as described elsewhere herein, shall be used exclusively by the Contract Administrator in the distribution of RFI responses and return of all submittals, inclusive of, but not limited to: Shop Drawings, Product data, samples, mock-up reviews, close-out documents.
 - .3 Newforma shall be used to issue Supplemental Instructions, Proposed Changes, Change Directives, Change Orders.
 - .4 Newforma shall be used to distribute correspondence to the Contractor, including but not limited to: meeting minutes, CAD files, BIM files, site visit reports, field review reports, deficiency review reports.
 - .5 The Contract Administrator shall not use, manage or consult the Contractor's own data management software.

General Instructions

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

*Architects in Joint Venture for the
Metro Fire Hall and Day Care*

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Project Name: xxx Project No: xxx
File Format(s): RVT, IFC, NWC, DWG No. of Files: x
File Name(s): (See table at the end of disclaimer)

- 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.

File Name	Date
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Allowances

PART 1- GENERAL

1.1 Cash Allowances

- .1 Expenditures from cash allowance stipulated sum shall be directed by Contract Administrator in writing.
- .2 Unexpended amounts of cash allowances shall be deducted from the Contract Price at completion of Work.
- .3 Cash allowances include supply and installation unless otherwise indicated.
- .4 The Contractor is responsible for coordination of parts of the Work to be paid for by cash allowance with the remainder of the Work, including shop drawings and other submittals, in the same manner as with other Subcontractors. Cost for such coordination work is not included in the cash allowance: Include such costs elsewhere in Contract Price.
- .5 Supply only cash allowances include:
 - .1 Net cost of Products.
 - .2 Delivery to the Place of the Work.
 - .3 Applicable taxes and duties (excluding *Value Added Taxes*).
- .6 Supply only cash allowances do not include costs for the following (include such costs elsewhere in Contract Price):
 - .1 Storage and handling at the Place of the Work.
 - .2 Installation costs.
- .7 Supply and install cash allowances include:
 - .1 Net cost of Products.
 - .2 Delivery to the Place of the Work.
 - .3 Unloading, storing, handling of Products on the Place of the Work.
 - .4 Installation, finishing, and commissioning of Products.
 - .5 Applicable taxes and duties (excluding *Value Added Taxes*).
 - .6 Preparation and submission of submittals in accordance with Section 01 33 00.
- .8 Inspection and testing cash allowances include:
 - .1 Net costs of inspection/testing services.
 - .2 Applicable taxes (excluding *Value Added Taxes*).
- .9 Contract Administrator may direct Contractor to obtain bids, at no additional cost to the Owner, for work for which payment is made from cash allowances.
- .10 List of cash allowances
 - .1 The following cash allowances are included in the Contract Price:
 - .1 Supply and install electromagnetic interference (EMI) work including selective shielding work in existing electrical room and floor shielding work in existing building space - refer to Electromagnetic Field Study by C-Intech: \$200,000.00.

Allowances

.2 Independent inspection and testing per Section 01 45 00: \$ to be confirmed.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

Product Substitution Procedures

PART 1 - GENERAL

1.1 Approved Alternates and Approved Equals

- .1 Named Products alternates or equals, indicated by the phrases "or approved alternate by XYZ Manufacturing" or "or approved equal by XYZ Manufacturing", shall be interpreted to mean that named Product alternate or equal, if selected for use in lieu of indicated or specified Product, meets or exceeds performance, appearance, general arrangement, dimensions, availability, code and standards compliance, and colour of specified Product. Be responsible for costs and modifications associated with the inclusion of named Product alternate or equal at no additional cost to the Owner.
- .2 The process for proposing and approving alternates or equals shall be the same process as for proposing and approving substitutions (refer to paragraph 1.2 below).
- .3 Confirm delivery of specified items prior to proposing alternates or equals.

1.2 Substitutions

- .1 Submission of substitutions:
 - .1 Proposals for substitutions of Products and materials must be submitted in accordance with DS-22.4 as supplemented by this section.
 - .2 Contract Administrator may review submissions, if directed by Owner, but in any case with the understanding that the Contract Time will not be altered due to the time required by the Contract Administrator to review the submission and by the Contractor to implement the substitution in the Work.
- .2 Submission requirements:
 - .1 Description of proposed substitution, including detailed comparative specification of proposed substitution with the specified Product.
 - .2 Manufacturer's Product data sheets for proposed Products.
 - .3 Respective costs of items originally specified and the proposed substitution.
 - .4 Confirmation of proposed substitution delivery, in writing by Product manufacturer.
 - .5 Compliance with the building codes and requirements of authorities having jurisdiction.
 - .6 Affect concerning compatibility and interface with adjacent building materials and components.
 - .7 Compliance with the intent of the Agreement, Drawings, Schedules, and Specifications.
 - .8 Effect on Contract Time.
 - .9 Reasons for the request.
 - .10 Detailed availability of maintenance services and sources of replacement materials and parts, including associate costs and time frames.
- .3 Substitutions submitted on shop drawings without following requirements of this section prior to submission of the affected shop drawings will cause the shop drawings to be rejected.

Product Substitution Procedures

- .4 Proposed substitutions shall include costs associated with modifications necessary to other adjacent and connecting portions of the Work.
- .5 Contract Administrator's decision concerning acceptance or rejection of proposed substitutions is final.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

Requests for Interpretation

PART 1 - GENERAL

1.1 Request for Interpretation – RFI

- .1 A request for interpretation (RFI) is a formal process used during the Work to obtain an interpretation of the Agreement, Drawings, Schedules, and Specifications pursuant to Schedule D - General Conditions 2.2.7 through 2.2.10 (inclusive).
 - .1 An RFI shall not constitute notice of claim for a delay.
- .2 Submittal procedures:
 - .1 RFI form:
 - .1 Submit RFI on “Request for Interpretation” in form acceptable to the Contract Administrator, an example of which is appended to this section. The Contract Administrator shall not respond to an RFI except as submitted on the form accepted by the Contract Administrator.
 - .2 Where RFI form does not provide sufficient space for complete information to be provided thereon, attach additional sheets as required.
 - .3 Submit with RFI form necessary supporting documentation. The Contract Administrator shall not respond to an RFI where necessary information is missing, insufficient, unclear, or ambiguous.
 - .2 Submit RFI form as follows:
 - .1 1 copy digitally in pdf format to Contract Administrator using the Contract Administrator’s document management system.
 - .1 Refer to Section 01 10 00 “Electronic Files” paragraph.
 - .2 Submit RFIs sufficiently in advance of affected parts of the Work so as not to cause delay in the performance of the Work. Costs resulting from failure to do this will not be paid by the Owner.
 - .3 RFIs shall be submitted only to the Contract Administrator.
 - .4 RFIs shall be submitted only by Contractor. RFIs submitted by Subcontractors or Suppliers shall not be accepted.
 - .5 Number RFIs consecutively in one sequence in order submitted.
 - .6 Submit one distinct RFI per RFI form.
 - .3 RFI log:
 - .1 Maintain log of RFIs sent to and responses received from the Contract Administrator, complete with corresponding dates.
 - .2 Submit updated log of RFIs with each progress draw submittal.
 - .4 Contract Administrator shall review RFIs from the Contractor submitted in accordance with this section, with the following understandings:
 - .1 Contract Administrator’s response shall not be considered as a Change Order or Change Directive, nor does it authorize changes in the Contract Price or Contract Time or changes in the Work.

Requests for Interpretation

- .2 Only the Contract Administrator shall respond to RFIs. Responses to RFIs received from entities other than the Contract Administrator shall not be considered.
- .5 Allow 10 Working Days for review of each RFI by the Contract Administrator.
 - .1 Contract Administrator's review of RFI commences on date of receipt by the Contract Administrator of RFI submittal and extends to date RFI returned by Contract Administrator.
 - .2 When the RFI submittal is received by Contract Administrator before noon, review period commences that day; when RFI submittal is received by Contract Administrator after noon, review period begins on the next Working Day.
 - .3 If, at any time, the Contractor submits a large enough number of RFIs such that the Contract Administrator cannot process these RFIs within 10 Working Days, the Contract Administrator, will confer with the Contractor within 3 Working Days of receipt of such RFIs, and the Contract Administrator and the Contractor will jointly prepare an estimate of the time necessary for processing same as well as an order of priority between the RFIs submitted. The Contractor shall accommodate such necessary time at no increase in the Contract Time and at no additional cost to the Owner.
 - .4 When RFI submittal has to be reviewed by one or more of Contract Administrator's subconsultants, increase the review period by 5 Working Days for each separate subconsultant.
- .6 Contractor shall satisfy itself that an RFI is warranted by undertaking a thorough review of the Agreement, Drawings, Schedules, and Specifications to determine that the claim, dispute, or other matters in question relating to the performance of the Work or the interpretation of the Agreement, Drawings, Schedules, and Specifications cannot be resolved by direct reference to the Agreement, Drawings, Schedules, and Specifications. Contractor shall describe in detail this review on the RFI form as part of the RFI submission. RFI submittals that lack such detailed review description, or where the detail provided is, in the opinion of the Contract Administrator, insufficient, shall not be reviewed by the Contract Administrator and shall be rejected.

PART 2- PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 General

- .1 Provide the Work in accordance with the Agreement, Drawings, Schedules, and Specifications and be responsible for delays or costs resulting from failure to properly inspect or coordinate the Work, and for replacement or corrective work required.

1.2 Identification of Systems

- .1 Provide identification of electrical and mechanical system installations and other automated systems or equipment in compliance with Agreement, Drawings, Schedules, and Specifications.

1.3 Commissioning and Systems Demonstrations

- .1 Provide testing, adjusting, balancing and certification and commissioning of mechanical and electrical installations and other automated systems or equipment in accordance with Section 01 77 00.
- .2 Instruct Owner's designated representatives in operation and maintenance of mechanical and electrical installations and other automated systems or equipment, in accordance with Section 01 77 00.

1.4 Superintendence

- .1 Provide superintendent and necessary supporting staff personnel who shall be in attendance at the Place of the Work while Work is being performed, with proven experience in erecting, supervising, testing and adjusting projects of comparable nature and complexity.
- .2 The Contractor shall appoint a superintendent at the Place of the Work who shall have overall authority at the Place of the Work and shall speak for the Contractor and represent the Contractor's interest and responsibilities at meetings at the Place of the Work and in dealings with the Contract Administrator and the Owner.

1.5 Dimensions

- .1 Verify dimensions at the Place of the Work before commencing shop drawings. Before fabrication commences report discrepancies to Contract Administrator in writing. Incorporate accepted variances on shop drawings and as-built records.

1.6 Coordination

- .1 Coordinate and ensure workers, Subcontractors, and Suppliers cooperate to ensure that the Work will be carried out expeditiously and in proper sequence.
- .2 Make adjustments to allow adjustable work fit to fixed work.

1.7 Building Dimension, Templates, Built-ins, and Coordination

- .1 Take necessary dimensions for the proper execution of the Work. Assume complete responsibility for the accuracy and completeness of such dimensions, and for coordination.

Coordination

- .2 Provide forms, templates, anchors, sleeves, inserts and accessories required to be fixed to or inserted in the Work and set in place or instruct separate Subcontractors as to their location.
- .3 Supply items to be built in, as and when required together with templates, measurements, shop drawings and other related information and assistance.
- .4 Pay the cost of extra work and make up time lost as a result of failure to provide necessary information and items to be built in.
- .5 Verify that the Work, as it proceeds, is executed in accordance with dimensions and positions indicated which maintain levels and clearances to adjacent work, as set out by requirements of the Agreement, Drawings, Schedules, and Specifications, and ensure that work installed in error is rectified before construction resumes.
- .6 Check and verify dimensions referring to interfacing of services. Verify such dimensions with interconnected portions of the Work.
- .7 Do not scale directly from drawings. Obtain clarification from Contract Administrator if there is ambiguity or lack of information.
- .8 Details and measurements of any work which is to fit or to conform with work installed shall be taken at the Place of the Work.
- .9 Advise Contract Administrator of discrepancies and omissions in the Agreement, Drawings, Schedules, and Specifications that affect aesthetics, or that interfere with services, equipment or surfaces. Do not proceed with work affected by such items without clarification from Contract Administrator.
- .10 Prepare and submit setting drawings, templates and other information necessary for the location and installation of material, holes, sleeves, inserts, anchors, accessories, fastenings, connections and access panels.
- .11 Subcontractors shall direct related Subcontractors on site of specific locations required for sleeves and openings. The Contractor shall be responsible for coordinating such activity to ensure no interruption in the progress of the Work.
- .12 Prepare interference drawings to properly coordinate the Work, where necessitated, in accordance with Section 01 33 00.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

Project Meetings

PART 1 - GENERAL

1.1 Administrative

- .1 The Contractor shall schedule meetings as specified herein, unless specified otherwise.
 - .1 Such scheduling shall be in consultation both with the Owner and with the Contract Administrator.
- .2 The Contract Administrator shall prepare agendas for meetings specified herein.
 - .1 Agendas shall include, as a minimum, the agenda items specified in the Agreement, Drawings, Schedules, and Specifications.
- .3 The Contract Administrator shall distribute written notice of each meeting specified herein, complete with meeting agenda, 5 Working Days in advance of meeting date to the following, each of who shall be responsible for distributing such notices to other affected parties associated with them (such as, for example, Subcontractors in the case of the Contractor):
 - .1 The Contractor.
 - .2 The Owner.
- .4 The Contract Administrator shall chair and record the minutes of meetings specified herein.
 - .1 The Contract Administrator shall distribute copies of minutes to the Owner, the Contractor, and all others in attendance within 3 Working Days after date of meeting.
- .5 Representatives of parties attending meetings shall be authorized to act on behalf of the parties they represent.
- .6 Subcontractors and Suppliers shall attend meetings only when directed by the Contract Administrator, or when specifically called for in the Agreement, Drawings, Schedules, and Specifications.

1.2 Contract Start-Up Meeting

- .1 Within 5 days after award of Contract, request a meeting of parties in Contract to discuss and resolve administrative procedures and responsibilities prior to the commencement of the Work.
 - .1 The Contract Administrator shall chair and minute the Contract start-up meeting, and distribute minutes as described above in Section 01 31 19.
- .2 Attendees at Contract start-up meeting shall include the following:
 - .1 Contractor.
 - .2 Contractor's site superintendent(s).
 - .3 Contractor's mechanical and electrical coordinator.
 - .4 Contract Administrator.
 - .5 Owner.
 - .6 Mechanical Subcontractor.

Project Meetings

- .7 Electrical Subcontractor.
- .3 Agenda to include the following:
 - .1 General:
 - .1 Welcome and Introduction.
 - .2 Owner's guidelines and policies.
 - .3 Communications:
 - .1 Appointment of official representatives of the participants on the Project.
 - .2 Project contact list.
 - .3 Emergency contact list.
 - .4 Correspondence protocols (email, telephone, Newforma).
 - .4 Schedule of progress meetings.
 - .5 Status of permits, fees and requirements of the authorities having jurisdiction.
 - .6 Status of Contract execution.
 - .7 Insurance, transcripts of policies.
 - .8 Workplace Safety and Insurance Board Certificate.
 - .9 Documents at the Place of the Work (Permit Set, Issued Incorporating Addenda Set / Issued for Construction).
 - .2 Contract Modifications and Instructions:
 - .1 Requirements for Contract Modification and interpretation procedures:
 - .1 Requests for Interpretation.
 - .2 Supplemental Instruction.
 - .3 Proposed Changes.
 - .4 Change Directives.
 - .5 Change Orders.
 - .2 Procedures for distribution, approvals, requests for time extension.
 - .3 Submittals:
 - .1 Construction schedule.
 - .2 Submittal procedures and schedule of submittals.
 - .3 Requests for Substitutions / Alternates.
 - .4 Delivery of specified equipment and "long-lead" items.
 - .5 Owner supplied products (SBO items).
 - .4 Newforma – Document management control.
 - .5 Schedule of Values, progress claims, administrative procedures and holdbacks.
 - .6 Site Policies and Logistics.
 - .1 Contractor's safety procedures.

Project Meetings

- .2 Site issues and limitations:
 - .1 Parking.
 - .2 Site access, loading and storage.
 - .3 Garbage and construction waste handling.
 - .4 Hazardous substances.
- .3 Site security.
- .4 Temporary Facilities – signs, offices, storage sheds and utilities.
- .5 Quality control.
- .6 Infection prevention and control requirements (healthcare projects only).
- .7 Insect control.
- .7 Project Close Out:
 - .1 Take-over procedures, acceptance and warranties.
 - .2 Publication to be used for publishing certificate of substantial performance.
 - .3 As-built drawings.
 - .4 Operation and Maintenance manuals.
 - .5 Owner Training.
 - .6 Substantial Performance of the Work.

1.3 Pre-Installation Meetings

- .1 During the course of the Work prior to Substantial Performance of the Work, schedule pre-installation meetings as required by the Agreement, Drawings, Schedules, and Specifications and coordinated with the Contract Administrator.
- .2 As far as possible, pre-installation meetings shall be scheduled to take place on the same day as regularly scheduled progress meetings.
- .3 Attendees at pre-installation meetings shall include the following:
 - .1 Contractor.
 - .2 Subcontractors affected by the work for which the pre-installation meeting is being conducted.
 - .3 Contract Administrator.
 - .4 Manufacturer's representatives, as applicable.
 - .5 Independent inspection and testing company, as applicable.
- .4 Agenda to include the following:
 - .1 Appointment of official representatives of participants in the Project.
 - .2 Review of existing conditions and affected work, and testing thereof as required.
 - .3 Review of installation procedures and requirements.
 - .4 Review of environmental and site condition requirements.
 - .5 Schedule of the applicable portions of the Work.

Project Meetings

- .6 Schedule of submission of submittals, samples, mock-ups, and items for Contract Administrator's consideration.
- .7 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences.
- .8 Requirements for notification for reviews. Allow a minimum of 48 hours' notice to Contract Administrator for review of the Work.
- .9 Requirements for inspections and tests, as applicable. Schedule and undertake inspections and tests.
- .10 Delivery schedule of specified equipment.
- .11 Special safety requirements and procedures.
- .12 Publication to be used for publishing certificate of substantial performance.

1.4 Progress Meetings

- .1 During the course of the Work prior to Substantial Performance of the Work, schedule progress meetings as directed by the Contract Administrator.
- .2 Attendees at progress meetings shall include the following:
 - .1 Contractor.
 - .2 Contractor's site superintendent(s).
 - .3 Contractor's mechanical and electrical coordinator.
 - .4 Contract Administrator.
 - .5 Owner.
 - .6 Mechanical Subcontractor.
 - .7 Electrical Subcontractor.
- .3 Agenda to include the following:
 - .1 Review, approval of proceedings of previous meeting.
 - .2 Review of items arising from proceedings.
 - .3 Review of progress of the Work since previous meeting and Contractor's monthly progress report.
 - .4 Field observations, problems, conflicts.
 - .5 Update construction schedule.
 - .6 Problems that impede compliance with construction schedule.
 - .7 Review of off-site fabrication delivery schedules.
 - .8 Review material delivery dates/schedule.
 - .9 Corrective measures and procedures to regain construction schedule.
 - .10 Revisions to construction schedule.
 - .11 Progress, schedule, during subsequent period of the Work.
 - .12 Review submittal schedules.

Project Meetings

- .13 Review status of submittals.
- .14 Maintenance of quality standards.
- .15 Pending changes and substitutions.
- .16 Review of Contract modifications and interpretations including, but not limited to: requests for interpretation and log, contemplated change orders, Change Orders, Change Directives, Supplemental Instructions, for effect on construction schedule and on Contract Time.
- .17 Review of status of as-built documents.
- .18 Other business.

1.5 Pre-Takeover Meeting

- .1 60 days prior to application for Substantial Performance of the Work, schedule a pre-takeover meeting.
- .2 Agenda to include the following:
 - .1 Review, approval of proceedings of previous meeting.
 - .2 Review of items arising from proceedings.
 - .3 Review of procedures for Substantial Performance of the Work, completion of the Contract, and handover of the Work.
 - .4 Field observations, problems, conflicts.
 - .5 Review of outstanding Contract modifications and interpretations including, but not limited to: requests for interpretation and log, contemplated change orders, Change Orders, Change Directives, Supplemental Instructions, for effect on construction schedule and on Contract Time.
 - .6 Problems which impede Substantial Performance of the Work.
 - .7 Review of procedures for deficiency review. Corrective measures required.
 - .8 Review of arrangements for hydro, heating, and other services.
 - .9 Progress, schedule, during succeeding period of the Work.
 - .10 Review submittal requirements for warranties, manuals, and all demonstrations and documentation required for Substantial Performance of the Work.
 - .11 Review of keying and hardware requirements.
 - .12 Review of status of as-built documents and record drawings.
 - .13 Status of commissioning and training.
 - .14 Review Contractor's deficiency list and status.
 - .15 Cleaning for occupancy.
 - .16 Other business.

1.6 Post-Construction Meeting

- .1 Prior to application for completion of Contract, schedule a post-construction meeting. 5 Working Days prior to date for meeting, Contract Administrator shall confirm a date for meeting based on evaluation of completion requirements.

Project Meetings

.2 Agenda to include the following:

- .1 Review, approval of proceedings of previous meeting.
- .2 Confirmation that no business is arising from proceedings.
- .3 Confirmation of completion of the Contract, and handover of reviewed documentation from the Contract Administrator to the Owner.
- .4 Confirmation of completion of contemplated change orders, Change Orders, Change Directives, and Supplemental Instructions.
- .5 Problems that impede Contract completion.
- .6 Identify unresolved issues or potential warranty problems.
- .7 Confirmation of completion of deficiencies.
- .8 Corrective measures required.
- .9 Confirmation of arrangements for hydro, heating and other services.
- .10 Confirm submittal requirements for warranties, manuals, and demonstrations and documentation for Contract completion are in order.
- .11 Review of procedures for communication during post-construction period.
- .12 Handover of reviewed record documents by the Contractor to the Owner.
- .13 Submission of final application for payment.
- .14 Review and finalize outstanding claims, pricing, and allowance amounts.
- .15 Status of commissioning and training.
- .16 Demobilization and the Place of the Work restoration.
- .17 Review of requests for interpretation log.
- .18 Other business.

1.7 Special Meetings

- .1 Owner and/or Contract Administrator reserve the right to require special meetings which may be held on short notice and at which attendance by Contractor and representatives of affected Subcontractors and Suppliers is mandatory. Contract Administrator shall keep detailed and accurate meeting notes and distribute copies within 3 Working Days to all in attendance and those affected by agreements made at such meetings.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

Construction Progress Documentation

PART 1 - GENERAL

1.1 General

- .1 Schedules required:
 - .1 Construction schedule.
 - .2 Product delivery schedule.
 - .3 Inspection and testing schedule.
- .2 Format:
 - .1 Prepare schedules in the form of a PERT or GANTT or Microsoft Project chart method utilizing Microsoft Project or Primavera Project Planner.
 - .2 Include a separate bar for each trade or operation.
 - .3 Include horizontal time scale identifying the first Working Day of each week.
 - .4 Format for listings: The chronological order of the start of each item or part of the Work.
 - .5 Identification of listings: By systems description.
- .3 Construction schedule:
 - .1 Include the complete sequence of construction activities, including provision for climate and weather.
 - .2 Include the dates for the commencement and completion of each major element of the Work parallel to the sections of the specifications.
 - .3 Show projected percentage of completion for each item as of the first Working Day of each week.
 - .4 Submit draft schedule for review, and incorporate responses to comments identified by Contract Administrator and/or Owner.
 - .5 Show dates for the commencement and completion of inspection and testing.
 - .6 Show dates for the commencement and completion of mock-ups and dates required for review of mock-ups by Contract Administrator.
 - .7 At each date of submission of schedule, indicate progress of each activity.
 - .1 Show changes occurring since previous submission of the construction schedule:
 - .1 Major changes in scope.
 - .2 Change Orders and Change Directives.
 - .3 Activities modified since previous submission.
 - .4 Revised projections of progress and completion.
 - .5 Other identifiable changes.
 - .2 Include a narrative report to define:
 - .1 Problem areas, anticipated delays, and the impact on the schedule.

Construction Progress Documentation

- .2 Corrective action recommended and its impact on the schedule.
- .3 Include cash flow projection with minimum look ahead as directed by the Contract Administrator.
- .8 Submit updated progress schedule to Owner and Contract Administrator at each regularly scheduled progress meeting in accordance with Section 01 31 19. In addition to requirements specified in Section 01 32 00 for each submission of construction schedule, include a written report on the activities completed in the week preceding the progress meeting, and a summary indicating the activities planned to be undertaken in the 2 weeks subsequent to the progress meeting, including human resource loading.
- .9 Submit updated progress schedule to Owner and Contract Administrator with each application for progress payment, indicating actual and projected start and finish dates with report date line and progress. Submit more frequently if requested by Owner or Contract Administrator.
- .4 Product delivery schedule:
 - .1 Include dates for delivery of Products, equipment, finish items, factory-finished manufactured items. Show last dates for order, shipment, and delivery in order to meet construction schedule.
- .5 Inspection and testing schedule:
 - .1 Prepare schedule for inspection and testing by advance discussion with the selected independent inspection and testing company to determine the time required for the independent inspection and testing company to perform its tests and to issue each of its findings, and allow for required time in the construction schedule.
 - .2 Refer to Section 01 45 00 for additional requirements for inspection and testing scheduling.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

Photographic Documentation

PART 1 - GENERAL

1.1 General

- .1 Provide photographic documentation in digital format and in accordance with procedures and submission requirements specified in this section.

1.2 Digital Photographs

- .1 Equipment: Provide photographs using minimum 10 megapixel digital camera.
- .2 Submit the required photographs to the Contract Administrator and to the Owner.
- .3 Output: Supply date stamped maximum resolution colour photos to Contract Administrator in JPEG format, on USB Flash Drive format or via file transfer.
- .4 Number of photos required:
 - .1 Prior to construction: Provide necessary number of photographs, as required to document existing conditions and verify damage to adjacent streets and property that may have existed prior to construction or demolition work: Minimum 50 photos.
 - .2 Each Progress draw: Provide 24 construction photographs each month to accompany each application for progress draw to document the stage of the Work from points selected by the Contract Administrator showing as much as possible of the Work installed during the previous month.
 - .3 Provide minimum of 8 photographs on each meeting report and for each progress meeting.
 - .4 Completion: When the Work is completed, arrange to take final photographs of the Work from a minimum of 8 points of view.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

Submittals

PART 1 - GENERAL

1.1 General Requirements

- .1 Submit submittals as requested by the Agreement, Drawings, Schedules, and Specifications, as specified herein, and in accordance with the conditions of the Contract.
- .2 In addition to submittals specifically requested by the Agreement, Drawings, Schedules, and Specifications, submit other submittals as may be reasonably requested by the Contract Administrator, or as are required to coordinate the Work and to provide the Owner with choices available, within the scope of Agreement, Drawings, Schedules, and Specifications.
- .3 Procedures and requirements for Contract closeout submittals shall be in accordance with the following sections:
 - .1 Section 01 77 00 - Contract Closeout Procedures and Submittals.
 - .2 Section 01 78 36 – Extended Warranties.
- .4 Contractor's review of submittals:
 - .1 Review submittals for conformity to Agreement, Drawings, Schedules, and Specifications before submitting to Contract Administrator. Submittals shall bear stamp of Contractor and signature of a responsible official in Contractor's organization indicating in writing that such submittals have been checked and coordinated by Contractor. Contractor's review shall be performed by qualified personnel who have detailed understanding of those elements being reviewed and of the conditions at the Place of the Work proposed for installation.
 - .2 Check and sign each submittal and make notations considered necessary before submitting to Contract Administrator for review. Where submittal is substantially and obviously in conflict with requirements of Agreement, Drawings, Schedules, and Specifications, reject submittal without submitting to Contract Administrator and request resubmission. Note limited number of reviews of each submittal covered under Contract Administrator's services as specified below.
 - .3 Contractor shall assume sole responsibility for any conflicts occurring in the Work that result from lack of comparison and coordination of submittals required for the Work.
 - .4 Submittals that have not been reviewed, checked, and coordinated by Contractor prior to submission to Contract Administrator, or that do not bear the stamp and signature of Contractor as described above, will be stamped "REVISE AND RESUBMIT" and returned.
 - .5 No changes to the Work or the Agreement, Drawings, Schedules, and Specifications shall be made by way of submittals.
 - .1 Changes to the Work shall only be made following procedures specified for changes in the Work.
 - .2 Submittals that include changes to the Work or the Agreement, Drawings, Schedules, and Specifications shall be stamped "REVISE AND RESUBMIT" and returned.
- .5 Contract Administrator's review of submittals:

Submittals

- .1 Review of submittals by Contract Administrator is for the sole purpose of ascertaining conformance with the general design concepts and the general intent of the Agreement, Drawings, Schedules, and Specifications. This review shall not mean that Contract Administrator approves the detail design inherent in the submittals, responsibility for which shall remain with the Contractor. Such review shall not relieve the Contractor of responsibility for errors or omissions in the submittals, or responsibility for meeting requirements of Agreement, Drawings, Schedules, and Specifications.
- .2 Contractor shall be responsible for dimensions to be confirmed and correlated at the Place of the Work for information that pertains solely to fabrication processes or to techniques of construction and installation, and for coordination of the Work.
- .3 As part of their scope of work, Contract Administrator shall review shop drawings no more than twice. Should three or more reviews be required due to reasons of Contractor omissions causing resubmission requests, then Contractor shall reimburse the Contract Administrator for time expended in these extra reviews. Time shall be invoiced to the Owner (to be deducted from monies due to the Contractor and paid to Contract Administrator by Owner) at rates recommended by Contract Administrator's professional association and disbursements shall be invoiced at Contract Administrator's cost. The Contractor shall cover directly costs and administration associated with courier services and the like for these extra shop drawing reviews.
- .4 Contract Administrator's review and markings on submittals do not authorize changes in the Work or the Contract Time, and will be accommodated at no additional cost to the Owner. If, in the opinion of the Contractor, the Contract Administrator's markings on submittals constitute a change in the Work or will effect a change in the Contract Time, then the Contractor shall so notify the Contract Administrator in writing and request an interpretation following the procedures for requests for interpretation in accordance with Section 01 26 00. If the Contract Administrator finds that the Contract Administrator's markings on submittals do constitute a change in the Work or will effect a change in the Contract Time, then a Change Order will be prepared therefore. The time taken to process such a request for interpretation shall not, in and of itself, constitute a change in the Work nor increase the Contract Time.
- .5 Submittals which are not required by the Agreement, Drawings, Schedules, and Specifications or not requested by the Contract Administrator will not be reviewed by the Contract Administrator and will be marked 'NOT REVIEWED' by the Contract Administrator and returned to the Contractor.
- .6 Make submittals with reasonable promptness and in an orderly sequence so as to cause no delay in the Work. Be responsible for delays, make up time lost and pay added costs, at no additional cost to the Owner, incurred because of not making submittals in due time to permit proper review by Contract Administrator.
 - .1 Once submitted, a submittal shall not be re-submitted until original submission has been reviewed by Contract Administrator and returned to Contractor.
- .7 Submittals that contain substitutions will be rejected. Substitutions are permitted only on substitution submittals as specified in Section 01 25 00.
- .8 Do not proceed with work affected by a submittal, including ordering of Products, until relevant submittal has been reviewed by Contract Administrator.

Submittals

- .9 Prepare submittals using SI (metric) units.
- .10 Contractor's responsibility for deviations in submittal from requirements of Agreement, Drawings, Schedules, and Specifications is not relieved by Contract Administrator's review of submittal, unless Contract Administrator gives written acceptance of specific deviations.
- .11 Engineered submittals:
 - .1 Submittals for items required to be sealed by professional engineer (engineered) shall be duly prepared, sealed, and signed under the direct control and supervision of a qualified professional engineer licensed in the jurisdiction in which the Place of the Work is located, having in force professional liability insurance with minimum coverage limit of \$2,000,000 per claim and annual aggregate.
 - .2 Include with engineered submittal, proof of insurance identifying insurer, policy number, policy term, and limit of liability, on duly signed letterhead and / or certificates of insurance.
 - .3 Design includes life safety, sizing of supports, anchors, framing, connections, spans, and as additionally required to meet or exceed requirements of applicable codes, standards, regulations, authorities having jurisdiction, and design requirements of the Agreement, Drawings, Schedules, and Specifications.
 - .4 Engineered submittals shall include design calculations, complete with references to codes and standards used in such calculations, supporting the proposed design represented by the submittal.
 - .5 Professional engineer responsible for the preparation of engineered submittals shall undertake periodic field review, including review of associated mock-ups where applicable, at locations wherever the work as described by the engineered submittal is in progress, during fabrication and installation of such work, and shall submit a field review report after each visit. Field review reports shall be submitted to the Contract Administrator, to authorities having jurisdiction as required, and in accordance with the building code.
 - .6 Field reviews shall be at intervals as necessary and appropriate to the progress of the work described by the submittal to allow the engineer to be familiar with the progress and quality of such work and to determine if the work is proceeding in general conformity with the Agreement, Drawings, Schedules, and Specifications, including reviewed shop drawings and design calculations.
 - .7 Upon completion of the parts of the Work covered by the engineered submittal, the professional engineer responsible for the preparation of the engineered submittal and for undertaking the periodic field reviews described above, shall prepare and submit to the Contract Administrator and authorities having jurisdiction, as required, a letter of general conformity for those parts of the Work, certifying that they have been Provided in accordance with the requirements both of the Agreement, Drawings, Schedules, and Specifications and of the authorities having jurisdiction over the Place of the Work.
 - .8 Costs for such field reviews and field review reports and letters of general conformity are included in the Contract Price.

Submittals

- .12 Keep copies of reviewed submittals at the Place of the Work in an organized condition. Only submittals that have been reviewed by the Contract Administrator and include the Contract Administrator's Submittal Review Form, as applicable, are permitted at the Place of the Work.
- .13 The Work shall conform to reviewed submittals subject to the requirements of this section. Remove and replace materials or assemblies not matching reviewed submittals at no increase in the Contract Time and at no additional cost to the Owner.

1.2 Schedule of Submittals

- .1 Before commencement of the Work, submit to the Contract Administrator a detailed schedule of submittals required by the Agreement, Drawings, Schedules, and Specifications.
 - .1 Schedule shall be accompanied by a checklist, correlated to each of the schedule of submittals, the construction schedule (specified under Section 01 32 16), the Product delivery schedule (specified under Section 01 32 16), and the schedule of inspections and tests (specified under Sections 01 32 16 and 01 45 00), listing the following:
 - .1 Shop drawings.
 - .2 Samples.
 - .3 Mock-ups.
 - .4 Reviews, tests and inspections by:
 - .1 Manufacturers.
 - .2 Authorities having jurisdiction.
 - .3 The Owner.
 - .4 The Contract Administrator.
 - .5 Independent inspection and testing companies.
 - .5 Demonstration and training.
 - .2 Indicate dates for submitting, review time, resubmission time, float time, and last date for meeting construction schedule.
 - .3 Contract Administrator will review submittal schedule and advise Contractor if volume and timing of submittals will permit timely review and response. Contract Administrator may require modifications to submittals schedule in order to allow adequate time for review of submittals. Adjust submittals schedule and construction schedule as required to comply with Contract Administrator's needs.
 - .4 Make provisions in schedule for at least 10 Working Days for Contract Administrator's review of submittals. When submittals have to be reviewed by one or more of Contract Administrator's subconsultants, add 5 more Working Days for a total 15 Working Day review period.
 - .5 If the Contract Administrator requires resubmission of submittals, allow for an additional 10 Working Days review for each resubmission.

Submittals

- .6 If, at any time, the Contractor submits a large enough number of submittals such that the Contract Administrator cannot process these submittals within 10 Working Days, the Contract Administrator, in consultation with the Contractor within 3 Working Days of receipt of such submittal, will provide the Contractor with an estimate of the time necessary for processing same. The Contractor shall accommodate such necessary time at no increase in the Contract Time and at no additional cost to the Owner.
- .7 The Contractor shall periodically resubmit the submittal schedule to correspond to changes in the construction schedule. Such resubmissions shall maintain the minimum 10 Working Day period for the Contract Administrator's review.
- .8 Schedule submissions of submittals well in advance of scheduled dates for installation, to provide lead time for reviews and possible resubmissions and for placing orders and securing delivery so as to avoid delays in the Work.

1.3 Submission Procedures

- .1 Coordinate each submittal with requirements of the Work and Agreement, Drawings, Schedules, and Specifications. Individual submittals shall include related information.
- .2 Distribute copies of submittals to parties whose work is affected by submittals except Contract Administrator and Owner before final submission for review by Contract Administrator.
- .3 Accompany submittals with transmittal letter containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Contractor's review stamp.
 - .5 Identification and quantity of each submittal.
 - .6 Other pertinent data.
- .4 Each submittal shall be identified numerically by relevant specification section number with a numeric indicator for multiple submittals by that section followed by revisions number, for example 04 05 19-01-R0.
- .5 Submit original PDF documents only: scanned documents shall not be accepted.
- .6 Make any changes in submittal that Contract Administrator may require, consistent with Agreement, Drawings, Schedules, and Specifications, and resubmit as directed by Contract Administrator.
- .7 Notify Contract Administrator, in writing, when resubmitting, of any revisions other than those requested by Contract Administrator.
- .8 After Contract Administrator's review, distribute copies to affected parties.

1.4 Product Data Sheets

- .1 Submit Product data sheets as follows:
 - .1 1 copy digitally in pdf format to Contract Administrator using the Contract Administrator's document management system.

Submittals

- .1 Refer to Section 01 10 00 "Electronic Files" paragraph.
- .2 Submit Product data sheets as called-for by the Agreement, Drawings, Schedules, and Specifications or as the Contract Administrator may reasonably request where shop drawings will not be prepared due to a standardized manufacture of a Product. Manufacturers' catalogue cuts will be acceptable in such cases, providing that they are 213 mm x 275 mm (8-1/2" x 11") originals, and that they indicate choices including sizes, colours, model numbers, options and other pertinent data, including installation instructions. Submissions showing only general information are not acceptable.
- .3 Where requirements of Agreement, Drawings, Schedules, and Specifications are more stringent than design proposed on Product data sheets, the requirements of the Agreement, Drawings, Schedules, and Specifications take priority.
- .4 Upon completion of review by Contract Administrator, 1 marked set of Product data sheets will be returned to Contractor in digital format for reproduction and distribution.
- .5 Retain 1 complete set of prints of reviewed Product data sheets for issuance to Owner immediately prior to Substantial Performance of the Work, in an acceptable, bound manner and in accordance with Section 01 77 00.

1.5 Shop Drawings

- .1 Submit shop drawings as follows:
 - .1 1 copy digitally in pdf format to Contract Administrator using the Contract Administrator's document management system.
 - .1 Refer to Section 01 10 00 "Electronic Files" paragraph.
 - .2 Lettering on shop drawings shall be not less than 3mm (1/8") high.
 - .3 Where requirements of Agreement, Drawings, Schedules, and Specifications are more stringent than design proposed on shop drawings, the requirements of the Agreement, Drawings, Schedules, and Specifications take priority.
 - .4 Contract Administrator markings and resulting action required:
 - .1 Shop drawings requiring no changes will be marked 'REVIEWED', and shall be submitted for as-built drawings purposes.
 - .2 Shop drawings requiring several changes will be marked 'REVIEWED as NOTED' and shall be revised and submitted for as-built drawings purposes.
 - .3 Shop drawings requiring substantial changes will be marked 'REVISE AND RE-SUBMIT' and shall be revised and resubmitted until Contract Administrator stamps drawings with 'REVIEWED' or 'REVIEWED as NOTED'.
 - .5 Shop drawing size shall be multiple of 213 mm and 275 mm (8-1/2" and 11") excluding 38 mm (1-1/2") binding margin and not larger than 838 mm x 1117 mm (33" x 44"). Leave minimum 150 mm x 100 mm (6" x 4") clear space for Contract Administrator's comments.
 - .6 Upon completion of review by Contract Administrator, 1 marked set of shop drawings will be returned to Contractor in digital format for reproduction and distribution.
 - .7 Retain 1 complete set of prints of reviewed shop drawings for issuance to Owner immediately prior to Substantial Performance of the Work, in an acceptable, bound manner and in accordance with Section 01 77 00.

Submittals

- .8 Submit copies of reviewed shop drawings to authorities having jurisdiction as required.
- .9 Shop drawings shall include:
 - .1 Fabrication and erection dimensions.
 - .2 Plans, sections, elevations, arrangements and sufficient full size details which indicate complete construction, components, methods of assembly as well as interconnections with other parts of the Work.
 - .3 Design calculations for items that require design calculations.
 - .4 Clear definition of the division of responsibility for the work described thereon. No Products, items or equipment, or description of work, shall be indicated to be supplied, or work to be done, "By Others" or "By Purchaser". Shop drawings marked with either of these phrases will be rejected without having been reviewed by the Contract Administrator.
 - .5 Location and type of exposed anchors, attachments and locations and types of fasteners, including concealed reinforcements to accept mounted fasteners.
 - .6 Adhesives, joinery methods and bonding agents.
 - .7 Kinds and grades of materials, their characteristics relative to their purpose, detailed description of finishes and other fabrication information.
 - .8 Configurations, types and sizes required; identify each unit type on drawing and on Product.
 - .9 Descriptive names of equipment and mechanical and electrical characteristics when applicable.
 - .10 Data verifying that superimposed loads will not affect function, appearance and safety or work shown on shop drawings, as well as other interconnected work.
 - .11 Assumed design loadings, dimensions of elements and material specifications for load-bearing members.
 - .12 Proposed chases, sleeves, cuts and holes in structural members.
 - .13 Wall thicknesses of metals.
 - .14 Location and types of welds. For structural welds use AWS symbols and clearly show net weld lengths and sizes.
 - .15 Materials, gauges, and sizes being supplied including connections, attachments, reinforcement, anchorage and locations of exposed fastenings.
 - .16 Installation instructions and details for Products to be installed by separate Subcontractors, including function of each part.
 - .17 A list of Products covered by, or included on, the shop drawing. List of Products shall be complete and show manufacturer's name, Product name, generic description, standard certification where specified, manufacturer's complete installation data and precautions against wrong installation, operation and maintenance.
 - .18 Refer to individual sections of the specifications for more particular requirements for shop drawings.

Submittals

- .19 Compatibility statement: Include with each shop drawing a statement that each Product and material indicated on the shop drawing is compatible with each Product and material with which it comes into contact.

1.6 Certificates and Certification Submittals

- .1 Certificates and certifications submittals: Provide a statement that includes signature of entity responsible for preparing certification.

1.7 Engineered Judgements

- .1 When an engineered judgement is required by authorities having jurisdiction, such engineered judgement shall be prepared as an engineered submittal in accordance with Section 01 33 00.

1.8 Project Firestopping Manual and Coordination

- .1 The Contractor shall assign a firestopping and smoke seal firestopping coordinator to coordinate the firestopping details and systems required in the Work. Applicator shall designate a single individual as Project foreperson who shall be present at the Place of the Work throughout the Work.
- .2 Firestopping manual:
 - .1 Contractor and firestopping and smoke seal coordinator shall prepare a preliminary fire stopping manual, inclusive of all firestopping systems in the Work, to be submitted to the Contract Administrator prior to the installation of any firestopping and smoke seal work.
 - .2 Manual shall include:
 - .1 Project key plans of each level, with enlarged key plans at areas where required, which identify and tag each anticipated penetration and fire stopping location and type (i.e. multiple metallic pipes through gypsum board wall assembly; single metallic pipe through concrete floor assembly, and the like)
 - .2 Product data sheets: data and installation instructions for Products providing descriptions sufficient for identification at the Place of the Work.
 - .1 Materials list of Products proposed for use in the Work; complying with listed systems designs.
 - .2 Listing agency's detailed drawing showing joint assemblies and firestopping materials, identified with listing agency's name and number or designation, fire rating achieved, and date of listing.
 - .3 Manufacturers' installation instructions and recommendations.
 - .3 Shop drawings:
 - .1 Submit drawings indicating fire resistance rated assembly number, required temperature, hose stream, and flame rating, material thicknesses, installation methods and materials of firestopping and smoke seals, primers, supports, damming materials as applicable, reinforcements, anchorages, fastenings and methods of installation for each condition to be encountered.

Submittals

- .2 Designate on shop drawings static through penetrations and dynamic joint systems, relative positions, expansion and control joints in rated slabs and walls, and firestopping details.
- .3 Engineered shop drawings; for engineering judgements:
 - .1 Where Project conditions require modification to an accredited third party testing agency's listed system design to address a particular firestopping condition that is not covered by a listed system, submit engineered shop drawings detailing the modifications to the listed system design as an engineering judgment or equivalent fire-resistance-rated assembly, for each Project location and condition.
 - .2 Submit the manufacturer's engineering judgment identification number and shop drawing details prepared by a professional engineer. The engineering judgment submittal shall include both Project name, Project location, and Subcontractor's name who will install firestop system as described in engineering judgement shop drawings.
 - .3 Provide complete details of specific application of listed system and its modifications upon which the engineered judgement is based upon.
 - .4 For perimeter fire barrier systems:
 - .1 Submit engineered shop drawings for engineering judgements covering perimeter fire barrier systems. Identify each cladding assembly type in contact with each perimeter fire barrier system.
 - .4 Fire resistance rating test listings for firestopping and smoke seal systems.
- .3 Firestopping manual shall be submitted within 4 weeks of Contract award.
- .4 Prior to concealment of firestopping conditions above a ceiling or by another assembly or finish, the Contractor shall submit an updated firestopping manual including as-built drawings that identify firestopping conditions and penetrations.
- .3 Closeout submittals:
 - .1 Submit closeout submittals in accordance with Section 01 77 00.
 - .2 Submit the following certification documents with closeout submittals:
 - .1 Manufacturer's certification: Submit manufacturer's certification that installed firestopping and smoke seal Products are suitable for the use indicated and comply with specified requirements.
 - .2 Installation certification: Installer shall submit certification that all joint firestopping system installations are completed and that installations comply with listed systems designs.
 - .3 As-built copy of the firestopping manual.

1.9 Samples

- .1 Submit a minimum of 3 samples unless a greater amount is specified.
- .2 Deliver samples to the following location with expenses, including carrying costs, prepaid, unless otherwise instructed:
 - .1 Contract Administrator's office.

Submittals

- .3 Identify samples or assemblies by Project number and name, name of Contract Administrator, Contractor and Subcontractor, and date of submission. Identify location, specified material reference and any other pertinent information. Show construction by layered method if necessary, clearly displaying textures and patterns.
- .4 Resubmit samples until written acceptance is obtained from Contract Administrator.

1.10 Coordination and Interference Drawings

- .1 The Contractor shall be responsible for preparing and submitting to the Contract Administrator for review, a consolidated set of installation coordination/interference drawings for the building showing how the building systems (including, but not limited to, domestic heating and cooling piping, air distribution systems, air control boxes, reheat coils, fire protection piping, electrical distribution, fire alarm systems, lighting, communication cabling, security cabling, new and existing structural work and conduit runs) will fit together above ceiling areas and in exposed ceiling, to allow ceiling heights required by the Agreement, Drawings, Schedules, and Specifications and by maintenance and control access.
 - .1 Each Subcontractor whose work is affected by the information presented on the coordination and interference drawings shall sign-off on the drawings prior to submission to the Contract Administrator and thereby agrees to coordinate their parts of the Work to preserve the coordination and interference guidelines represented by the coordination and interference drawings.
- .2 Prepare sleeve drawings for work of Divisions 03 and 05 and Divisions 21, 22, and 23, and Divisions 26, 27, and 28 showing size and location of penetrations through load bearing elements. Submit sleeving drawings in electronic form to Contract Administrator for review not less than 10 Working Days prior to construction of affected work.
- .3 Prepare embedded conduit drawings, showing size and location of penetrations through load bearing elements. Submit embedded conduit drawings in electronic form to Contract Administrator for review not less than 10 Working Days prior to construction of affected work.
- .4 Prepare insert setting drawings for work to be cast into concrete and/or mortared into masonry elements. Submit insert setting drawings in electronic form to Contract Administrator for review not less than 10 Working Days prior to construction of affected work.
- .5 Coordinate placement of equipment to ensure that components will be properly accommodated within spaces Provide prior to commencement of Work. In areas where equipment and services are exposed care shall be taken to organize and layout services in an organized and orderly manner. Where possible services are to run parallel or at right angles to one another as required. Contract Administrator may request that service layout be reconfigured to suit sightline concerns during the coordination drawings review phase. These drawing changes are to be executed at no additional cost to the Owner.
- .6 Take complete responsibility for remedial work that results from failure to coordinate the Work prior to fabrication and installation.
- .7 Ensure that accesses and clearance required by jurisdictional authorities and/or for easy maintenance of equipment are Provided in layout of equipment and services.

Submittals

- .1 Indicate required access points, clearances, and sizes for equipment and pieces of equipment required in the Work. Note areas where access is compromised by interferences with other services for review by the Contract Administrator. Do not proceed with installation of equipment in such compromised areas until a proposed means of providing access has been accepted by the Contract Administrator.
- .8 Prepare and circulate coordination, interference and sleeving drawings prior to placing orders for equipment and materials.
- .9 Coordination and interference drawings shall be circulated for mark-ups by Subcontractors responsible for work of Divisions 3, 5, 9, 11, 14, Divisions 21, 22, and 23, and Divisions 26, 27, and 28.
- .10 Coordinate preparation and submission of coordination and interference drawings with shop drawings.
- .11 Show cross sections in key areas, as required, and as defined by Contract Administrator. Show re-bar, structural elements, piping, air handling and heating systems distribution, sprinkler system distribution, lighting, gypsum board wall and ceiling assemblies, acoustical isolation, Products and systems involving life safety, conveying systems, electrical distribution.
- .12 Show ductwork as 2 lines. Show cross sections in key areas, as required, and as directed by Contract Administrator. Show re-bar, structural elements, air handling and heating systems distribution, gypsum board wall and ceiling assemblies, acoustical isolation, Products and systems involving life safety, conveying systems, and electrical distribution.
- .13 Coordination and interference drawings shall be produced in uniform scale on media that will allow overlays to be assembled. Upon incorporation of details, drawings shall be submitted to Contract Administrator for review. Areas of conflict or interference shall be resolved in a mutually agreed manner between Subcontractors and resubmitted on coordination and interference drawings until accepted by Contract Administrator.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

Special Procedures for Work in Occupied Buildings

PART 1 - GENERAL

1.1 General Procedures

- .1 For the purposes of this section:
 - .1 The words “worker” or “workers” shall mean the Contractor, Contractor’s staff or employees, Subcontractors, Subcontractor’s staff or employees, Suppliers, Supplier’s staff or employees, or anyone engaged for the Work, directly or indirectly, by the Contractor, unless otherwise indicated.
 - .2 The words “make good” or “making good” shall mean that, when a finish or material has been altered, the material or finish shall be repaired or replaced, and refinished to match existing quality and appearance to acceptance of Contract Administrator, and that repaired or replaced and refinished Work shall not be discernible from existing materials or finishes when judged by the Contract Administrator from a viewing distance of 1830 mm (6'), and that such work is included in the Contract Price.
- .2 Operational limitations:
 - .1 The existing building will remain in full use and occupancy throughout the Work, except for such parts of the building that have been vacated for the Work.
 - .2 Contractor’s use of the Place of the Work is limited to permit regular use of existing Owner’s facilities to continue with the least amount of interference and disruptions possible.
 - .3 In consultation with, and to acceptance of, the Contract Administrator in the presence of the Owner, designate an entrance and a circulation route that workers shall use and that shall not be used by Owner’s staff, building occupants, or the public.
- .3 Dust tight enclosure and partition doors and entrance doors to the Place of the Work shall remain closed.
- .4 Areas of the existing building adjacent to the Place of the Work or areas affected by the Work, including circulation and access routes, shall be maintained in a clean state equivalent to the level of cleanliness maintained in the existing building, and as follows:
 - .1 Clean and vacuum the Place of the Work and areas surrounding the Place of the Work daily or more frequently as required.
 - .2 Wet mop floor areas in vicinity of access doors to the Place of the Work daily, or more frequently as required.
 - .3 Vacuum carpeted areas daily or more frequently as required.
 - .4 Wet clean carpets in accordance with manufacturer’s recommendations once work in such areas is complete.
 - .5 Final cleaning shall be in accordance with Section 01 77 00.
- .5 Waste protection and removal:
 - .1 Waste management and disposal shall be in accordance with Section 01 74 19 as supplemented herein.

Special Procedures for Work in Occupied Buildings

- .2 Transport waste in containers with tightly fitting lids or cover waste with a wet sheet.
- .3 Remove waste as it is created. Debris shall be contained and covered if it can not be removed immediately.
- .4 Do not transport waste through occupied areas of existing building.
- .5 Remove waste at the end of each Working Day through construction access routes.
- .6 Document condition of the existing building in areas immediately adjacent to the Place of the Work by means of construction photographs in accordance with Section 01 32 33.

1.2 Security

- .1 The Contractor shall be solely responsible for securing the Place of the Work and the Work, and for securing areas used for the storage of Products or construction machinery and equipment. The Owner shall have no responsibility in this regard.
 - .1 Provide and maintain security lighting.
 - .2 Provide and maintain temporary locks. Premises to be locked after working hours.
- .2 Provide security for the Place of the Work by methods compatible with the security system for the existing building.
 - .1 Contractor shall coordinate the Work with the Contract Administrator in the presence of the Owner in order to ensure no disruption to the existing building's security system.
 - .2 Where existing building's security system is breached due to Contractor's negligence, be responsible for any damage or theft of property, regardless if area where damage or theft occurred is under Contractor's control or not.

1.3 Use of Existing Facilities

- .1 Restrict access, parking, material deliveries, execution of work, operations and procedures to designated locations and times and do not deviate from designated procedures without prior acceptance by the Contract Administrator in the presence of the Owner.
- .2 Periodically review proposed construction operations with the Contract Administrator in the presence of the Owner and cooperate as required to ensure that Owner's interests and requirements are not unduly compromised with regard to the normal operation and function of occupied areas on the existing building.
- .3 Traffic through occupied areas of the existing building shall be kept to a minimum. Travel within occupied areas of the existing building shall be via the most direct route.
- .4 Noise, dust and debris, and odours shall be minimized to ensure building occupants in adjacent areas are disturbed as little as possible. Corrective action to cease or limit disagreeable annoyances to building occupants shall be implemented immediately upon notification by the Contract Administrator or the Owner.
- .5 Use of existing garbage chutes shall not be permitted.
- .6 Use of existing containers and garbage bins shall not be permitted.

Special Procedures for Work in Occupied Buildings

- .7 Confirm access to existing elevators with the Owner.
- .8 Existing fire protection equipment:
 - .1 Existing fire protection equipment shall only be used in an emergency situation.
 - .2 Do not remove existing fire protection equipment.
 - .3 If any existing fire protection equipment is used or interfered with in any way, the Owner's fire equipment inspector shall be retained to inspect, test, recharge, and otherwise repair such equipment at no additional cost to the Owner.
- .9 Sanitary facilities:
 - .1 The Owner will designate existing washrooms for use of workers.
 - .1 Regularly maintain and clean these washroom facilities, in compliance with applicable regulations, codes and by-laws, for the duration of the *Work*.
 - .2 At Substantial Performance of the Work, turn over to Owner, clean washroom facilities, in same condition facilities were prior to commencement of the Work. Arrange and pay for repairs, making good and replacement if necessary, as directed by Contract Administrator.
 - .3 Provision of such access to existing washrooms does not relieve the Contractor of the responsibility to Provide and maintain, in compliance with applicable regulations, codes and by-laws, sufficient sanitary temporary water closets and washbasins for use of workers as required by applicable regulations, codes and by-laws.
 - .4 Additional sanitary temporary water closets and washbasins for use of workers, as required, shall be provided at no additional cost to the Owner.

1.4 Parking

- .1 A parking area will be designated for the use of workers engaged for the Project.
 - .1 Use of the parking area shall be by vehicles with parking permits only.
 - .2 Designation in underground Parking will be agreed during the preconstruction meeting.
 - .3 Obtain parking permits from the Owner. There will be no cost for the parking permit. The parking permit validity duration will be determined by the Owner.
 - .4 Submit a list of vehicles for which permits are required to the Owner. The list shall include the make, model, year, and licence plate number for each vehicle. The list shall be updated at least once a month, or more frequently as required.
- .2 Throughout the Work, ensure that there is no interference with the operation of the existing premises, and that the existing parking areas and road system remain free and clear of obstructions.
- .3 The Contractor will be responsible for cost of street parking.
- .4 Illegally parked vehicles will be ticketed and/or towed at vehicle owner's expense, and at no additional cost to the Owner.

Special Procedures for Work in Occupied Buildings

1.5 Existing Services Interruptions

- .1 Connection or disconnection of services that will interfere with the operation of the Owner's facilities shall not be done without the prior written acceptance of the Contract Administrator in the presence of the Owner and during the times designated by the Owner. Premium charges associated with such work shall be included in the Contract Price.
- .2 Provide at least 10 Working Days' prior written notice to the Contract Administrator and the Owner of requirement or intention to interrupt services, and obtain written permission of the Contract Administrator in the presence of the Owner prior to commencing such interruption.
- .3 In no instance shall interruptions affect the entire existing building.
- .4 As far as possible, coordinate interruptions with the Owner's regular maintenance of building services and systems.
- .5 Areas adversely affected by changes in air flows outside the construction areas as a result of a required shut-down of portions of the existing HVAC system within the construction areas are to be re-balanced to comfortable levels as advised by the Contract Administrator.
- .6 Should existing services be interrupted in breach of the above, Make Good immediately and provide protection against further such disruptions. Costs resulting from such interruptions and for making good shall be the responsibility of the Contractor at no additional cost to the Owner.

1.6 Protection of the Existing Building

- .1 Protection requirements shall be in accordance with Section 01 50 00, as supplemented herein.
- .2 Keep Place of the Work safe and secure, denying access to unauthorized personnel.
- .3 Protect existing work from damage. Make Good any damage caused. The onus is on the Contractor to substantiate that damage existed prior to commencement of the Work.
- .4 Do not overload the existing structure due to the Work.
- .5 Take special measures to protect existing work from damage when moving heavy loads or equipment. Protect areas used as passageways or through which materials are moved. Use resilient tired conveyances only when moving materials and equipment inside building. Provide coverings as required to protect existing work from damage.
- .6 Separate exterior access, work and storage areas from Owner occupied existing areas, with fencing and hoarding. Rearrange fencing/hoarding as Work progresses to suit extent and configuration of the Work.
- .7 Provide guards, barricades and other temporary protection to prevent injury to persons.
- .8 Protect existing building components and contents from damage by weather, when executing Work affecting integrity of the building envelope. Provide temporary insulated and air tight weatherproof closures to protect openings made in existing building envelope. Make Good existing building components and contents damaged by weather resulting from inadequate temporary protection measures.
- .9 Protection of existing occupied areas:

Special Procedures for Work in Occupied Buildings

- .1 Existing exterior walls with windows of plain glazing, when exposed to the Work, shall be protected with 16 mm (5/8") gypsum board for interior surfaces and 9.5 mm (3/8") exterior grade plywood for exterior surfaces, mounted on suitable framing.
 - .1 Plywood: in accordance with Section 06 10 53.
 - .2 Metal framing: in accordance with Section 09 22 00.
 - .3 Gypsum board: in accordance with Section 09 29 00.
- .2 Maintain such protection throughout the Work.
- .3 Other openings in the existing exterior walls, such as doors and louvres, shall be similarly protected or replaced with doors of solid core wood or hollow steel construction.

1.7 Emergency and Fire Protection

- .1 Provide and maintain ready access to fire protection equipment, in accordance with Section 01 50 00.
- .2 Provide temporary fire resistant closures at existing areas openings exposed to construction areas for the Work to maintain fire and life safety of existing building.
- .3 Contractor shall coordinate the work with the Owner in order to ensure no disruption to the existing fire detection and annunciation systems. Failure to provide such coordination shall result in the Contractor incurring the responsibilities and expenses associated with disruption to the existing fire detection and annunciation systems at no additional cost to the Owner.
 - .1 Provide fire watch when existing fire detection and annunciation systems are not operational or on bypass.
 - .2 Whenever a changeover time occurs, which is an outage time of at least a portion of the fire alarm system, the municipal fire department shall be notified of the temporary shutdown and alternative measures shall be devised.
- .4 Contractor shall coordinate the work with the Contract Administrator in the presence of the Owner in order to prevent unapproved disruptions to the existing sprinkler system, standpipe system, or other fire protection systems.
 - .1 Where temporary shut-down is necessitated, such shut down shall be in accordance with the requirements of authorities having jurisdiction and the building code.
- .5 Obtain 'Hot Work Permit' from Owner prior to hot work operation, which may cause the building's fire alarm system to be activated or create an unwarranted fire risk condition. The prevention of fires and false fire alarms caused by hot work operations is the primary goal of this procedure. Gas hoses, backflow preventers, fire resistive tarpaulins, curtains and other cutting and welding equipment must be in good repair before the permit is issued.
 - .1 'Hot Work' is defined as work using open flames or sources of heat that could ignite materials in the work area.
- .6 Fire separations:

Special Procedures for Work in Occupied Buildings

- .1 Maintain the integrity of fire separations, fire protection systems, and fire rated assemblies.
- .2 Make Good fire separations, fire protection, and fire rated assemblies compromised as a result of the Work.
- .7 Temporary fire separations:
 - .1 Provide temporary fire separations between existing occupied floor areas and new areas under construction.
 - .2 Construct temporary fire separations out of steel studs and gypsum board to provide a construction equivalent to a minimum of 1 hour fire resistance rating, unless otherwise indicated.
 - .1 Firestopping and smoke sealant: in accordance with Section 07 84 00.
 - .2 Gypsum board: in accordance with Section 09 29 00.
 - .3 Steel studs: in accordance with Section 09 22 00.
 - .3 Where access is required, the doorway shall be protected by a door of solid core wood or hollow steel construction.
 - .4 Finish hardware equivalent to a minimum of 1 hour fire resistance rating, unless otherwise indicated.
- .8 Maintaining existing building exit facilities:
 - .1 Maintain exit facilities serving the existing building.
 - .2 Where an exit is blocked-off or deleted as a result of the Work, an alternative exit shall be Provided that is acceptable to the Contract Administrator, the Owner, and authorities having jurisdiction.
 - .3 Where it is necessary for access to be gained to an exit through the Place of the Work, the access shall be clearly defined and protected so that it is separated from construction areas by a smoke tight fire separation equivalent to a minimum of 1 hour fire resistance rating, unless otherwise indicated.
- .9 Fire department access:
 - .1 Do not obstruct access route designated for fire department equipment.
 - .2 If it is necessary that existing access routes be obstructed or deleted, alternative access routes acceptable to the fire department and in accordance with the requirements of the Agreement, Drawings, Schedules, and Specifications and authorities having jurisdiction shall be Provided prior to commencement of work that will obstruct or delete existing access.
- .10 Combustible materials:
 - .1 Stockpiling of combustible materials adjacent to or inside the existing building shall not be acceptable.
- .11 Temporary protection of openings in fire separations:
 - .1 Openings in existing floor assemblies and vertical fire rated assemblies required by the Work, shall be temporarily protected with materials as required to maintain continuity of the required fire resistance rating for existing fire rated assembly.

Special Procedures for Work in Occupied Buildings

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

Quality Control

PART 1 - GENERAL

1.1 Section Includes

- .1 General administrative and procedural requirements for quality assurance and quality control as specified elsewhere in the Agreement, Drawings, Schedules, and Specifications.

1.2 Related Requirements

- .1 Pre-installation meetings: in accordance with Section 01 31 19.
- .2 Materials and workmanship quality assurance and reference standards: in accordance with Section 01 60 00.
- .3 Balancing and testing of systems - under Divisions 21, 22, and 23, and Divisions 26, 27, and 28.

1.3 Contractor's Quality Assurance Program

- .1 Within thirty (30) Days after the Effective Date, submit to the Owner and the Contract Administrator for their information, a quality assurance program (the "QA/QC Plan").
- .2 The QA/QC Plan shall meet the requirements of Canadian Standards Association CSA Z299.3 or such other requirements as set out in the Agreement, Drawings, Schedules, and Specifications.
 - .1 The QA/QC Plan shall be designed so that quality requirements are obtained by progressive implementation of the controls and inspection functions stated in the QA/QC Plan.
 - .2 The Contractor shall make any modifications to the QA/QC Plan as reasonably requested by the Owner and/or the Contract Administrator.
 - .3 The QA/QC Plan shall include, but shall not be limited to, the following:
 - .1 A system by which changes to the Agreement, Drawings, Schedules, and Specifications and correspondence with Subcontractor and other correspondence is handled in a controlled manner.
 - .2 A system for purchased or manufactured materials to be identified, inspected to the specified standard, and covered by a material test report.
 - .3 A system by which measuring and testing equipment is properly stored, handled, and calibrated to a known standard.
 - .4 A system by which incoming materials are: inspected to the specified standard; accepted; allocated safe storage; and properly recorded.
 - .5 A system by which process inspection requirements shall be clearly stated for operations and carried out by qualified personnel.
 - .6 A system by which final inspections will be carried out and accepted by authorized personnel prior to release for shipping or major assembly.
 - .7 A system by which non-conformance to requirements of the Agreement, Drawings, Schedules, and Specifications shall be recorded and solutions proposed by the Owner or the Contract Administrator are also recorded.

Quality Control

- .8 A system by which instructions for handling and storage of equipment shall be given.
 - .9 A system by which Owner Supplied Material items can be inspected and received in a manner which allows replacement or correction.
 - .10 A system by which a record of quality inspections, tests, and actions shall be kept.
 - .11 A system by which the Owner and the Contract Administrator shall be afforded access to manufacturing areas and quality records and issued with copies of pertinent drawings and manufacturing schedules.
- .3 The Contractor shall provide the Owner and the Contract Administrator with regular Quality Assurance Reports for their information according to an agreed schedule.

1.4 Contractor's Field Quality Control

- .1 The Contractor is responsible for field quality control of the Work including quality control of Subcontractors and material Suppliers.
- .2 Ensure that the only specified or approved Products and materials are used.
- .3 Provide and maintain an effective quality control program, in accordance with the QA/QC Plan, and perform sufficient inspections and tests of all items of work, including those of Subcontractors, to ensure compliance with Agreement, Drawings, Schedules, and Specifications.
- .4 Furnish appropriate facilities, instruments, and testing devices required for performance of the quality control function.
- .5 Required certificates of inspection testing or approval shall be secured by the Contractor and delivered to the Owner in such time as not to delay progress of the Work.
- .6 The Contractor shall develop a field quality control manual covering both factory and field installation. The form of the manual shall be reviewed and accepted by the Contract Administrator. This manual will document quality control practices of the Contractor, Subcontractors, and major Suppliers. The manual shall include, but not be limited to, specific criteria related to:
 - .1 Concrete slab moisture and pH testing and surface preparation, including flatness and levelness.
 - .2 Surface preparation.
 - .3 Fastener and anchor installation.
 - .4 Air barrier continuity: identify continuity of air barrier systems, including joints and overlapping of dissimilar systems.
 - .5 Air barrier, adhesion testing.
 - .6 Sealant mixing, tack time, set time.
 - .7 Sealant staining of porous substrate testing.
 - .8 Sealant adhesion testing, including butterfly tests where applicable.
 - .9 Painting, verification and adhesion testing where required.
 - .10 Material compatibility testing.

Quality Control

- .11 On line fabrication quality control practices.
 - .12 Shipping.
 - .13 Field installation.
 - .14 Field inspection and testing (by Contractor).
 - .15 Field inspection and testing (independent).
- .7 Inspection and testing shall be performed by company qualified to perform the inspections or tests specified or required.
- .8 The Contractor is to maintain a logbook (copies to be provided to the Contract Administrator at completion of fabrication) documenting date, time, results, and significance of in-plant testing carried out, where applicable, linked to daily production. The form of this logbook shall be reviewed and accepted by the Contract Administrator.

1.5 Independent Inspection and Testing – Owner’s Quality Assurance

- .1 Independent inspection and testing services will be used to verify compliance with requirements of the Agreement, Drawings, Schedules, and Specifications. These services do not relieve the Contractor of responsibility for compliance with the Agreement, Drawings, Schedules, and Specifications.
- .1 Specified tests, inspections, and related actions do not limit the Contractor’s other quality assurance and control procedures that facilitate compliance with the Agreement, Drawings, Schedules, and Specifications requirements.
 - .2 Requirements for the Contractor to provide quality control services required by Contract Administrator, Owner, or authorities having jurisdiction are not limited by provisions of this section.
 - .3 Inspections and tests specified or required that are not specified as independent inspection and testing are the responsibility of the Contractor and are not covered under the Owner’s quality assurance requirements.
- .2 The Contract Administrator will, on behalf of Owner, appoint independent inspection and testing companies, representing, reporting and responsible to the Owner through the Contract Administrator.
- .1 Cost of independent inspection and testing company services will be authorized as a disbursement from Cash Allowance as specified in Section 01 21 00. Independent inspection and testing company shall submit monthly invoice original to Contractor for review, relating invoices to tests and inspection reports. Provide original receipts for disbursements. Invoices for independent inspection and testing services shall be forwarded by Contractor to Contract Administrator for inclusion in progress payment application.
 - .3 Additional testing services required because of changes in materials, proportions of mixes requested by Contractor or Subcontractors as well as additional testing services for materials occasioned by lack of identification or by failure of such materials being replaced to meet requirements of the Agreement, Drawings, Schedules, and Specifications or testing of structure or elements including load testing, shall be carried out at no additional cost to the Owner.

Quality Control

- .4 Inspection and testing required by codes or ordinances, or by an authority having jurisdiction, and made by a legally constituted authority, shall be the responsibility of the Contractor and shall be paid for by the Contractor and not be paid by Owner, unless otherwise specified in the Agreement, Drawings, Schedules, and Specifications.
- .5 Inspection or testing performed exclusively for Contractor's convenience shall be sole responsibility of Contractor, and will not be paid by Owner.
- .6 Independent inspection and testing shall be performed by company qualified to perform the inspections or tests specified or required.
- .7 Requirements of regulatory companies:
 - .1 Testing shall be conducted in accordance with requirements of the building code.
 - .2 Obtain certification where required by the building code and standards.
- .8 Cooperation with independent inspection and testing companies:
 - .1 Provide independent inspection and testing companies with materials and installation information as required and /or requested.
 - .2 Provide access to the Work for representatives of independent inspection and testing companies.
 - .3 Cooperate with independent inspection and testing companies and give adequate notification of any changes in source of supply, additional work shifts and other proposed changes.
 - .4 Permit access to the Work for independent inspection and testing companies wherever the Work is in progress, or wherever Products, materials, or equipment are stored prior to shipping.
 - .5 Supply labour required to assist independent inspection and testing companies in sampling and making tests.
 - .6 Repair work damaged as a result of inspection and testing work.
 - .7 Inspection and testing company services do not relieve the Contractor of responsibility for normal shop and site inspection, and quality control of manufacturing and installation.
- .9 Where evidence exists that defective workmanship may have occurred, or that the Work may have been carried out incorporating defective materials, or tests demonstrate that installed conditions do not comply with the requirements of the Agreement, Drawings, Schedules, and Specifications, the Contract Administrator reserves the right to have appropriate inspections, tests, and surveys performed, analytical calculation of structural strength made and the like in order to help determine the extent of defect and whether such work must be replaced. Inspections, tests, and surveys carried out under these circumstances will be made at the Contractor's expense, and will not be paid by Owner, unless the results indicate that the work so tested, inspected or surveyed is not defective or that, in Contract Administrator's opinion, the work so tested, inspected, or surveyed may be accepted, in which case tests, inspections or surveys will be paid by Owner.
- .10 Prepare schedule for independent inspection and testing company services in accordance with Section 01 33 00 and as follows:
 - .1 Establishing schedule:

Quality Control

- .1 By advance discussion with the independent inspection or testing company, determine the appropriate time necessary to perform the required services and to issue related reports.
- .2 Allow for required time within construction schedule.
- .2 Adherence to schedule:
 - .1 Contractor shall advise independent inspection and testing companies in advance when inspection and testing of the Work is required.
 - .1 Amount of advance notice shall be as required by the independent inspection and testing company, but shall be no less than 2 Working Days.
 - .2 When independent inspection and testing company is ready to perform inspection and testing according to predetermined schedule, but is prevented from inspection and testing or taking specimens due to incompleteness of the parts of the Work scheduled for inspection and testing, extra costs for inspection and testing attributable to the delay may be back-charged to Contractor at no additional cost to the Owner.
- .3 Notify independent inspection and testing company at least 3 Working Days before work required to be inspected commences, and arrange for a meeting at the Place of the Work, to be held 1 Working Day before the work starts with the following present:
 - .1 The Contractor, and the Subcontractor responsible for the work to inspected and/or tested, the independent inspection and testing company representatives, the product manufacturer's representative when required, and the Contract Administrator.
- .4 Give 2 Working Days' prior notice to independent inspection and testing company of the commencement of each phase of the Work requiring inspection, and provide independent inspection and testing company with materials and installation information.
- .11 Reports and documents:
 - .1 Independent inspection and testing company shall submit shop inspection and site inspection reports within 5 Working Days of each inspection.
 - .2 Distribute reports as follows:
 - .1 Digitally on 3 USB drives and via electronic transfer.
 - .3 Independent inspection and testing companies shall submit a written report for each inspection or test, including pertinent data such as conditions at the Place of the Work, dates, test references, locations of tested materials, actual Product identification, testing methodology, procedures, and descriptions, site instructions given, recommendations and/or any other information required by standard applicable to reporting of tests and inspections.
 - .1 Report shall clearly indicate failure of Product or procedures to meet applicable standards, give recommendations for retesting or correction. Inspector shall contact Contractor and Contract Administrator immediately when Product or Product assembly fails to meet requirements of the Agreement, Drawings, Schedules, and Specifications.

Quality Control

- .4 Upon completion of portions of the Work subject to independent inspection and testing, submit to the Contract Administrator duplicate certificates of acceptance of the installation issued by the independent inspection and testing company.
- .12 Inspection and test specimens:
 - .1 Inspection and testing will, generally, consist of procedures listed in the following paragraphs, but additional tests may be performed as required to verify conformance to Agreement, Drawings, Schedules, and Specifications.
 - .2 Specimens and samples for testing, unless otherwise specified in the Agreement, Drawings, Schedules, and Specifications, will be taken by the independent inspection and testing company; sampling equipment and personnel will be provided by the independent inspection and testing company; and deliveries of specimens and samples to the testing company will be performed by the testing company unless otherwise specified.
 - .3 Independent inspection and testing company shall take samples necessary to verify quality as specified. Taking of samples shall not endanger the structure or life safety, and shall be taken so as to best represent the Work as a whole.
 - .4 Samples shall be handled, packaged, stored and delivered in accordance with specified tests. Sample handling where required shall duplicate conditions at the Place of the Work (such as site-cured concrete cylinders).

1.6 Mock-Ups

- .1 Provide field or shop erected example of work complete with specified materials and workmanship.
- .2 Erect mock-ups at locations as specified and as acceptable to Contract Administrator. Do not proceed with work for which mock-ups are required prior to Contract Administrator's review of mock-ups.
- .3 Protect and maintain mock-ups until directed to be removed. Commence work demonstrated in mock-up only after review and acceptance of workmanship. Mock-ups may not become part of finished work, except with explicit, prior, written acceptance of Contract Administrator.
- .4 Reviewed and accepted mock-ups will become standards of workmanship and material against which installed work will be compared.
- .5 Remove and replace materials or assemblies not matching reviewed mock-ups.
- .6 Resubmit mock-ups until written acceptance is obtained from Contract Administrator.

1.7 Manufacturer's Field Review

- .1 Where manufacturer's field review is specified, manufacturer's representative shall review the relevant parts of the work at the Place of the Work, or wherever such affected work is in progress, to ensure that work is being executed in accordance with manufacturer's written recommendations and verify its product to be fit-for-purpose intended.
- .2 Manufacturer's field review is to ensure that the Products specified are being used in the Work and are being applied on surfaces prepared in accordance with their recommendations and the requirements of the Agreement, Drawings, Schedules, and Specifications.

Quality Control

- .3 Unless otherwise indicated, manufacturer's representative shall undertake a minimum of 1 field review, with additional reviews as deemed necessary by the manufacturer, to determine that the work of such sections is in accordance with the manufacturer's written recommendations.
- .4 Manufacturer's representative shall submit a type-written report on manufacturer's letterhead within 2 Working Days after each field review. Report shall document manufacturer's representative's field observations and recommendations.
- .5 Manufacturer's field review reports shall be prepared and distributed following the procedures specified for preparation and submittal of inspection and testing reports given above.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

Temporary Facilities and Controls

PART 1 - GENERAL

1.1 General Instructions

- .1 Temporary facilities and controls specified in this section shall be supplemented as applicable in accordance with Section 01 35 13.
- .2 Arrange, obtain and pay cost for permits required for temporary facilities and controls.
- .3 Provide and maintain temporary facilities and controls for the Work and remove them from the Work upon issuance of certificate of Substantial Performance of the Work.
- .4 Arrange and pay for required temporary services, unless otherwise indicated by Contract Administrator.
- .5 Protect and maintain without interruption, existing water, heating, drainage, telephone and other services within the Place of the Work to existing buildings not within the scope of the Work of this Contract. Obtain written permission of the Owner for services required to be temporarily shut off, at least 2 full Working Days in advance.
- .6 Do not use permanent conveying, mechanical, or electrical systems, except standpipe for firefighting, during the course of the Work unless specific written permission is provided by the Contract Administrator. Use of permanent facilities or services for temporary construction service shall not prejudice warranties.
- .7 Provide connection and disconnection of temporary services and facilities required in the Work, including connection to existing services made available by the *Owner*.

1.2 Existing Services and Facilities

- .1 Do not use any existing services and facilities during construction unless specific written permission is provided by Owner.
- .2 Where existing services are made available by the Owner, Provide meters for measuring usage, the costs for which usage and meters shall be the responsibility of the Contractor.

1.3 Temporary Electrical Services

- .1 Provide and maintain an adequate temporary electrical service for performance of the Work including, but not limited to, operation of electric pumps, motors, vibrators and other power tools, hoisting and related construction and general illumination during the Work.
 - .1 Use existing power, where available, subject to Owner's approval. Pay for usage at rates stipulated by the Owner.
- .2 Provide and maintain any components and equipment necessary to transform supply power to necessary temporary power voltage.

1.4 Temporary Water Supply

- .1 Provide and maintain a temporary supply of water for use in the Work.
 - .1 Use existing water supply, where available, subject to Owner's approval. Pay for usage at rates stipulated by the Owner.
- .2 Extend supply pipe or pipes from nearest available sources and maintain in good condition until permanent system is installed and ready for use.

Temporary Facilities and Controls

1.5 Temporary Sanitary Facilities

- .1 Temporary sanitary facilities shall be in accordance with Section 01 35 13.

1.6 Temporary Site Offices

- .1 Owner shall make available to Contractor a designated space within existing building for use as temporary site office of sufficient size to accommodate site meetings for 12 people. Furnish with meeting table and chairs, drawing layout table, filing cabinets, telephone, and Wi-Fi as described below.

1.7 Temporary Telephone, and Wi-Fi

- .1 Provide and maintain a telephone in temporary site office for exclusive use of Contract Administrator, Contractor, and Subcontractors. Pay phone is not acceptable.
- .2 Superintendent shall be equipped with mobile telephone device.
- .3 Long distance charges shall be paid by party making call.
- .4 Provide and maintain internet access for the Contract Administrator and other guests through a high bandwidth Wi-Fi hub capable of supporting traffic with 50 connected devices simultaneously; provide for the use of the Contract Administrator a Wi-Fi enabled colour printer capable of printing 11" x 17" format.

1.8 Temporary Heating and Ventilation

- .1 Provide and pay for temporary heating, cooling and ventilating required for the Work, including attendance, maintenance and fuel.
- .2 Provide temporary heat and ventilation as required to:
 - .1 Facilitate continuous uninterrupted progress of the Work.
 - .2 Protect the Work and Products against damage and defacement caused by weather, harmful levels of temperature, humidity, and moisture.
 - .3 Provide ambient temperatures and humidity levels for proper storage, installation and curing of materials, in accordance with specified standards and manufacturer's requirements.
 - .4 Provide adequate ventilation to meet health regulations for safe working environment.
- .3 Solid fuel salamanders will not be permitted.
- .4 Furnish other temporary heating as required by various sections of the specifications or by Product manufacturers.
- .5 Replace with new, any work damaged due to failure to provide adequate heat at no cost to Owner.

1.9 Temporary Enclosures and Protection

- .1 Provide temporary enclosures and protection of adequate construction to prevent dispersion of dust and dirt into other areas of existing building and to prevent dispersion of dust and dirt beyond the Place of the Work.

Temporary Facilities and Controls

- .2 Provide temporary weather-tight enclosures and protection for exterior openings in building as soon as walls, floors and roofs are built so as to protect the Work from weather and vandalism. Provide doors in enclosures as necessary to maintain fire exits.
- .3 Temporary enclosure and protection shall be of finished appearance and painted to colour approved by Owner.
- .4 Provide dust seal and sound resistant enclosures to protect existing building and operations as indicated. Include temporary doors, fastenings and keys.
- .5 Insulate and airseal exterior enclosures to prevent condensation and drafts.
- .6 Supplement these requirements in accordance with Section 01 35 13.

1.10 Signs and Notices

- .1 Project sign:
 - .1 Design and erect a 1220 x 2440 mm (4' x 8') free standing project sign including overlaid plywood, backing posts, post foundations, framing and installation.
 - .2 Sign shall contain information regarding the project, Owner, Contract Administrator, Contractor and other information as required.
 - .3 Sign shall be professionally finished according to the design provided by Contract Administrator.
 - .4 Location of sign: In prominent location to Contract Administrator acceptance.
- .2 Contract Administrator signs:
 - .1 Install at the Place of the Work corporate signs as provided by Contract Administrator.
 - .2 Location of sign: In prominent location to Contract Administrator's acceptance.
 - .3 Mount sign on suitable supports.

1.11 Plant, Machinery and Scaffolding

- .1 Provide formwork, scaffolding, equipment, tools, machinery, including lifts, and incidental appurtenances necessary for the proper execution of the Work.
- .2 Erect plant, machinery and scaffolding to permit access to building and the Work.
- .3 Use scaffolds in such manner as to interfere as little as possible with other trades' operations.
- .4 Support scaffolds from finished surfaces only after taking precautions to prevent damage. No supports, clips, brackets, or similar devices shall be welded, bolted, or otherwise affixed to any finished member or surface without prior permission.

1.12 Site Storage

- .1 Handle and store materials so as to prevent damage or defacement to the Work and surrounding property.
- .2 Construct weather-tight storage sheds for storage of materials that may be damaged or defaced by weather. Provide floors raised 150 mm (6") clear of ground for storage of Products.

Temporary Facilities and Controls

- .3 Owner is not responsible for securing Products or materials at the Place of the Work.

1.13 Protection of the Public

- .1 Provide fencing, barricades, hoarding, notices and warning boards and maintain lights and signals for protection of workers engaged on the Work, for protection of adjoining property and for protection of the public.
- .2 Such protective measures shall be finish painted to Owner's approved colour, when visible to the public.
- .3 Where any special hazard exists from which it is not possible to protect the public safety by other means, watchpersons shall be employed to preserve public safety until the area of special hazard no longer poses a risk to public safety.

1.14 Protection of the Work

- .1 Protect the Work from damage, discolouring, and defacement. Maintain protection until the Work is complete.
- .2 Protect completed work from soiling, abrasion, punctures, damage, and defacement, and maintain protection until the surrounding or overhead work is complete.
- .3 Keep surfaces free of oils, grease or other materials that may damage or deface them or affect bond of applied Products.
- .4 Remove and replace materials damaged or defaced as a result of failure to provide adequate protection.
- .5 Have damaged or defaced work corrected by workers meeting qualification requirements of the Agreement, Drawings, Schedules, and Specifications.
- .6 Provide minimum 3 mm thick Masonite board protection, or finish flooring manufacturer approved alternative, to all finished floors.
- .7 Contractor shall provide the Contract Administrator a minimum of 15 Working Days prior written notice of the intent to drive vehicles or heavy equipment over finished floors or floor slabs and submit supporting data. Any shoring or other supplementary support required shall be provided by the Contractor at no increase in the Contract Price and at no additional cost to the Owner.

1.15 Protection of Foundations

- .1 In cold and freezing weather, prevent heaving of foundations due to freezing action of ground.

1.16 Protection of Concrete Floors to Remain Exposed in Finished Work

- .1 Non-marking protection material shall be placed over concrete floors designated as exposed.
- .2 Post the following on warning signs at locations leading to areas of where concrete floors are to remain exposed in finished work (see Concrete Floor Contractors Association of Canada):
 - .1 Concrete floors shall be protected from staining, damage and excessive loading at all times:

Temporary Facilities and Controls

- .1 No traffic is permitted on new concrete floors for the first 3 days after placement.
- .2 Foot traffic is permitted between 3-7 days after placement (curing materials must be replaced where disturbed by traffic).
- .3 Scissorlifts and light equipment are permitted 7 days after slab placement.
- .4 Vehicles shall be diapered to prevent oil and other liquid spills (remove leaking equipment from the jobsite immediately).
- .5 Tires shall be non-marking or taped with non-marking tape to prevent marking of the floors.
- .6 Trucks, forklifts and any other heavy loads may only to be placed on the floor if they have been previously approved by the Contract Administrator.
- .7 Spills shall be cleaned up immediately to avoid permanent staining of the concrete.
- .8 Concrete shall be protected from scratching and impact damage at all times. No cutting, painting, welding or other injurious activities shall be performed without protecting the concrete from damage prior to the commencement of work.

1.17 Pest Control

- .1 Provide rodent control and other pest control programs during the Work in accordance with the requirements of authorities having jurisdiction.

1.18 Control of Dust, Debris and Noise

- .1 Cover or wet down dry materials and rubbish to prevent blowing dust and debris.
- .2 Control dust and dirt produced during the Work to prevent dispersion beyond the immediate work areas.
- .3 Prevent materials from contaminating air beyond application area, by providing temporary enclosures and ventilation/filtration.
- .4 Limit noise levels in accordance with requirements of authorities having jurisdiction and the Owner.
- .5 Prevent abrasive-blasting, pressure-washing spray, and other extraneous materials from contaminating air beyond application area.
- .6 Supplement these requirements in accordance with Section 01 35 13.

1.19 Security

- .1 Provide security for the Place of the Work in accordance with Section 01 35 13.

Temporary Facilities and Controls

1.20 Design and Safety Requirements for Temporary Facilities

- .1 Be responsible for design, erection, operation, maintenance and removal of temporary structural and other temporary facilities. Engage and pay for registered professional engineering personnel skilled in the appropriate disciplines to perform these functions where required by law or by the Agreement, Drawings, Schedules, and Specifications; and in cases where such temporary facilities and their method of construction are of such a nature that professional engineering skill is required to produce safe and satisfactory results.
- .2 Engage and pay for professional engineer(s) registered in Place of the Work to design and supervise construction and maintenance of hoardings, covered ways, protective canopies and project sign(s). Designs provided by Contract Administrator or Owner for such work cover general appearance only.

1.21 Moisture Control

- .1 Concrete slabs shall be properly cured and dried before installation of finished flooring assemblies.
 - .1 Allow for one of the following methods:
 - .1 Drying time.
 - .2 Drying action by mechanical methods.
 - .3 Moisture mitigation coating as specified below.
 - .4 Drying action by other method and/or materials as approved by affected flooring manufacturer.
- .2 Before installation of weather barriers, when materials are subject to wetting, protect as follows:
 - .1 Protect porous materials from water damage.
 - .2 Protect stored and installed material from flowing or standing water.
 - .3 Keep porous and organic materials from coming into prolonged contact with concrete.
 - .4 Remove standing water from decks.
 - .5 Keep deck openings covered or dammed.
- .3 After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture, protect as follows:
 - .1 Do not load or install gypsum board or other porous materials or components, or items with high organic content, into partially enclosed building.
 - .2 Keep interior spaces reasonably clean and protected from water damage.
 - .3 Periodically collect and remove waste containing cellulose or other organic matter.
 - .4 Discard or replace water-damaged material.
 - .5 Do not install material that is wet.
 - .6 Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.

Temporary Facilities and Controls

- .4 After completing and sealing of the building enclosure but prior to the full operation of permanent heating, ventilation, and air conditioning systems, maintain as follows:
 - .1 Control moisture and humidity inside building by maintaining effective drying conditions.
 - .2 Use permanent heating, ventilation, and air conditioning system to control humidity subject to the prior written approval of the Contract Administrator.
 - .3 Comply with manufacturer's written requirements for temperature, relative humidity, and exposure to water limits.

PART 2 - PRODUCTS

2.1 Moisture Mitigation Coating

- .1 100% solids epoxy one coat system, 0 VOC, suitable for application to 100% RH floors per ASTM F2170-19a, designed to protect moisture sensitive adhered flooring systems from elevated moisture and alkalinity levels, warranted by manufacturer to cover subsequent flooring materials and labour, compatible with finish flooring products.
- .2 ASTM E96/E96M-13 water vapour transmission (wet methods) performance shall be documented by independent testing laboratory at a minimum 97% for water vapour transmission reduction compared to untreated concrete.
- .3 ASTM E96/E96M-13 perm rating shall not exceed a 0.10 Perm rating.
- .4 ASTM D1308-02(2013) insensitivity to alkaline environment up to, and including, pH 14 in a 14 day bath test.
- .5 Manufacturer certifies acceptance and exposure to continuous topical water exposure after final cure.
- .6 Water vapour reduction system shall be a single coat, stand alone system with no requirements for additional components such as sand broadcast for adhesion of flooring systems.
- .7 System shall reduce Calcium Chloride readings of up to 25lbs/1000 ft²/24 hrs by 97% in one coat. System must be able to perform as required with RH Probe readings of 100%.
- .8 Acceptable manufacturers that provide Products which are known to meet above performance criteria as follows:
 - .1 Koster American Corporation as distributed by DRE Industries.
 - .2 Substitutions: in accordance with Section 01 25 00.

PART 3 - EXECUTION

3.1 Moisture Mitigation Coating

- .1 Preparation and installation shall be in accordance with manufacturer's written requirements.
- .2 Field quality control:
 - .1 Conduct quality control in accordance with Section 01 45 00:
 - .1 Field tests and inspections:

Temporary Facilities and Controls

- .1 Test for moisture vapour transmission in accordance with ASTM F710-22 and ASTM F1869-22 or ASTM F2170-19a in accordance with manufacturer's written flooring installation requirements. Results must not exceed $170 \mu\text{g}/\text{m}^2$ (3 pounds per 1,000 square feet) in 24 hours when tested to ASTM F1869-22, or exceed 75% when tested to ASTM F2170-19a.
 - .2 Test for surface pH. Levels of pH shall not exceed the written recommendations of the flooring manufacturer and adhesive manufacturer. Test in accordance with ASTM F710-22.
 - .3 For each test type: Conduct 3 tests for flooring applications up to 93 m^2 (1000 square feet) in area, and 1 additional test for each additional 93 m^2 (1000 square feet) of flooring area.
 - .4 Testing shall be conducted by independent inspection and testing company and in accordance with Section 01 45 00.
- .2 Manufacturer's field review to be in accordance with Section 01 45 00.

END OF SECTION

Product Requirements

PART 1 - GENERAL

1.1 Availability of Products

- .1 In the event of delays in supply of Products, and should it subsequently appear that the Work may be delayed for such reason, Contract Administrator reserves the right to substitute more readily available Products of similar character, at no additional cost to the Owner.

1.2 Product Handling

- .1 Handle and store Products in a manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturers' and Supplier's recommendations and so as to ensure preservation of their quality and fitness for the Work, and protect from vandalism and theft.
- .2 Store packaged or bundled Products in original and undamaged condition with manufacturer's seals and labels intact, facing to outside. Do not remove from packaging or bundling until required in the Work.
- .3 Store materials susceptible to environmental damage in a weathertight enclosure raised clear of ground so that they are protected from weather, dampness and deterioration. Do not use such materials which have been damaged by exposure to moisture.
- .4 Keep sand, when used as ingredients for grout, mortar or similar mixed materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- .5 Store sheet materials, lumber and other Products susceptible to deterioration on flat, solid supports and keep clear of ground or slab. Slope to shed moisture.
- .6 Handle materials to preclude damaging existing surfaces and work of others.
- .7 Remove damaged Products and replace with new undamaged Products.
- .8 Transportation:
 - .1 Pay cost of transportation of Products required in performance of Work.
 - .2 Transportation cost of Products supplied by Owner will be paid for by Owner. Unload, handle and store such Products at the Place of the Work.
 - .3 Reject Products damaged during transport.
 - .4 Transportation of Products must be undertaken to suit construction schedule. Contractor is responsible for determining mode of transport to ensure delivery, obtaining shop drawings, placement of orders, and on-time premium costs, air freight, and the like.

PART 2 - PRODUCTS

2.1 Product Requirements and Quality

- .1 Compatibility of options: If given option of selecting between two or more Products, select Product compatible with products previously selected, even if previously selected products were also options.

Product Requirements

- .2 Products and Product installation shall be in compliance with building code, regulations and requirements of authorities having jurisdiction.
- .3 Specified options: The Work is based on materials, Products and systems specified by manufacturer's catalogued trade names, references to standards, by prescriptive specifications and by performance specifications.
 - .1 Where only one manufacturer's trade name is specified for a Product, the Product is single sourced and shall be supplied by the specified manufacturer.
 - .2 Where more than one manufacturer's trade name is specified for a Product, supply one Product from list of Products specified.
 - .3 When a Product is specified by reference to a standard, select one Product from manufacturer that meets or exceeds the requirements of the standard and manufacturer's written application directions.
 - .4 When a Product or system is specified by prescriptive or performance specifications, Provide one Product or system which meets or exceeds the requirements of the prescriptive or performance specifications and manufacturer's written application directions.
 - .5 The onus is on the Contractor to prove compliance with governing published standards, prescriptive specifications and with performance specifications.
 - .6 Visual selection specification:
 - .1 Where specifications include the phrase "as selected by Contract Administrator from manufacturer's full range" or similar phrase, select a product that complies with requirements. Contract Administrator will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.
 - .7 Visual matching specification:
 - .1 Where specifications require "match Contract Administrator's sample", provide a product that complies with requirements and matches Contract Administrator's sample. Contract Administrator's decision will be final on whether a proposed product matches.
- .4 Products, materials, equipment and articles (referred to as Products throughout the Agreement, Drawings, Schedules, and Specifications) incorporated in the Work shall be new, not damaged or defective, and of the quality standards specified, for the purpose intended. If requested, furnish evidence as to type, source and quality of Products Provided.
- .5 Basis of design:
 - .1 Where Agreement, Drawings, Schedules, and Specifications list "basis of design", this indicates the Product or system that was used in the preparation of the design included in the Agreement, Drawings, Schedules, and Specifications, and which may be deemed as an acceptable Product.
 - .2 The basis of design establishes the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products from other manufacturers.

Product Requirements

- .3 This does not preclude the use of other Products or systems in the Work, provided the proposed Product or system complies with the design and performance requirements contained in the Agreement, Drawings, Schedules, and Specifications, and Products or systems proposed for use in the work that are not the named basis of design follow procedures for product substitutions specified under Section 01 25 00.
- .6 Where Agreement, Drawings, Schedules, and Specifications list acceptable Products or acceptable manufacturers, select as applicable, one Product meeting performance of specifications and manufacturer's written application directions.
- .7 Where Agreement, Drawings, Schedules, and Specifications require design of a Product or system, and minimum material requirements are specified, the design of such Product or system shall employ materials specified within applicable section. Where secondary materials or components are not specified, augment with materials meeting applicable code limitations, and incorporating compatibility criteria with adjacent work.
- .8 Defective Products, whenever identified prior to completion of the Work, will be rejected, regardless of previous reviews. Review of the Work by the Contract Administrator or independent inspection and testing companies does not relieve the Contractor of the responsibility for executing the Work in accordance with the requirements of the Agreement, Drawings, Schedules, and Specifications, but is a precaution against oversight or error.
- .9 Should dispute arise as to quality or fitness of Products, the decision rests strictly with Contract Administrator based upon the requirements of the Agreement, Drawings, Schedules, and Specifications.
- .10 Unless otherwise indicated in the Agreement, Drawings, Schedules, and Specifications, maintain uniformity of Product and manufacturer for any like item, material, equipment or assembly for the duration of the Work.
- .11 Products exposed in the finished work shall be uniform in colour, texture, range, and quality, and be from one production run or batch, unless otherwise indicated.
- .12 Permanent labels, trademarks and nameplates on Products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical, electrical, machinery or like rooms.
- .13 Owner retains right to select from choices available within specified Products for colours, patterns, finishes or other options normally made available. Submit full range of Product options in accordance with 01 33 00 for such selection.
- .14 Quality control:
 - .1 Implement a system of quality control to ensure compliance with Agreement, Drawings, Schedules, and Specifications.
 - .2 Notify Contract Administrator of defects in the Work or departures from intent of Agreement, Drawings, Schedules, and Specifications that may occur during construction. Contract Administrator will recommend appropriate corrective action in accordance with requirements of the Contract.
- .15 Exposed to weather: Products and materials in environments not protected by the building's HVAC and/or climate control systems shall be considered exposed to weather.

Product Requirements

2.2 Inserts, Anchors, and Fasteners

- .1 Use only factory made, threaded or toggle type inserts as required for supports and anchors, properly sized for load to be carried.
- .2 Where inserts cannot be placed, use factory made expansion shields for light weights only.
- .3 Supply and locate inserts, holes, anchor bolts and sleeves during placement or fabrication of structural elements.
- .4 Fasteners stressed in withdrawal are not acceptable, except where otherwise indicated.
- .5 Metal fastenings shall be uniform to metals materials and components being anchored or of a metal which will not set up a galvanic action causing damage to the fastening or metal component under moist conditions.
- .6 Fastenings for prefinished materials shall be of concealed type unless otherwise indicated, and when exposed finish is required, of matching prefinishing materials.
- .7 Metal fastenings and accessories shall be same texture, colour and finish as material on which they occur, as selected by Contract Administrator.
- .8 Power actuated fasteners:
 - .1 Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E1190-11(2018) conducted by a qualified independent testing agency.
 - .2 Do not use power actuated fasteners which are stressed in withdrawal in finished work.
 - .3 Do not use power actuated fasteners within 100 mm (4") of the edge of concrete or masonry, unless otherwise accepted in writing by Contract Administrator.
 - .4 Do not use power actuated fasteners in post-tensioned concrete.

PART 3 - EXECUTION

3.1 Manufacturer's Instructions

- .1 Unless otherwise indicated in the Agreement, Drawings, Schedules, and Specifications, install or erect Products in accordance with manufacturer's written requirements. Do not rely on labels or enclosures supplied with Products. Obtain written requirements directly from manufacturers.
- .2 Notify Contract Administrator in writing, of conflicts between the Agreement, Drawings, Schedules, and Specifications and manufacturer's requirements.
- .3 Improper installation or erection of Products, due to failure in complying with these requirements, authorizes Contract Administrator to require removal and re-installation at no additional cost to the Owner.
- .4 Manufacturers' representatives shall have access to the Work at all times. Contractor shall render assistance and facilities for such access in order that the manufacturers' representatives may properly perform their function.

Product Requirements

3.2 Overloading

- .1 Protect the building from loads which may cause permanent deformation.
- .2 Protect the Work from loads which may cause permanent deformation.

3.3 Galvanic/Dissimilar Metal Corrosion

- .1 Insulate dissimilar metals from each other by suitable plastic strips, washers or sleeves to prevent galvanic corrosion where conductive liquid or electrolyte (rainwater or condensation) exists.

3.4 Penetrations

- .1 Holes or voids created in assemblies or partitions for penetrating mechanical, electrical, or sprinkler service items, shall be of sufficient size to accommodate the penetrating item as well as additional required fill materials, such as sealants, firestopping and smoke sealants, insulation, and the like, without exceeding the maximum opening allowable by the manufacturer of the additional required fill material and design requirements appropriate for size of penetration.
 - .1 Finish penetrations in areas exposed to view to satisfaction of Contract Administrator.

3.5 Product Installation Requirements

- .1 General:
 - .1 Execute the Work using workers experienced and skilled in the respective duties for which they are employed.
 - .2 Do not employ an unfit person or anyone unskilled in their required duties.
 - .3 Upon request by the Contract Administrator, submit proof, in the form of Certificate of Recognition (COR) or equivalent OHS Certification to verify Subcontractor's qualifications and experience meet or exceed the requirements of the Agreement, Drawings, Schedules, and Specifications.
 - .1 If, upon review of the COR or equivalent OHS Certification, it is found that the Subcontractor does not meet the qualification requirements specified in the Agreement, Drawings, Schedules, and Specifications pertaining to the parts of the Work for which the Subcontractor has been retained, the Contractor shall replace the unqualified Subcontractor with a qualified Subcontractor, satisfactory to the Contractor and the Owner, at no additional cost to the Owner and at no increase in the Contract Time.
 - .4 Remove Products or materials that have been broken, chipped, cracked, discoloured, abraded, or damaged during construction period and Provide undamaged Products or materials meeting the requirements of the Agreement, Drawings, Schedules, and Specifications.
- .2 Coordination:
 - .1 Ensure cooperation of workers in layout of the Work. Maintain efficient and continuous supervision.
 - .2 Be responsible for coordination and placement of openings, sleeves and accessories.

Product Requirements

- .3 Backer plates:
 - .1 Provide backer plates to support and provide anchorage base to carry loads from surface or recessed applied materials.
- .4 Concealment:
 - .1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
 - .2 Before installation, inform Contract Administrator of any contradictory situation. Install as directed by Contract Administrator.
- .5 Cutting and remedial work:
 - .1 Perform cutting and remedial work required to make parts of the Work come together. Coordinate the Work to ensure this requirement is maintained. Obtain permission from Contract Administrator before commencing any cutting. Refer also to requirements of Section 01 73 29.
- .6 Location of fixtures:
 - .1 Consider location of fixtures, access panels, outlets and mechanical and electrical items indicated as approximate only. Locate fixtures, and the like approximately; Architectural drawings will relate these items to known dimensions, such as ceiling tile grid or wall locations and the like.
 - .2 Obtain Contract Administrator's acceptance for precise locations of fixtures, access panels, outlets, mechanical, and electrical items.
 - .3 Contract Administrator reserves the right to relocate electrical outlets and mechanical fixtures at a later date, but prior to installation, without cost, provided that the relocation per outlet does not exceed 3050 mm (10') from the original location.
 - .4 Inform Contract Administrator of conflicting installations. Install only as directed by Contract Administrator.
- .7 Protection of work in progress:
 - .1 Take reasonable and necessary measures, including those required by authorities having jurisdiction, to Provide protection.
 - .2 Adequately protect parts of the Work completed or in progress. Parts of the Work damaged or defaced due to failure in providing such protection is to be removed and replaced, or repaired, as directed by the Contract Administrator, at no additional cost to the Owner.
 - .3 Prevent overloading of any part of the building. Do not cut, drill or sleeve any load bearing structural member without written permission of Contract Administrator, unless specifically indicated. Refer also to Section 01 73 29.
 - .4 Adequately protect finished flooring from damage. Take special measures when moving heavy loads or equipment on them.
 - .5 Keep floors free of oils, grease or other materials likely to discolour them or affect bond of applied surfaces.

Product Requirements

- .6 Protect work of other Subcontractors from damage while doing subsequent work. Damaged work shall be made good by appropriate Subcontractors but at expense of those causing damage.
- .8 Protection of mechanical and electrical Products or materials:
 - .1 Wrap in protective plastic and seal mechanical and electrical items of mechanical and electrical equipment prior to and during shipment, storage at the Place of the Work and after installation.
 - .2 Remove protective coverings only to the extent required for installation of the items. Re-install protection immediately following installation.
 - .3 Remove protective coverings in stages, as work areas are completed, or when directed by Contract Administrator.
- .9 Operational requirements:
 - .1 Operable Products shall be Provided fully operational and ready for intended use.
 - .2 Adjust operating hardware and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts for smooth squeak-free function, in accordance with manufacturer's requirements.

END OF SECTION

Cutting and Patching

PART 1 - GENERAL

1.1 Cutting, Patching and Remedial Work

- .1 Submittal Items:
 - .1 Comply with administrative requirements of Section 01 33 00.
 - .2 Submit written request in advance of cutting, coring, and alteration that affects:
 - .1 Structural integrity of any element of 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 Owner or work of other contractors.
 - .3 Include in request:
 - .1 Identification of Project.
 - .2 Location and description of affected work.
 - .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 Owner or work of other contractors.
 - .7 Written permission of affected separate contractor.
 - .8 Date and time work will be performed.
 - .9 Non-destructive structural survey (performed after hours): Radiography (X-ray) imaging of work to be cut or cored.
 - .4 Do not commence cutting, patching, or remedial work until request has been reviewed by Contract Administrator.
- .2 Preparation:
 - .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
 - .2 After uncovering, inspect conditions affecting performance of the Work.
 - .3 Beginning of cutting or patching means acceptance of existing conditions.
 - .4 Provide supports to assure structural integrity of surroundings; devices and methods to protect other portions of the Work from damage.
 - .5 Provide protection from elements for areas which may be exposed by uncovering work; maintain excavations free of water.

Cutting and Patching

- .6 Where uncovering of area exposes local deterioration, cracking, evidence of water infiltration, structural settlement, previous modifications, or other unexpected conditions, advise Contract Administrator immediately in writing and leave conditions exposed until receipt of Contract Administrator's written instructions. If area is exposed to the exterior, Provide temporary protection from inclement weather.
- .3 Execution:
 - .1 Execute cutting, fitting, and patching to complete the Work. Under no circumstances will overcutting of corners of opening be accepted. Ensure corners of openings to be cut are predrilled or sawed.
 - .2 Remove and replace defective and non-conforming work.
 - .3 Remove samples of installed work for testing if directed by Contract Administrator.
 - .4 Shop drawings identifying precise locations and size of openings to be cored and cut are to be submitted for review by Contract Administrator. Provide non-destructive structural survey of structural concrete to be cored or cut, for Contract Administrator review. Coring and cutting work locations shall be reviewed by Contract Administrator for acceptance before proceeding.
 - .5 Provide openings in non-structural elements of the Work for penetrations of mechanical and electrical work.
 - .6 Perform work by methods to avoid damage to other work, and which will Provide proper surfaces to receive patching and finishing.
 - .7 Employ qualified installer with at least 3 years of relevant experience to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
 - .8 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed to be used anywhere within existing buildings unless approved by Contract Administrator.
 - .9 Restore work with new Products in accordance with requirements of Agreement, Drawings, Schedules, and Specifications.
 - .10 Fit work to pipes, sleeves, ducts, conduit, and other penetrations through surfaces and with suitable allowance for deflection, expansion, contraction, and firestopping.
 - .11 Enclose pipes, ducts, conduit and wires passing through floors at areas where faucets occur in a 100 mm (4") high metal sleeve and make air and watertight with water resistant firestopping.
 - .12 Completely seal voids of penetrations of fire rated wall, ceiling, and floor constructions with firestopping and smoke seals.
 - .13 Refinish surfaces to match adjacent finishes. Refinish continuous surfaces to nearest intersection. Refinish entire assembly units.

PART 2 - PRODUCTS

Not applicable.

Cutting and Patching

PART 3 - EXECUTION

Not applicable.

END OF SECTION

Progressive Cleaning

PART 1 - GENERAL

1.1 Environmental Controls

- .1 Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.
- .2 Store volatile wastes in covered metal containers, and remove from Place of the Work daily.
- .3 Prevent accumulation of wastes which create hazardous conditions.
- .4 Provide adequate ventilation during use of volatile or noxious substances.

PART 2 - PRODUCTS

2.1 Materials

- .1 Use only cleaning materials recommended by manufacturer of surface to be cleaned and as recommended by cleaning material manufacturer.

PART 3 - EXECUTION

3.1 Cleaning During Construction

- .1 Clean-up the Place of the Work daily. Maintain clean and clear egress routes.
- .2 Maintain Place of the Work, grounds and public properties free from accumulations of waste materials and rubbish.
- .3 Provide containers at the Place of the Work for collection of waste materials and rubbish. Remove waste materials and rubbish from the Place of the Work when containers become full.
- .4 Vacuum and clean interior building areas when ready to receive finish painting, and continue vacuum cleaning on an as-needed basis until Substantial Performance of the Work.
- .5 Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on wet, newly painted surfaces.
- .6 Promptly as the Work proceeds, on a daily basis and upon completion, clean up and remove rubbish, surplus materials and equipment.
- .7 Remove as the work of this section progresses, corrosive and foreign materials which may set or become difficult to remove at time of final cleaning or which may damage members.
- .8 Wash exposed surfaces with a cleaning solution approved by Product manufacturers.
- .9 Debris and waste not permitted within cavities of Work.

END OF SECTION

Waste Management and Disposal

PART 1 - GENERAL

1.1 Section Includes

- .1 Objectives, procedures, and requirements for waste management and disposal.

1.2 Reference Documents

- .1 The following documents may be used as guides for developing and implementing a construction waste management program for the Work but are not part of the Agreement, Drawings, Schedules, and Specifications:
 - .1 Toronto Green Standard Version 3: Solid Waste for City Agency, Corporation & Division-Owned Facilities.
 - .2 Ontario Ministry of the Environment. A Guide to Source Separation of Recyclable Materials for Industrial, Commercial and Institutional Sectors and Multi-Unit Residential Buildings as Required Under Ontario Regulation 103/94.
 - .3 Ontario Environmental Protection Act. Ontario Regulation 102/94: Waste Audits and Waste Reduction Workplans.
 - .4 Ontario Ministry of the Environment. A Guide to Waste Audits and Reduction Workplans for Construction and Demolition Projects as Required Under Ontario Regulation 102/94.
 - .5 Canadian Construction Association. Standard Construction Document CCA 27-1997: A Guide on Construction Environmental Management Planning.
 - .6 Canadian Construction Association. Standard Construction Document CCA 81-2001: A Best Practices Guide to Solid Waste Reduction.

1.3 Glossary of Certain Terms Used in This Section

- .1 Materials source separation program: A series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.
- .2 Recyclable: Ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse by others.
- .3 Recycle: Process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .4 Recycling: Process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- .5 Reuse: Repeated use of a product in same form but not necessarily for same purpose. Reuse includes:
 - .1 Salvaging reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.
 - .2 Returning reusable items including pallets or unused products to vendors.
- .6 Salvage: Removal of structural and non-structural materials from demolition, deconstruction, or disassembly work for the purpose of reuse or recycling.

Waste Management and Disposal

- .7 Source-separation / source-separated: The act of keeping different types of waste materials separate beginning from first time they became waste.
- .8 Waste audit: Detailed inventory of materials in building. Involves quantifying by volume/weight/item amounts of materials and wastes generated during a construction, demolition, deconstruction, or renovation project. Indicates quantities of reuse, recycling and landfill.
- .9 Waste management coordinator: Contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.
- .10 Waste reduction workplan: Written report which addresses opportunities for reduction, reuse, or recycling of materials. The waste reduction workplan is based on information acquired from the waste audit and waste audit report.

1.4 Quality Assurance

- .1 Waste management coordinator:
 - .1 Contractor shall appoint a representative who shall be responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.
 - .2 Such representative shall be designated the waste management coordinator.
 - .3 Waste management coordinator shall be present at all project meetings in accordance with Section 01 31 19.
- .2 Pre-construction meeting:
 - .1 Conduct a pre-construction meeting following procedures for pre-installation meetings in accordance with Section 01 31 19.
 - .2 After review of the waste reduction workplan and material source separation program, and prior to start of solid waste generating activities at the Place of the Work, conduct a pre-construction meeting to present the waste management and disposal requirements and procedures to Subcontractors, Suppliers, and other workers or persons entering or working upon the Place of the Work. Agenda shall include the following, in addition to the requirements of Section 01 31 19:
 - .1 General description of waste management requirements.
 - .2 Review of waste reduction workplan.
 - .3 Review of material source separation program.
 - .3 Submit copies of the current waste reduction workplan and material source separation program, and provide necessary training and instruction in waste management and disposal requirements, to Subcontractors, Suppliers, and other workers or persons entering or working upon the Place of the Work, who were not present at the pre-construction meeting.
- .3 Documents at the Place of the Work:
 - .1 Maintain one complete, current copy of each of the following documents at the Place of the Work:
 - .1 Waste audit report.

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- .2 Waste reduction workplan.
- .3 Material source separation program.
- .4 Waste tracking report.
- .2 Submit current copies of the above referenced documents to all Subcontractors and Suppliers working at the Place of the Work.
- .3 Post current copies of the above referenced documents at the Place of the Work in a location that is easily accessible for review by all workers at the Place of the Work.

1.5 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
 - .1 Submit following procedures for submittal of shop drawings.
 - .2 Submittals required by this section shall bear the date of issue on their covering page.
- .2 Prepare and submit the following prior to commencement of solid waste generating activities at the Place of the Work:
 - .1 Completed waste audit report.
 - .2 Completed waste reduction workplan.
 - .3 Materials source separation program description.
- .3 Submit the following on a monthly basis throughout the course of the Work prior to each application for progress payment:
 - .1 Revised and updated copies of the waste audit report.
 - .2 Waste tracking reports.

1.6 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Submit the following as part of the project record documents:
 - .1 Summary of waste materials salvaged for reuse, recycling, or disposal as part of the Work.
 - .2 Provide receipts, scale tickets, waybills, and show quantities and types of materials reused, recycled, commingled and separated off-site or disposed of.
 - .3 For each material reused, sold or recycled from project, include amount in tonnes, or quantities by number, type and size of items, as applicable, and the destination.
 - .4 For each material land filled or incinerated from project, include amount of material in tonnes, or quantities by number, type and size of items, as applicable, and identity of landfill, incinerator or transfer station.

Waste Management and Disposal

1.7 Waste Management Requirements

- .1 It is a requirement of the Work to minimize the amount of solid waste generated by the Work, including land-clearing debris. The strategies utilized to achieve this requirement shall include:
 - .1 Reducing the generation of waste materials.
 - .2 Reusing waste materials at the Place of the Work and/or salvaging waste materials for use in other construction projects.
 - .3 Recycling waste materials back into the manufacturing processes.
- .2 It is the intent that a minimum of 75% of the solid waste generated by the Work shall be diverted from landfill.
- .3 Comply with applicable Provincial and municipal guidelines, policies, and regulations relating to construction and demolition waste management.
- .4 Construction waste management program:
 - .1 Develop a construction waste management program to identify, analyze, implement, document, and evaluate measures to meet the waste management requirements.
 - .2 The construction waste management program shall include the following, the particular requirements for each of which are described later in this section:
 - .1 Waste audit and waste audit reports.
 - .2 Waste reduction workplan.
 - .3 Material source separation program.
 - .4 Waste tracking reports.

1.8 Waste Audit

- .1 Conduct a waste audit prior to start of solid waste generating activities at the Place of the Work.
 - .1 The waste audit shall assess the amount, nature and composition of the waste generated by the Work.
- .2 Itemize waste materials by material category, material type and material usage. Arrange material categories following conventional division breakdown used in construction specifications.
- .3 For each waste material item:
 - .1 Provide projections for the amounts to be generated, reused, salvaged, recycled and sent to landfill (by weight, volume, or item as applicable).
 - .2 List the receiving facility.
 - .3 Provide estimates for the costs/revenues associated with disposal (including transportation costs).
- .4 Update waste audit report monthly to reflect the most recent information available as the Work progresses.

Waste Management and Disposal

1.9 Waste Reduction Workplan

- .1 Prepare waste reduction workplan prior to start of solid waste generating activities at the Place of the Work.
 - .1 The waste reduction workplan shall identify, analyze and implement measures to reduce, reuse and recycle the waste generated by the Work..
- .2 The waste reduction workplan shall include, but not be limited to, the following:
 - .1 Identification of the Project, the Owner, and the Contractor.
 - .2 Description of management of waste.
 - .3 Destinations of waste materials listed.
 - .4 Protection measures to be implemented and maintained.
 - .5 Clear labelling of storage areas.
 - .6 Details of materials handling and removal procedures.
 - .7 Identification of opportunities for reduction, reuse, and recycling of materials based on information acquired from waste audit report.
 - .8 Description of material source separation program.
 - .9 Quantities for materials to be salvaged for reuse or recycled and materials sent to landfill.
 - .10 Listing of prefabricated assemblies to be used in the Work that are built at a central facility to avoid waste generation at the Place of the Work.
 - .11 Plans and schedules of installation procedures and sequences that will use materials efficiently by minimizing cutting and/or other modifications that generate waste.
- .3 Structure waste reduction workplan to prioritize actions and with reduction as first priority, followed by reuse, then recycling.
- .4 Set realistic goals for waste reduction, recognize existing barriers and develop strategies to overcome these barriers.
- .5 Monitor and report on waste reduction by documenting total volume and cost of actual waste removed from project in accordance with the requirements for waste tracking specified below in this section.

1.10 Material Source Separation Program

- .1 Prepare a material source separation program and have in place prior to start of solid waste generating activities at the Place of the Work.
 - .1 The material source separation program shall describe and identify processes and procedures to separate reusable, salvageable, and recyclable waste materials generated as a result of the Work into their material categories from other types of waste at the point of generation.
- .2 Based on the results of the waste audit and waste reduction workplan, develop a list of materials to be salvaged or recycled.
- .3 Contact local salvaging/recycling facilities and arrange for services.

Waste Management and Disposal

- .1 Only facilities operating under a Certificate of Approval as required by the Environmental Protection Act shall be considered.
- .4 Provide facilities at the Place of the Work for the collection, handling and storage of anticipated quantities of reusable and recyclable materials.
 - .1 Source-separated materials:
 - .1 Follow the material acceptance requirements of local salvaging/recycling facilities so that materials are properly sorted, grouped, packaged, bundled, stored, protected, and shipped.
 - .2 Provide suitable containers for the collection of waste that are properly sized and made from materials that can adequately contain the waste.
 - .3 Provide separate containers for each recyclable or reusable material, as appropriate, based on type of material being diverted.
 - .2 Commingled materials:
 - .1 Provide a separate container for waste generated by persons at the Place of the Work that is not construction or demolition waste, collected in a commingled condition that will be separated for recycling away from the Place of the Work.
 - .2 Provide a separate container for remaining commingled waste that will be transported to a facility for separation and recycling.
 - .3 Locate containers to facilitate the deposit of materials without hindering daily operations or causing delays in the Work.
 - .4 Clearly mark all containers with signs indicating what materials are allowed to be deposited.
 - .5 Protect materials from damage and contamination.
- .5 Transport source-separated and commingled materials from the Place of the Work and deliver to approved facilities for salvaging or recycling.
- .6 Submit to the Contract Administrator upon request waybills, invoices, and other documentation confirming that all materials have been transported to the required locations.

1.11 Waste Tracking Reports

- .1 Prepare waste tracking reports summarizing the status of the construction waste management program.
- .2 Prepare regularly updated written reports summarizing the total amount of solid waste generated by the project, the waste quantities diverted from landfill and the means by which the diversions were achieved. Clearly indicate the percentage of total solid waste materials diverted from landfill.
- .3 For each waste material item shown in the most recent version of the waste audit:
 - .1 Provide the amounts generated, reused, salvaged, recycled and sent to landfill (by weight, volume, or item as applicable).
 - .2 List the receiving facility.

Waste Management and Disposal

- .3 Provide the costs/revenues associated with disposal (including transportation costs).
- .4 Keep and maintain receipts and documentation of waste transfer from the Place of the Work, including tipping fees and revenues from salvaged and recycled materials. Make such available for review by the Contract Administrator upon request.

1.12 Storage, Handling and Protection

- .1 Store, materials to be reused, recycled and salvaged in locations to prevent contamination of materials being diverted from landfill.
- .2 Prevent contamination of materials to be salvaged and recycled, and handle such materials, in accordance with requirements for acceptance by designated facilities.

1.13 Coordination

- .1 Coordinate waste management and disposal procedures and requirements with other activities at the Place of the Work so that there is no delay in the Work, and at no increase in either the Contract Time or the Contract Price.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.1 Waste Management

- .1 Perform waste management in accordance with waste reduction workplan.
- .2 Separate waste materials that can be reused at the Place of the Work from other waste materials and store with construction materials.
- .3 Handle waste materials not reused, salvaged or recycled in accordance with appropriate regulations and codes.

3.2 Disposal of Waste

- .1 Do not bury rubbish and waste materials at the Place of the Work.
- .2 Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways, storm or sanitary sewers.
- .3 Do not burn waste materials at the Place of the Work.
- .4 Comply with waste disposal requirements of authorities having jurisdiction.
- .5 Remove waste material from the Place of the Work daily.
- .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris. Pay fees.

END OF SECTION

Contract Closeout Procedures and Submittals

PART 1 - GENERAL

1.1 General Instructions

- .1 The procedures for completing Contract and acceptance by the Owner shall be in accordance with the methods described in OAA/OGCA Document 100 (July 1, 2018, and reissued January 8, 2019) and any additional requirements described below.
- .2 Stages will be reviewed at the Contract start-up meeting to ensure that parties understand their responsibilities. Refer to Section 01 31 19 for procedures and requirements for Contract start-up meeting.
- .3 Within 4 weeks of commencement of the Work, submit to the Contract Administrator a list of closeout submittals required by the Agreement, Drawings, Schedules, and Specifications.

1.2 Cleaning Prior to Substantial Performance of the Work

- .1 Immediately prior to Contract Administrator's review to determine if Substantial Performance of the Work has been achieved, remove surplus Products and construction machinery and equipment not required for the performance of the remaining Work and clean as described under paragraph 1.3 - Final Cleaning to the greatest extent practicable given work remaining to be completed. Cleaning shall be to a sufficient extent to permit the Contract Administrator's review to be performed properly and reasonably.

1.3 Final Cleaning

- .1 Environmental controls:
 - .1 Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.
 - .2 Store volatile wastes in covered metal containers, and remove from Place of the Work daily.
 - .3 Prevent accumulation of wastes which create hazardous conditions.
 - .4 Provide adequate ventilation during use of volatile or noxious substances.
- .2 Materials:
 - .1 Use only cleaning materials recommended by manufacturer of surface to be cleaned and as recommended by cleaning material manufacturer.
- .3 Final cleaning:
 - .1 Remove waste Products and debris other than that caused by the Owner, and leave the Work clean and suitable for occupancy by Owner.
 - .2 When the Contract is completed, remove surplus Products, tools, construction machinery and equipment.
 - .3 Clean glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, prefinished surfaces, and fixtures.
 - .4 Remove stains, spots, marks and dirt from decorative parts of the Work, electrical and mechanical fixtures, furniture fittings, walls, and floors.

Contract Closeout Procedures and Submittals

- .5 Vacuum clean and remove dust from building interiors, behind grilles, louvres, and screens. Vacuum clean interior of electrical equipment.
- .6 Clean floor finishes to written requirements of manufacturer.
- .7 Remove non-permanent labels.
- .8 Remove dirt and residue from surfaces.
- .9 Inspect finishes, fittings and equipment and ensure specified workmanship and operation.
- .10 At completion of the Work, remove protective coatings, clean surfaces and remove excess compounds and sealant materials. Make good defective, scratched or damaged work.
- .11 Broom clean and wash exterior walks, steps and surfaces.
- .12 Remove dirt and other disfigurements from exterior surfaces.
- .13 Clean and sweep roofs, gutters, areaways, downspouts, and drainage systems.
- .14 Sweep and wash clean paved areas at the Place of the Work.
- .15 Clean equipment and fixtures to a sanitary condition, clean or replace filters of mechanical equipment.
- .16 Remove seal wrap on mechanical and electrical Products and materials and clean as required.
- .17 Clean and/or replace lamps, light fixtures, lenses and grilles.
- .18 Remove protective covering and labels from lamps, hardware, and speciality items.
- .19 Under the direction of the Contract Administrator, aim adjustable luminaires except for theatrical lighting instruments.
- .20 Clean architectural concrete to remove surface discolouration, efflorescence and the like. Use a suitable cleaning agent which will not itself stain the surfaces or mar the texture through chemical reaction.
- .21 Clean architectural metal surfaces to remove surface discolouration and rust staining.

1.4 Closeout Submittals

- .1 Collect reviewed submittals, and assemble required closeout submittals executed by Subcontractors, Suppliers, and manufacturers. Prior to submitting closeout submittals to the Contract Administrator, undertake the following:
 - .1 Review maintenance manual contents (operating, maintenance instructions, as-built drawings, materials) for completeness.
 - .2 Review supply and completeness of spare parts required by Agreement, Drawings, Schedules, and Specifications and manufacturers.
 - .3 Review in relation to Contract Price, Change Orders, Change Directives, holdbacks and other adjustments to the Contract Price.

Contract Closeout Procedures and Submittals

- .4 Review inspection and testing reports to verify conformance to intent of Agreement, Drawings, Schedules, and Specifications and that changes, repairs or replacements have been completed.
- .5 Execute transition of performance bond and labour and materials payment bond to warranty period requirements.
- .6 Submit a final statement of accounting giving total adjusted Contract Price, previous payments, and monies remaining at time of application for completion of the Contract. Contract Administrator will issue a final change order reflecting approved adjustments to Contract Price not previously made.
- .2 No later than 20 Working Days prior to submitting request for Contract Administrator's review to determine if Substantial Performance of the Work has been achieved, submit to the Contract Administrator the closeout submittals specified in this section, including, but not limited to, reviewed shop drawings, Product data sheets, samples, operating instructions, as-built records, fully executed warranties and guarantees, reports recording demonstration and instruction provided to Owner for operation and maintenance of building systems, software required for operation and maintenance of building systems, maintenance materials, and keys.
- .3 For equipment put into use with Owner's permission during the Work, submit required closeout submittals within 10 Working Days after start-up.
- .4 For items of the Work delayed materially beyond date of *Substantial Performance of the Work*, provide updated closeout submittals within 10 Working Days after acceptance, listing date of acceptance as start of warranty period.
- .5 Neither the Contract Administrator's review to determine if Substantial Performance of the Work has been achieved, nor acceptance of the Work, will take place until receipt, by the Contract Administrator, of acceptable copies of the closeout submittals required herein and by the Agreement, Drawings, Schedules, and Specifications.
- .6 As-built documents:
 - .1 Owner will provide 1 set of Agreement, Drawings, Schedules, and Specifications to the Contractor for as-built documentation purposes.
 - .2 Accurately document as-built conditions and deviations from Agreement, Drawings, Schedules, and Specifications as the Work progresses.
 - .3 Mark changes in red ink.
 - .4 Document, without being limited to, the following:
 - .1 Survey of as-built conditions and survey logs prepared by the registered land surveyor responsible for setting out the work and field engineering.
 - .2 Depths of various elements of foundation in relation to survey datum.
 - .3 Horizontal and vertical location of utilities and appurtenances referenced to permanent surface improvement.
 - .4 Other underground installations and services set beneath slabs-on-grade referenced to visible and accessible features of structure.
 - .5 'As-built' elevations of paving, sidewalks, manholes and catchbasins.
 - .6 Field changes of dimensions/details.

Contract Closeout Procedures and Submittals

- .7 Changes by Change Orders, Change Directives, and Supplemental Instructions.
- .8 Locations of interior mechanical and electrical equipment and distribution.
- .9 Elevations and location depths of services. Identify type and size of service and materials used.
- .10 Specification as-builts: Document as-built Products, including manufacturer, manufacturer's model or system number.
- .5 As-built documentation:
 - .1 Submit copies as described in Schedule D – General Conditions 3.10.2.
- .7 Operation and maintenance manuals:
 - .1 Submit operation and maintenance manuals, consisting of the following general components:
 - .1 Operation and maintenance documents.
 - .2 Shop drawing documents.
 - .3 Warranty documents.
 - .4 Project data documents.
 - .2 Submit operation and maintenance manuals as follows:
 - .1 Submit digital versions ("PDF" files) of operation and maintenance manuals. Files shall be original PDF files, not scanned, and shall be searchable.
 - .2 Submit using digital storage medium or transfer process acceptable to the Contract Administrator and the Owner.
 - .3 Operation and maintenance documents shall contain operating and maintenance data and information specified below for supplied Products, in English, and shall be made up as follows:
 - .1 Charts, diagrams and reports identified in Divisions 21, 22, and 23 and Divisions 26, 27, and 28 of the specifications.
 - .2 Description, operation and maintenance instructions for equipment and parts list. Indicate nameplate information such as make, size, capacity, serial number.
 - .3 Neatly type lists and notes. Use clear drawings, diagrams of manufacturers' literature.
 - .4 Shop drawing documents:
 - .1 Submit one copy of each final accepted shop drawing issued for the Work on which have been recorded changes made during fabrication and installation caused by unforeseen conditions.
 - .2 Engineered shop drawings shall include copies of the certificate of insurance, the engineer's field review reports, and the engineer's letters of general conformity that were provided as part of the engineered submittal in accordance with Section 01 33 00 appended to the pertinent engineered shop drawing in the shop drawing manual.

Contract Closeout Procedures and Submittals

- .5 Warranty documents:
 - .1 Submit copies of bonds, guarantees, warranties and extended warranties together in one report binder, complete with an indexed summary list of warranties and expiration dates. Warranties to be in accordance with Section 01 78 36.
- .6 Project data documents: shall include the following information supplemented by additional required data specified elsewhere in the Agreement, Drawings, Schedules, and Specifications:
 - .1 Maintenance instructions for finished surfaces and materials.
 - .2 Copy of hardware and paint schedules.
 - .3 Names, addresses and phone numbers of Subcontractors and Suppliers, as applicable.
 - .4 Additional material used in the Work listed under various sections showing name of manufacturer and source of supply.
 - .5 Report recording demonstration and instruction provided to Owner for operation and maintenance of building systems as described below in this section.
 - .6 Key construction photos.
 - .7 Permits and forms:
 - .1 Workplace Safety & Insurance Board certificate of clearance.
 - .2 Certificates of approval of the Work by local building department (if available).
 - .3 Electrical authority certificate of inspection.
 - .4 Elevator authority certificate of approval.
 - .8 Waste management and disposal reports, prepared in accordance with Section 01 74 19.
- .8 Posted operating instructions:
 - .1 Prepare operating instructions in English for posting near equipment and systems. Posted instructions to be glass covered, framed and mounted.
 - .2 Posted instructions to consist of simplified, consolidated equipment, control and power diagrams graphically representing the entire system, including concise instructions on how to start and stop systems, what settings and conditions are to be observed by the operators, and what control adjustments are to be made or maintained by the operator.
 - .3 Posted instructions shall include control diagrams with added specific operating instructions, controls, interlocks, and the like.
 - .4 Posted instructions shall include:
 - .1 HVAC controls for each system;
 - .2 One line schematic diagrams of water supply;
 - .3 One line isometric diagrams of sanitary drainage;

Contract Closeout Procedures and Submittals

- .4 One line diagrams of steam distribution, hot and cold water systems, including risers, valves, control devices, etc.
- .9 Maintenance materials:
 - .1 Provide overage, extra stock, and maintenance materials. For required materials, see individual sections of specifications. Deliver to a location and at a time specified by the Owner, and as follows:
 - .1 Use unbroken cartons, or if not supplied in cartons, material shall be strongly packaged.
 - .2 Clearly mark cartons or packaging as to contents, project name, and Supplier.
 - .3 If applicable give colour and finish, room number or area where material is used.
 - .4 Include necessary information for re-ordering of materials as part of packaging of materials.
 - .2 Replace incorrect or damaged maintenance materials delivered to Owner, including damage through shipment.
 - .3 Provide a typed inventory list of maintenance materials prior to Substantial Performance of the Work application. List all items, complete with quantities, and storage locations.
 - .4 Establish a master list identifying maintenance materials and maintain a log of when materials are turned over to Owner and signing authority for acceptance of materials on behalf of Owner.

1.5 System Demonstration and Project Commissioning

- .1 Refer also to requirements of Divisions 21, 22, and 23 and Divisions 26, 27, and 28 with respect to commissioning for control systems, sound / voice / communications systems, mechanical / electrical systems.
- .2 Perform system demonstration and commissioning work no later than 10 Working Days prior to submitting request for Contract Administrator's review to determine if Substantial Performance of the Work has been achieved.
- .3 Submit required certificates of approval or acceptance from authorities having jurisdiction.
- .4 Meet with other Contract Administrator; acoustical, sound/voice/communications systems, structural, mechanical, electrical, to coordinate demonstration, instruction, commissioning and completion.
- .5 Review condition of equipment such as lighting, elevators and heating system, which has been used in the course of the Work to ensure turning over at completion in "as new condition" with warranties dated and
- .6 d certified from time specified.
- .7 When partial occupancy of uncompleted project is required by Owner, coordinate Owner's uses, requirements, access, and the like, with Contractor's requirements to complete the Work.
- .8 Demonstration and instruction:
 - .1 Demonstrate operation of each system to Owner and Contract Administrator.

Contract Closeout Procedures and Submittals

- .2 Instruct Owner's personnel in operation, adjustment and maintenance of equipment and systems, using operation and maintenance data provided as the basis for instructions. Arrange and coordinate instruction of Owner's staff in care, maintenance and operation of building systems and finishes
- .3 Contractor, manufacturer's representatives, and responsible personnel from Subcontractors whose work is being demonstrated shall be present at these demonstrations.
- .4 Instruct Owner's representative on use of software required for operation and maintenance of building systems and provide a toll-free telephone number or website address for further assistance to the Owner.
- .5 Prepare and insert additional data in the operation and maintenance data manuals when the need for additional data becomes apparent during demonstration or instruction.
- .6 Demonstration and instruction report: Submit a written report of such demonstration, instruction, and commissioning to the Contract Administrator as part of the contract closeout submittals described earlier in this section. Report shall include time and date of each demonstration, instruction, and commissioning activity, complete with a list of persons present.
- .9 Correct deficiencies and defects identified during demonstration, instruction, or commissioning.
- .10 Attend 'end-of-work' testing and break-in or start-up demonstration.

1.6 Substantial Performance of the Work

- .1 Deficiency review:
 - .1 Neither Owner nor Contract Administrator will be responsible for preparation or issuance of extensive lists of deficiencies. Contractor assumes prime responsibility for ensuring that items shown and described in the Agreement, Drawings, Schedules, and Specifications are complete. Any reviews to approve the certificate of Substantial Performance of the Work will be immediately cancelled if it becomes obvious to the Contract Administrator that extensive deficiencies are outstanding.
 - .2 The Contractor shall conduct an inspection of the Work to identify deficiencies and defects, which shall be repaired. When the Contractor considers that the Work is substantially performed, the Contractor shall prepare and submit to the Contract Administrator a comprehensive list of items to be completed or corrected (the deficiency list) and apply for a review of the Work by the Contract Administrator to determine if Substantial Performance of the Work has been achieved.
 - .3 The Contractor's request described above shall include a statement by Contractor that the Work to be reviewed by Contract Administrator for deficiencies is, to the best of the Contractor's knowledge, in compliance with Agreement, Drawings, Schedules, and Specifications, reviewed shop drawings, and samples, and that deficiencies and defects previously noted by Contract Administrator have been repaired.

Contract Closeout Procedures and Submittals

- .4 No later than 10 Working Days after the receipt of the Contractor's request described above, but contingent upon the prior receipt, by the Contract Administrator, of the closeout submittals in the manner and form specified in this section, the Contract Administrator and the Contractor will review the Work to identify any defects or deficiencies. If necessary, the Contractor shall tabulate a list of deficiencies to be corrected prior to Substantial Performance of the Work being certified by the Contract Administrator. During review, the Contract Administrator and the Contractor will decide which deficiencies or defects must be rectified before Substantial Performance of the Work can be certified, and which defects are to be treated as warranty items.
- .5 Provide a schedule of planned deficiency review having regard to the foregoing.
- .2 Certification of Substantial Performance of the Work:
 - .1 When the Contract Administrator considers that the deficiencies and defects have been completed and that it appears that the requirements of the Agreement, Drawings, Schedules, and Specifications have been substantially performed, the Contract Administrator shall issue a certificate of Substantial Performance of the Work to the Contractor, stating the date of Substantial Performance of the Work.
 - .2 The certificate of Substantial Performance of the Work shall be prepared and issued in accordance with the Construction Act.
 - .1 Inform Owner, Contract Administrator, Subcontractors, and Suppliers which publication is to be used for publishing certificate of substantial performance in accordance with Section 01 31 19.
- .3 Final Inspection for completion of the Contract:
 - .1 Deficiencies and defects shall be made good before the Contractor submits a written request for final review of the Work and before the Contract is considered complete.
 - .2 When Contractor is satisfied that the Work is complete, and after the Contractor has reviewed the Work to verify its completion in accordance with the requirements of the Agreement, Drawings, Schedules, and Specifications, the Contractor shall submit a written request for a final review by the Contract Administrator, who in turn will notify the Owner.
 - .3 If there are any deficiencies identified as a result of this review, they shall be listed by the Contract Administrator and submitted to the Contractor. This list shall be recognized as the final deficiency list for purposes of acceptance of the Work under the Contract.
 - .4 Such deficiencies shall be corrected by a date mutually agreed upon between Contract Administrator and the Contractor, unless a specific date is required by Contract, and a further review by the Contract Administrator shall be called for by the Contractor following his own review to take place within 7 days from date of request.
 - .5 Contractor shall thereafter submit invoice for final payment.
 - .6 Money shall be withheld for deficiency work and will be released only when all deficiencies have been completed. No partial payment to be recognized until all work is completed.

Contract Closeout Procedures and Submittals

1.7 Warranty Period

- .1 Provide on-going review and attendance to building call-back, maintenance and repair problems during the warranty periods.
- .2 At the beginning of the 12th month after Substantial Performance of the Work, the Owner, Contractor and Contract Administrator, along with key Subcontractors as designated, shall carry out a complete review of building and its systems to determine which deficiencies are to be rectified under the warranty. Contractor shall be responsible for timely written notification of Owner, and Contract Administrator prior to such end of warranty period inspection and any delay in such notification shall extend such warranty period until proper notification is received by Owner, and Contract Administrator.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

Extended Warranties

PART 1 - GENERAL

1.1 Extended Warranties

- .1 Extended warranties shall be in accordance with Schedule D – General Conditions 9.3 and as follows:
 - .1 Where specifically identified in the Agreement, Drawings, Schedules, and Specifications, extended warranties shall be furnished by individual manufacturer for particular product/system/assembly.
 - .2 Extended warranties shall include for proper performance of the portion of the Work as defined by the scope of the applicable specification section to the extent that the design and Agreement, Drawings, Schedules, and Specifications permit such performance.
 - .3 The Owner shall promptly give the warrantor notice in writing of observed defects and deficiencies which occur during the warranty period.
 - .4 Extended warranties shall commence at date of Substantial Performance of the Work.
 - .5 Extended warranties specified shall be in addition to, and run concurrent with, other warranties required by the Agreement, Drawings, Schedules, and Specifications. Manufacturer's disclaimers and limitations on product warranty do not relieve Contractor of obligations under requirements of the Agreement, Drawings, Schedules, and Specifications.
 - .6 Submit extended warranty on form acceptable to the Owner specifically endorsed by the warrantor to the Owner and shall include the following information:
 - .1 Name and address of Project.
 - .2 Warranty commencement date (date of Substantial Performance of the Work).
 - .3 Warranty period.
 - .4 Specific warranty terms as required in applicable portion of Agreement, Drawings, Schedules, and Specifications.
 - .5 Name and title of authorized signing officer and seal of warrantor.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END OF SECTION

Demolition

PART 1- GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Demolition and removal of selected non-structural portions of building.
 - .2 Salvage:
 - .1 Salvaging of designated items for reuse by Owner.
 - .2 Salvage of designated items to be reused or recycled.
 - .3 Removal of surplus materials from the Place of the Work.
 - .4 Related mechanical and electrical work and demolition requirements are covered under Divisions 21, 22, and 23 and Divisions 26, 27, and 28 respectively.
- .2 Section excludes:
 - .1 Demolition, removal, remediation, or abatement of designated substances or materials and toxic and hazardous substances.

1.2 Administrative Requirements

- .1 Pre-demolition meeting:
 - .1 Schedule a pre-demolition meeting following the procedures specified for pre-installation meetings in accordance with Section 01 31 19.
 - .2 Review existing conditions at the Place of the Work thoroughly to establish full extent of items to be removed and items to remain. Commencement of demolition work will be considered to be acceptance of existing conditions at the Place of the Work and removal of such items.
 - .3 Examine adjacent properties to determine extent of protection required.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Demolition report:
 - .1 Prior to commencement of the work of this section at the Place of the Work, prepare and submit to the municipal building department having jurisdiction over the Place of the Work a report on the proposed demolition methods and procedures for the removal of indicated structures for the safe retention of structures to remain.
 - .2 Prepare report under the supervision, and bear the seal and signature, of a professional engineer licensed to practice engineering in the Place of the Work, experienced in this type of engineering, and in accordance with Section 01 33 00.
 - .3 Submit a PDF of the demolition report to the Contract Administrator for record purposes only: Contract Administrator shall neither review nor accept any liability for the contents of the report.

Demolition

- .4 Without limiting the requirements of authorities having jurisdiction, the demolition report shall include:
 - .1 Drawings, diagrams and details showing sequence of demolition work and supporting structures.
 - .2 Description, in detail, of the methods and procedures for working at the base of existing buildings to remain.
 - .3 Schedule of demolition activities indicating the following:
 - .1 Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.
 - .2 Interruption of utility services.
 - .3 Coordination for shutoff, capping, and continuation of utility services.
 - .4 Location of temporary street barricades, building interior partitions and means of egress.
 - .4 Written description of methods for removal and temporary bracing of structural members or supporting construction.
- .3 Special procedures submittals:
 - .1 Existing conditions documentation:
 - .1 Document existing conditions of adjoining construction and site improvements, including pre-existing damage to finish surfaces that might be misconstrued as damage caused by demolition operations.
 - .2 Comply with Section 01 32 33.
 - .3 Submit existing conditions documentation before demolition work begins.
 - .2 Inventory of items to be salvaged:
 - .1 Prepare typed inventory of units to be salvaged and cross-reference to drawing showing existing elevations.
 - .2 Submit inventory following procedures for submittal of Shop Drawings in accordance with Section 01 33 00.

1.4 Quality Assurance

- .1 Qualifications:
 - .1 Subcontractor:
 - .1 Shall have 5 years' specialized demolition experience, minimum.
 - .2 Shall be able to deploy adequate equipment and skilled personnel to complete work expediently in an efficient and orderly manner.

PART 2 - PRODUCTS

Not applicable.

Demolition

PART 3 - EXECUTION

3.1 Examination

- .1 Verify that utilities have been disconnected and capped.
- .2 Observe existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- .3 Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- .4 When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Contract Administrator.
- .5 Survey of existing conditions: Record existing conditions by use of photographs in accordance with Section 01 32 33.

3.2 Utility Services and Mechanical / Electrical Systems

- .1 Refer to Divisions 21, 22, and 23 and Divisions 26, 27, and 28 respectively.

3.3 Selective Demolition, General

- .1 Demolish and remove existing construction only to the extent required by new construction, and as otherwise indicated. Use methods required to complete the work within limitations of governing regulations and as follows:
 - .1 Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - .2 Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 - .3 Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - .4 Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
 - .5 Maintain adequate ventilation when using cutting torches.
 - .6 Remove decayed, infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 - .7 Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - .8 Dispose of demolished items and materials promptly.

Demolition

- .2 Dispose of demolished materials from Project site except where noted otherwise and in accordance with authorities having jurisdiction. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- .3 Do not sell demolished material at the Place of the Work.
- .4 Clean existing surfaces specified to receive new applied finishes to assure proper adherence.

3.4 Selective Demolition Procedures for Specific Materials

- .1 Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.
- .2 Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- .3 Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

3.5 Salvage

- .1 Remove and store items indicated or directed for salvage. Remove, handle and transport such items to storage area designated in the Agreement, Drawings, Schedules, and Specifications, to an area within the Place of the Work designated by Contract Administrator, or to an area away from the Place of the Work as directed by the Contract Administrator. Perform such work to prevent damage to the items during removal and in storage.
- .2 The Owner shall review Place of the Work prior to commencement of demolition and instruct the Contractor of the items to be retained for re-use or be turned over to the Owner.
- .3 Remove and store indicated items for future use by Owner. Remove, handle and transport such items to storage area indicated in the Agreement, Drawings, Schedules, and Specifications or to an area within the Place of the Work designated by Contract Administrator. Perform such work carefully and with diligence to prevent any damage to the items during removal and in storage.

3.6 Protection

- .1 Prevent movement, settlement or damage of adjacent structures, services, walks, paving, trees, landscaping, adjacent grades and parts of existing building to remain. Make good damage caused by demolition.
- .2 Take precautions to support affected structures and, if safety of building being demolished or adjacent structures or services appears to be endangered, cease operations and notify demolition engineer, Contractor and Contract Administrator.
- .3 Provide temporary weather enclosures in accordance with Section 01 50 00.
- .4 Prevent debris from obstructing active services and drainage systems.
- .5 Protect work to remain against damage. Repair or replace damaged work at no additional cost to the Owner.

END OF SECTION

1.0 GENERAL

1.1 Documents

- .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.
- .2 Drawings include architectural, mechanical, and electrical drawings.

1.2 Description of Work Included

- .1 Provide all labour, materials, equipment, access, cooperation, coordination, and services to allow the testing of structural steel, structural steel deck, and welds to be carried out by a Testing Agency responsible to the Owner.
- .2 The scope of the required quality assurance testing is described in this section to inform the Contractor of the type and scope of testing on the project and to allow the Contractor to make appropriate allowances. The costs for the testing described in this section are not the responsibility of the Contractor. It will be paid for by the Owner.
- .3 Testing required by the Contractor for the Contractor's own quality control will be paid for by the Contractor.

1.3 Related Work Specified Elsewhere

- .1 Section 05 12 00 – Structural Steel Framing
- .2 Section 05 31 00 – Steel Decking
- .3 Section 05 50 00 – Metal Fabrications

1.4 Reference Standards

- .1 Testing of 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 CSA S16 – Limit States 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 CSA S136 – North American Specification for the Design of Cold-Formed Steel Structural Members
 - .5 ASTM A6/A6M – Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
 - .6 CSA W47.1 – Certification of Companies for Fusion Welding of Steel Structures
 - .7 CSSBI 10M – Standard for Steel Roof Deck
 - .8 CSSBI 12M – Standard for Composite Steel Deck
 - .9 RCSC Specification for Structural Joints Using ASTM A325 or A490 Bolts
 - .10 SDI Manual of Steel Construction with Steel Deck
 - .11 CSA W59 – Welded Steel Construction (Metal Arc Welding)
 - .12 CSA W178.1 – Certification of Welding Inspection Organizations
 - .13 ASTM A653/A653M – Standard Specification for Sheet Steel, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- .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 E376 – Standard Practice for Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Testing Methods
- .7 ASTM A780/A780M – Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
- .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.
- .3 Where the Standard is referenced in this specification, it shall mean the documents specified in this clause and their referenced Standards.
- .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 “Owner”, “Contractor”, and “Consultant” as per the General Conditions and Definitions.
- .2 “Structural Engineer” shall mean a representative of Read Jones Christoffersen Ltd.
- .3 “Testing Agency” shall mean the testing agency responsible to the Owner.
- .4 “Non-Destructive Testing” shall mean liquid penetrant (LP), magnetic particle (MP), ultrasonic (UT), or radiographic testing (RT) as determined appropriate by the Testing Agency.
- .5 “Standard” and “Standards” shall mean the reference standards listed under “Reference Standards” in this section.
- .6 “Extra Smooth” shall mean a surface finish with surface variation of 12.7 um or less as per AWS C4.1, Sample #4.
- .7 “Heavy Sections”, “Heavy Rolled Sections”, or “Heavy Plate” in these specifications and drawings shall include hot rolled steel shapes with flanges exceeding 38 mm (1-1/2”) in thickness and build up cross sections with plates exceeding 50 mm (2”) in total thickness.

1.6 Appointment of Testing Agency

- .1 The Owner will appoint a Testing Agency approved under W178.1 (Building Category).
- .2 Testing paid for by the Owner is outlined in Part 3.0.
- .3 Testing paid for by the Contractor:
 - .1 Testing of pre-approved connections not on the structural drawings and required by the Contractor for ease of fabrication, transportation, or erection.
 - .2 Any additional costs due to overtime, shift work, and holiday or weekend work required to meet the schedule.
 - .3 Costs for retesting or additional testing due to work having failed to meet the specified requirements.
 - .4 Non-destructive testing will be performed on samples of the work as outlined in Article 3.4 of the specification. Any repair and re-testing costs shall be borne by the Contractor.
 - .5 Deficiencies in work will trigger required additional testing.

2.0 DUTIES

2.1 Responsibility of the Contractor

- .1 The Contractor shall cooperate fully with the Testing Agency. Allow free access to all parts of the work for the purpose of testing and review at all times.
- .2 Notify the Testing Agency and Structural Engineer when work is ready for review.
- .3 Prior to commencement of work, provide a schedule of shop fabrication and erection to the Testing Agency and Structural Engineer. Changes in this schedule shall be communicated to these parties in a timely fashion.
- .4 Provide a quantity takeoff of all the members in the project for use in determining the number of members required for testing. This takeoff should also indicate the divisions in which the members are to be fabricated to aid in shop inspection planning.

- .5 Provide mill certificates in accordance with the Standard, properly correlated to the elements being fabricated.
- .6 The contractor shall make available any non-destructive testing reports performed in the shop during fabrication.
- .7 The contractor shall prep all areas requiring NDE to an acceptable level. Preparation shall include, but not be limited to:
 - .1 Provision of all necessary access platforms or scaffolding to allow for inspections to be carried out.
- .8 The Contractor is solely responsible to provide a finished product that meets the specifications and contract documents. Testing is not carried out for the Contractor's benefit, nor does it make the Structural Engineer or Testing Agency guarantors of the Contractor's work.

2.2 Responsibility and Duties of the Testing Agency

- .1 The Testing Agency is responsible to the Owner and has the authority to, and is expected to, reject any work not meeting the specifications.
- .2 Identify the number, type, and locations of members, connections etc. to be tested and coordinate required shop and site visits.
- .3 Review the structural drawings and specifications prior to carrying out the work.
- .4 Provide testing as per the Standards and as per this specification.
- .5 Provide timely test reports to the Structural Engineer, Consultant, and Contractor.

3.0 TESTING AND INSPECTION

3.1 General

- .1 The Structural Engineer may reject at any time during the progress of the work a piece of material or any member which the Structural Engineer may find defective or not in accordance with the detailed drawings. This material may be rejected notwithstanding any previous acceptance, and components so rejected shall be replaced at no expense to the Owner. In case of dispute, the decision of the Structural Engineer shall be final.

- .2 If initial tests indicate that the work failed to meet specification, the Structural Engineer shall decide if any additional testing is necessary. This testing shall be done by the Owner's agency. The proposed additional testing shall have prior approval of the Structural Engineer.
- .3 Non-destructive testing operators shall have a Level II qualification as a minimum.

3.2 Documents and Materials

- .1 Confirm that the fabricator and erector are certified to CSA-W47.1 and that all welders are properly qualified.
- .2 Review mill certificates for all types of material used in the project ensure they meet the requirements of 05 12 00 and forward to the Structural Engineer.
- .3 Review approved shop welding procedures.
- .4 Confirm welding consumables provided will meet the levels of strength, notch toughness and quality of the base member and that they are properly stored in shop and field.
- .5 Review bolt storage, handling, and installation procedures including pre-installation verification testing as required depending on the types of bolts or washers to be used.
 - .1 Tension Control (TC) Bolts
 - .1 Pre-installation verification must be carried out in accordance with CSA S16 to ensure that the 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.
- .6 Review all available non-destructive testing reports performed by the contractor.
- .7 Where more than one type of paint is specified, ensure that the colour of each coat of paint differs so that they can be visually identified after applications.

- .8 Obtain invoices and product data from the steel supplier for the purchase of the specified primers and paints required for the project. Circulate these documents to both the Structural and Architectural consultants.

3.3 Visual Testing (VT) of Members and Connections (Welded or Bolted)

- .1 Perform visual testing of the structural components, framing and connections through a combination of shop and field visits to meet the requirements below.

Structural Framing	Total Project Minimum Sampling
Columns & Base Plates	25%
Braces	25%
Beams	15%
Girders (Supporting Infill Members)	30%
Moment Connections	50%
Splices	100%

- .2 The Visual Testing (VT) requirements above shall include but not be limited to verifying:

- .1 Grade markings on structural steel in fabricator's plant prior to fabrication.
 - .2 Dimensions, including cross-section, in relation to the specified members (in-house plant QC may be relied upon to perform this task assuming the testing agency is satisfied with the level of QC being carried out).
 - .3 Locations of all 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 the approved welding procedures.
 - .6 Snug tight bolted connections are properly compacted and brought to the snug tight condition progressing outward from the most rigid part.
 - .7 Specified beam camber and that the cambering procedure does not reduce the member capacity.
 - .8 Erection tolerances meet the tolerances of CSA S16.
 - .9 All steel surface preparation prior to priming and / or painting is in conformance with the requirements of the Structural and Architectural specifications.
 - .10 All 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 the contract documents.
- .3 Any defects noted during the Visual Testing (VT) work shall be reviewed using appropriate comprehensive Non-Destructive Evaluation (NDE), which shall be in addition to the requirements in clause 3.5.

3.4 NDE Testing of Connections (Welded or Bolted)

- .1 Perform testing of the connections through a combination of shop and field visits to meet the sampling required in Tables 1.

- .2 The requirements of Table 1 shall include but not be limited to verifying:
 - .1 At least one type of unique connection shall be tested irrespective of the sampling requirements.
 - .2 Bolt types conform to the drawings and specifications prior to start of bolting operations and that any pre-installation verification has been completed.
 - .3 All bolted connections shall be tested in accordance with CSA S16 with a minimum of two bolts tested for each pre-tensioned connection.
 - .4 For all bolted connections that are indicated as pre-tensioned or slip critical, pre-installation verification testing is performed by the inspector in cooperation with the Contractor.
 - .5 For bolted connections indicated as pre-tensioned, the Testing Agency shall be present during installation with sufficient frequency to ensure that the pre-tensioning methods of RCSC 8.2.1, 8.2.3, or 8.2.4, as appropriate, are performed.
 - .6 All welded connections shall be tested in accordance with Annex P of CSA S16 clause 9.5 with an inspection class of **IC2 (Medium)**.
 - .7 When the overall length of a weld is less than 900 mm, the entire length shall be tested.
 - .8 Splices not shown on the structural drawings shall be 100% ultrasonically tested (UT) at the Contractor's expense.
- .3 Post-installation review of bolts using the following techniques:
 - .1 Conventional bolts
 - .1 Turn of the nut method marked on the washer and bolt head or calibrated torque wrench.
 - .2 Tension Control (TC) Bolts
 - .1 Post-installation should be carried out to ensure that the bolt tip is sheared off at the tension control point.

.3 Direct Tension Indicator (DTI) Washers

- .1 A post-installation review shall be carried out to ensure even bearing of the connection and no obstructions are present that would cause uneven pressure to be applied to the DTI.

.4 Welded connections for heavy sections for the following additional requirements:

- .1 Testing of welds at heavy sections and high restraint welds shall be performed not less than 48 hours after the weld has been completed.
- .2 Inspection and Testing by the Testing Agency of high restraint welds and where Heavy Sections are to be joined by partial or complete joint penetration welds in tension.
- .3 Fit up and joint preparation (bevel angle, etc) for conformance to the submitted welding procedure including preheat and interpass temperature shall be monitored. Base me
- .4 Metal temperature shall be monitored during welding operations.
- .5 Review ultrasonic testing reports of Heavy Sections for de-laminations performed in accordance with ASTM A435.

3.5 Testing of Steel Deck

- .1 Provide visual testing (VT) of the steel deck gauge and connections to meet the 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 ≤ 20 Gauge	10%	30%
Composite	t > 20 Gauge	10%	40%

- .2 Sampling of deck connections shall be done in a representative fashion to ensure equal distribution between support, seam, and edge connections.
- .3 The Visual Testing (VT) requirements above shall include but not be limited to verifying:

- .1 The types of connections (welds) or fasteners (mechanical) and verify they meet what has been specified in the engineering drawings.
 - .2 That the welds align with the supporting structure below and proper fusion has been achieved.
 - .3 Verify that all localized deck supports have been provided at discontinuous deck ends that do not bear on structure due to framing interruptions.
 - .4 Verify the deck galvanizing as per the specifications by taking random zinc thickness measurements of 10% of supplied galvanized deck. Ensure that the areas where testing has taken place are touched up with zinc rich paint.
- .4 If the Testing Agency determines that the quality of the welds appear deficient, they shall request a weld quality control test in accordance with the SDI Manual of Steel Construction with Steel Deck. The Structural Engineer shall be immediately notified of this requirement and may request to be present at the time of the test.

Table 1: Single Piece Members

Structural Framing	Minimum Total % Connection Testing
Columns & Base Plates	10%
Beams	10%
Girders	10%
Bracing	10%

Moment Connections	20%
Splices	100%

END OF SECTION

1.0 GENERAL

1.1 Documents

- .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.
- .2 Drawings include architectural, mechanical, and electrical drawings.

1.2 Description of Work Included

- .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, mechanical couplers; deformed bar anchors, wedge anchors, and epoxy anchors that will form the connection between the structural steel 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.
- .2 Co-ordinate with Section 03 31 00 – Concrete Framework and Section 03 20 00 – Concrete Reinforcement for the design, supply, installation, and erection of embedded steel parts.
- .3 Co-ordinate with Section 05 12 50 – Architectural Exposed Structural Steel where required as indicated in the structural and architectural contract documents.

1.3 Related Work Specified Elsewhere

- .1 Section 03 11 00 – Concrete Forming and Accessories
- .2 Section 03 20 00 – Concrete Reinforcing
- .3 Section 03 31 00 – Structural Cast-in-Place Concrete
- .4 Section 04 20 00 – Unit Masonry
- .5 Section 05 00 50 – Testing of Structural Steel
- .6 Section 05 31 00 – Steel Decking
- .7 Section 05 50 00 – Metal Fabrications

.8 Section 07 81 00 – Applied Fireproofing

.9 Section 09 91 00 – Painting

1.4 Reference Standards

.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 A500/A500M – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

.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 CSA G164 – Hot Dip Galvanizing of Irregularly Shaped Articles
 - .2 ASTM A123/A123M – Standard Specification for Zinc (Hot-Dip Galvanizing) Coatings on Iron and Steel Products
 - .3 ASTM A143/A143M – Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
 - .4 ASTM A153/A153M – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - .5 ASTM A384/A384M – Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies

- .6 ASTM A385/A385M – Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
 - .7 ASTM A780/A780M – Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
 - .8 CGSB-85-GP-16M – Painting Galvanized Steel
- .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.
 - .3 Where the Standard is referenced in this specification, it shall mean the documents specified in this clause and their referenced Standards.
 - .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 “Owner”, “Contractor”, and “Consultant” as per the General Conditions and Definitions.
- .2 “Structural Engineer” shall mean a representative of Read Jones Christoffersen Ltd., herein also referred to as RJC.
- .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.
- .4 “Testing Agency” shall mean the testing agency responsible to the Owner.
- .5 “Standard” and “Standards” shall mean the reference standards listed under “Reference Standards” in this section.

1.6 Qualifications

- .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.

- .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.
- .3 Engineers responsible for welding design, procedures, and practice shall be certified in accordance with CSA W47.1, section 6.1.
- .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.
- .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.
- .6 Erector shall not have less than **five year(s)** experience in the erection of structural steel.

1.7 Examinations

- .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 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.

- .2 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.
- .3 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.
- .4 The Contractor shall submit, **before starting work**, written evidence of qualification of the steel fabricators and erectors for welding under Canadian Welding Bureau requirements.
- .5 The Contractor shall submit, **before starting work**, written evidence of ability to weld reinforcing steel to structural steel in accordance with CSA W186.
- .6 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.
- .7 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.
- .8 The Contractor shall submit accurate surveys of steel erection as noted in this section, and on the structural drawings.
- .9 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.
- .10 The Contractor shall submit a description of welding procedures for use on structural steel a minimum one month prior to fabrication or use.

1.9 Shop and Erection Drawings

- .1 Specialty Structural Engineer(s) responsible for the structural steel work, connections 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.
- .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.
 - .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.

- .3 Structural drawings shall not be scaled.
- .4 Submit structural steel connection design details shop, erection, field work details, and setting drawings for review by the Consultant.
- .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.
- .6 Erection Drawings
 - .1 Submit erection drawings for review prior to preparation of detailed shop drawings.
 - .2 Erection drawings shall be included with each submission of detailed shop drawings.
 - .3 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.
 - .4 Well in advance of erection, submit a detailed sequence of construction method statement including procedures, methods, sequences of erection, erection bracing, shoring and guying requirements, keys assumptions and design considerations during construction and equipment proposed for use in erecting structural steel and bearing the seal and signature of a qualified licensed Specialty Structural Engineer licensed in the Province of Ontario.

- .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 holes;
 - .7 camber;
 - .8 finishes;
 - .9 grade(s) of steel;
 - .10 bolt or threaded fastener material grade, size, and designation;
 - .11 weld type, size, extent, and if shop or field applied with AWS welding symbols as specified in the CSA W59 Appendix D and E;
 - .12 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 Prior to starting erection work, submit a description of the methods, sequence of erection, and type of equipment proposed for use in erecting structural steel for review of the effects of construction loads on the remainder of the structure.

- .6 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.
 - .7 Fabrication that commences prior to shop drawing review by the Structural Engineer is at the risk of the Contractor.
 - .8 Clearly identify on the shop drawing all revisions, changes, or modifications.
 - .9 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.
 - .10 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.
 - .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.
- .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 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 See Section 05 00 50 – Testing of Structural Steel.
- .2 Prior to the commencement of work, provide a schedule of shop fabrication to the Testing Agency.
- .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.

- .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 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.
- .2 The Contractor shall be responsible for proper scheduling of delivery and erection for the structural steel in accordance with the construction schedule.
- .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.
- .4 Steel that is stored outdoors after fabrication shall be protected from accumulations of standing water.
- .5 Other materials shall be stored in a weather tight and dry place until ready for use in the Work.
- .6 Packaged materials shall be stored in their original unbroken packages or containers.

1.13 Coordination with Other Trades

- .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

.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 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.
- .4 Structural wide flange shapes (W) to conform to CSA G40.20/ G40.21 grade 345WM.
- .5 Angles (L), plates, channels (C, MC) and miscellaneous beams (S, ST, M and MT) to conform to CSA G40.20/ G40.21 grade 300W.
- .6 Square and rectangular hollow structural sections (HSS) to conform to ASTM A500 Grade C.

- .7 Round hollow structural sections (HSS) to conform to ASTM A500 Grade C.
 - .8 Rolled plates and bars shall conform to CSA G40.20/ G40.21 grade 300W.
 - .9 Anchor Rods: Conform to ASTM F1554 Grade 36, 55, 105 unless otherwise noted or shown.
 - .10 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.
 - .11 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 Shop Paint/Primer
- .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 Primer used in a multi-coat system where a final shop or field paint finish is to be applied shall conform to Section 09 91 00 - Painting and shall be selected and preapproved by the Architect based on surface preparation, exposure conditions and compatibility with subsequent coatings, unless noted otherwise.
 - .3 Shop Paint: To CISC/CPMA 1-73a or SSPC Paint 15.
 - .4 Shop Primer: To CISC/CPMA Standard 2-75.
 - .5 Hot Dip Galvanizing: To CSA G164, minimum zinc coating of 600 g/m².
 - .6 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).
 - .7 Epoxy Paint: Devran 224 HS high build epoxy coating (4 to 6 mils dry film thickness) or approved alternative.

- .8 Zinc-Rich Touch-up Paint: Galvalite as supplied by ZRC Products Company or Galvafrid as supplied by W. R. Meadows Limited or approved alternative.
- .9 “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.
- .3 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.
- .4 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.
- .5 Welding electrode strengths to be equal to E49XX (E70XX) or better, and to be matched to base metal capacity.
- .6 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

- .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 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, 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.
- .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 Transfer beams
 - .4 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 and provide end bearing connections of inclined members such that the bearing plane between the inclined members and their supporting members is either horizontal or vertical unless noted otherwise on the drawings.

- .14 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.
- .15 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
- .16 Provide separators for all double members in accordance with CSA S16.
- .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 key 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 safely resist all dead loads, live loads, lateral loads, construction 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.
- .4 Colour Coding
- .1 Use a colour coding technique to aid in the shop and field identification of all different grades of steel. Each member used shall bear its particular colour code as required by G40.21. Inventory controls other than colour coding may also be used, subject to agreement with the Consultant.

3.0 EXECUTION

3.1 Fabrication

- .1 Fabrication shall conform to the requirements of CSA S16 and the reviewed shop drawings.
- .2 Fabricated units shall be straight and true, without sharp kinks or bends, and accurate to sizes shown.
- .3 Flame cut steel columns shall have their ends milled. Steel base plates supporting columns shall be flat.
- .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.
- .5 Modify installation methods and methods for connecting to suit site conditions found and to the approval of the Consultant.

- .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.
- .7 Provide drain holes in closed sections to prevent water build-up during erection.
- .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.
- .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.
- .10 Visually inspect all plates and shapes for laminations. Replace plates or shapes that contain laminations..
- .11 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.
- .12 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 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.
- .13 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.
- .14 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.
- .15 Cutting of Heavy Sections
 - .1 Where ASTM A6 Groups 4 or 5 rolled shapes or plates 38 mm (1-1/2") or thicker are to be jointed by partial or full penetration welds in tension, preheating shall be required for all thermal cutting operations. Preheat shall be sufficient to prevent cracking but in no case less than 150°F. Weld access holes and copes shall be ground to a smooth radius after cutting and testing for cracks by the magnetic particle method. All cut edges shall be free of sharp notches and gouges.
- .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.
- .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.

- .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.

 - .2 For weldments comprised of plates in more than one plane and whose configuration could cause restraint to uniform cooling of the weldment, conform to detailed welding procedures prepared by a welding expert.

 - .3 For weldments comprised of plates thicker than 38 mm, take adequate precaution to control welding and cooling processes in order to control thermal shrinkage stresses. Use stress-relieving techniques where necessary.

 - .4 Each welder's work shall be traceable.

- .3 Special Requirements: For high restraint welds and welds at heavy sections, follow approved welding procedures for weld process, sequence, pre-heating, and cooling. Use stress-relieving techniques where shown in the approved procedure developed by the Contractor's Welding Consultant.
 - .1 Prior to the start of production welding, the Contractor shall demonstrate to the Testing Agency that preheat can be maintained without relying on heat from the arc. For field welding, the Contractor shall provide a shelter to protect each joint from inclement weather (rain, snow, etc.), from start until completion of the joint.
 - .2 Preheat shall be sufficient to prevent cracking, but in no case less than 107°C. Preheat shall be performed in accordance with AWS D1.1-2010, Section 5.6. Preheat to be measured on the face on the opposite side of heat application. Preheat to be applied uniformly in a manner that does not harm the surface of the material or cause surface temperatures to exceed 594°C. Should stress-relief heat treatment be required, submit a written procedure for review.
 - .3 Prior to heat treatment on a production weld, prepare and treat a test sample per materials section (Charpy V-notch test).
- .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.
- .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.

3.2 Cleaning and Priming

- .1 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.
- .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 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.
- .4 Apply primers in accordance with the manufacturer’s instructions.
- .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.
- .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.
- .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
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

Zone	Description	Exposure Conditions		Expected Finish (Arch to Specify)	Minimum Surface Preparation
		Conditioned Space	Condensation		
I3	Exposed within building but not defined as AESS.	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

.2 Steel that will be non-intumescent paint fireproofed, zinc coated or galvanized, welded, 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 manufactures specifications.

.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

.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.

.10 Hot Dip Galvanized Structural Steel

- .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

- .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
- .2 Structural steel shall be assembled and erected in accordance with the approved erection drawings and specified reference Standards.
- .3 The erector is fully responsible for erection methods, equipment, workmanship, and safety precautions.
- .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.
- .2 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. Base plates longer than 900 shall be set on steel angle seats only.

- .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.
- .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.
- .7 The Contractor shall be responsible for the design of all hooks, erection connections, and handling gear.
- .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.
- .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.
- .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.
- .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.

- .12 Plumb, level, and align individual members of steel work as specified in CSA S16
- .13 The various members forming parts of complete frame or structure after being assembled shall be aligned and adjusted accurately before being fastened.

3.4 Welding

- .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.
- .2 Submit, when requested, welding procedures prepared and sealed by a Specialty Structural Engineer for review.
- .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.
- .4 Appearance, quality of welds made, and methods of correcting defective work shall be in accordance with CSA W59.
- .5 Welding of reinforcing bars to structural steel as per CSA W186.

3.5 Completion

- .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.
- .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

Metal Fabrications

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Work of this section includes metal fabrications identified on the drawings and as set-out in the Metal Fabrications Schedule.

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting in accordance with Section 01 31 19.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Submit list of fabrications to be Provided as part of the work of this section.
- .3 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .4 Shop drawings:
 - .1 Submit engineered shop drawings.
 - .2 Include plans, sections and large scale details, and indicate components and methods of assembly, materials and their characteristics, fastenings, metal finishes, welds, and their structural characteristics relative to their purpose, and other fabrication information required.
 - .3 Indicate proposed Place of the Work connections and methods.
 - .4 Submit coordination drawings indicating locations of concealed grounds, cutouts, plates, and other required fabrications.
 - .5 Show relation to adjoining construction, details of outside and inside corners and door openings.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit operation and maintenance data for incorporation into maintenance manual specified in Section 01 77 00.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Subcontractor:
 - .1 Has adequate plant, equipment, and skilled tradespersons to perform work expeditiously.

Metal Fabrications

- .2 Has successfully completed installations similar to that required in the Work during a period of at least the immediate past 5 years.
- .2 Requirements of regulatory agencies: the work of this section that functions to resist forces imposed by dead and live loads shall conform to requirements of jurisdictional authorities.

1.6 Delivery, Storage, and Handling

- .1 Label, tag or otherwise mark metal fabrications supplied for installation by other sections to indicate its function, location in building and shop drawing designation.
- .2 Protect work from damage during delivery, storage and handling.
- .3 Deliver work to location at the Place of the Work designated by Contractor and to meet requirements of construction schedule.

1.7 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Design, fabricate, and install work of this section in accordance with the building code and requirements of authorities having jurisdiction.
- .2 Welding:
 - .1 Steel: Weld components to conform to requirements of CSA W59-18, and by a fabricator fully certified by the Canadian Welding Bureau to conditions of CSA W47.1-19 and CSA W55.3-08 (R2018) as applicable.
 - .2 Stainless steel: Weld components to conform to requirements of CSA W59 and ANSI/AWS D1.6/D1.6M-2007 as applicable, and by a fabricator fully certified by the Canadian Welding Bureau to conditions of CSA W47.1.
- .3 Design assemblies and connections to withstand own dead load, live loads, super-imposed dead loads, and fabrication forces, without permanent distortions or deformation, to maximum allowable deflection of L/360, within the following construction tolerances:
 - .1 Maximum variation from plumb in vertical lines: 3.2 mm (1/8") in 3 m (10'-0").
 - .2 Maximum variation from level: 3.2 mm (1/8") in 9 m (30'-0").
 - .3 Maximum variation from straight: 3.2 mm (1/8") in 3 m (10'-0") under a 3 m (10'-0") straight edge.
 - .4 Maximum variation from angle indicated: 10 seconds.
 - .5 Tolerances shall be non-cumulative.

Metal Fabrications

2.2 Materials

.1 General:

- .1 Unless detailed or specified otherwise, standard Products will be acceptable if construction details and installation meet requirements of the Agreement, Drawings, Schedules, and Specifications.
- .2 Include materials, Products, accessories, and supplementary parts necessary to complete assembly and installation of work of Section 05 50 00.
- .3 Incorporate only metals that are free from defects that are visible, or that impair strength or durability. Install only new metals that are of best quality, free from rust or waves and buckles, clean, straight, with sharply defined profiles.

.2 Steel:

- .1 Structural shapes, plate, bars: hot-rolled, in accordance with CSA G40.21-13, Grade 300W.
- .2 Hollow structural sections: hot-formed, seamless, in accordance with CSA G40.21-13, Grade 350W, Class H.
- .3 Mild sheet and strip: hot rolled, in accordance with ASTM A1011/A1011M-14.
- .4 Cold rolled sheet: stretcher levelled, fully pickled, in accordance with ASTM A1008/A1008M-13, Grade CS Type A exposed, matte finish, dry, unless otherwise indicated.
- .5 Steel pipe: in accordance with ASTM A53/A53M-12, Type E or S, Grade A or B, standard weight, Schedule 40 seamless black or AISI MT 1010/1015.

.3 Stainless steel:

- .1 Type 304 unless otherwise indicated.
- .2 Stainless steel tubing: in accordance with ASTM A269, Commercial Grade, seamless welded.
- .3 Stainless steel sheet and plate: in accordance with ASTM A167.
- .4 Stainless steel bar and angle: in accordance with ASTM A276.
- .5 Stainless steel seamless pipe: in accordance with ASTM A312.

.4 Steel gratings:

- .1 In accordance with ANSI/NAAMM MBG 531, Type W-19-4 welded steel.
- .2 Grating with serrated edge.
- .3 Finish: hot dip galvanized.

2.3 Accessories

.1 Fasteners:

- .1 Exposed fasteners to match the material surface on which they occur.
- .2 For fastening steel: Zinc plated screws and bolts, and in accordance with ASTM A307-21, Type 304 stainless steel where exposed to exterior.

Metal Fabrications

- .3 High strength bolts: in accordance with ASTM A325-14.
- .4 Concrete anchors; exterior exposed to weather: embedded epoxy set anchors, unless otherwise indicated.
 - .1 Size: in accordance with manufacturer's written requirements and reviewed shop drawings. Embedment depth shall not be greater than 80% of concrete thickness.
- .5 Other types of fasteners as appropriate to meet design requirements.
- .6 Fasteners shall be tamperproof where exposed.
- .2 Welding materials:
 - .1 Steel: in accordance with CSA W59-18.
 - .2 Stainless steel: in accordance with ANSI/AWS D1.6/D1.6M-2007.
- .3 Grout:
 - .1 Epoxy grout; non-shrink, non-expanding.
 - .1 Acceptable Products:
 - .1 Hilti 'HY-200'.
 - .2 Sika 'Sika AnchorFix 3001'.
 - .3 W.R. Meadows 'REZI-WELD 3/2 EPOXY GROUT/PATCH'.
 - .4 Substitutions: in accordance with Section 01 25 00.
 - .2 Cementitious grout: non-shrink, non-expanding in accordance with ASTM C1107/C1107M-20:
 - .1 Acceptable Products:
 - .1 Sika 'Sika Grout 212' or 'Sika M-Bed Standard'.
 - .2 W.R. Meadows 'Sealtight CG-86 Construction Grout'.
 - .3 Substitutions: in accordance with Section 01 25 00.
 - .4 Dielectric separator: Best grade, quick drying non-staining alkali resistant bituminous paint in accordance with CAN/CGSB 1.108-M89, or membrane type to acceptance of Contract Administrator.

2.4 Finishes

- .1 Quick-drying one-coat paint: in accordance with CISC/CPMA 1-73a. Colour to later selection by Contract Administrator.
- .2 Shop primer; steel; standard quality:
 - .1 In accordance with CISC/CPMA 2-75 or SSPC-Paint 20, Paint Specification No. 20: Zinc-Rich Primers (Type I "Inorganic" and Type II "Organic").
- .3 Zinc rich paint; steel: Two-component zinc-rich coating, zinc powder in accordance with ASTM D520-00(2019) Type III, SSPC-Paint 20, Type 1 Inorganic or single-component zinc-rich coating to SSPC-Paint, Type 2 Organic, CAN/CGSB 1.181-M99, VOC content <100 g/l to ASTM D1475-13(2020).

Metal Fabrications

- .1 Acceptable Products:
 - .1 Aervoe Industries, Inc. 'Low VOC Cold Galvanize Coating 93% Zinc'.
 - .2 ZRC Worldwide 'ZRC Zero-VOC Galvanizing Compound'.
 - .3 Substitutions: in accordance with Section 01 25 00.
- .4 Hot dip galvanizing: in accordance with ASTM A123/A123M-13, minimum zinc coating of 600 g/m². Use air cooling method (no water or chromate dipping treatment permitted).
- .5 Stainless steel: in accordance with AISI No. 4 brushed finish.
- .6 Field painting: in accordance with Section 09 91 00.

2.5 Fabrication

- .1 General:
 - .1 Fabricate metal fabrications with machinery and tools specifically designed for the intended manufacturing processes and by skilled tradesmen.
 - .2 Fit and assemble metal fabrications in shop. When this is not possible, make a trial shop assembly.
 - .3 Incorporate means for fastenings of other work secured to work of this section.
- .2 Construction:
 - .1 Fabricate with materials, component sizes, metal gauges, reinforcing, anchors, and fasteners of adequate strength to withstand intended use, and within allowable design factors imposed by jurisdictional authorities. Fabricate items from steel unless otherwise noted.
 - .2 Metal fabrications shall remain free of warping, buckling, opening of joints and seams, distortion, and permanent deformation.
 - .3 Construct items that are part of floor construction, such as gratings and trench covers, to support the same live loads for which surrounding construction is designed.
 - .4 Non-galvanized steel fabrications at exterior locations: Provide drainage holes at exterior exposed tubular fabrications to permit drainage of moisture to exterior of metal fabrications.
- .3 Assembly:
 - .1 Accurately cut, machine and fit joints, corners, copes and mitres so that junctions between components fit together tightly and in true planes.
 - .2 Provide smooth welds with splatter removed where exposed to view.
 - .1 Finish welds shall comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #4 - Good quality, uniform undressed weld with minimal splatter as shown in NAAMM-AMP 521-01(R2012).
 - .3 Allow for differential movements within assemblies and at junctions of assemblies with surrounding Work.

Metal Fabrications

- .4 Field welding of hot dipped galvanized members permitted only when other fastening methods are not possible. Locations of field welds to be clearly identified on reviewed shop drawings.
- .5 Incorporate holes and connections for work installed under other sections.
- .6 Cleanly and smoothly finish exposed edges of materials including holes.
- .7 Cap open ends of sections exposed to view, such as pipes, channels, angles, and other similar work.
- .4 Shop prime painting; standard quality:
 - .1 Clean loose mill scale, rust, dirt, weld flux and spatter from the work after fabrication.
 - .2 Prepare and prime paint in accordance with manufacturer's installation requirements. Prepare steel by methods specified in CISC/CPMA 2-75 or SSPC SP3.
- .5 Galvanizing:
 - .1 Galvanize metal fabrications following fabrication.
 - .2 Paint damage galvanized surfaces with zinc rich paint, immediately following damage to galvanized protection. Prepare substrate to remove oil and grease to SSPC-SP1-16, rust scale to SSPC-SP3-18, mill scale to SSPC-SP6/NACE No. 3-07.
 - .3 At interior locations, fill vent and drain holes exposed in the finished Work by plugging with zinc solder and filing off smooth.
 - .4 At exterior locations, except where indicated to remain as weep holes, fill vent and drain holes exposed in the finished Work by plugging with zinc solder and filing off smooth.

PART 3 - EXECUTION

3.1 Examination

- .1 Take measurements at the Place of the Work to verify that metal fabrications fit surrounding construction, around obstructions and projections in place, or as indicated, and to suit service locations.

3.2 Installation

- .1 Install metal fabrications plumb, true, square, straight, level, and accurately and tightly fitted together and to surrounding work.
- .2 Include in work of this section anchor bolts, high tensile bolts, washers and nuts, expansion bolts, toggles, straps, sleeves, brackets, clips, and other items necessary for secure installation as required by loading and jurisdictional authorities.
- .3 Countersink holes at wood screw locations where wood is attached to work of this section.
- .4 Attach metal fabrications to interior concrete and masonry with corrosion resistant expansion bolts to support load with a safety factor of 3.

Metal Fabrications

- .5 Attach metal fabrications to exterior concrete and masonry with non-shrink epoxy cement to support load with a safety factor of 3.
- .6 Insulate between dissimilar metals or between metal, and masonry or concrete with bituminous paint to prevent electrolytic action.
- .7 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .8 Field painting: in accordance with Section 09 91 00.

3.3 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00.
 - .1 Inspection and testing:
 - .1 Test stainless steel for free iron in accordance with ASTM A380-06. If test results or inspections show stainless steel work to be contaminated with free iron or other impurity which can lead to discolouration of stainless steel work when exposed to moisture, remove and replace or repair the stainless steel work in accordance with recommendation of Nickel Development Institute and as required to provide stainless steel which meets the requirements of this section.

3.4 Adjusting and Cleaning

- .1 After erection, touch up primed surfaces that are burned, scratched or otherwise damaged with prime paint to match shop paint.
- .2 Clean and repair areas of bare metal and welds on galvanized surfaces with zinc rich paint. Mask welded areas of members to minimize overpainting of adjacent undamaged surfaces. Prepare substrate to remove oil and grease in accordance with SSPC-SP1-16, rust scale in accordance with SSPC-SP3-18, mill scale in accordance with SSPC-SP6/NACE No. 3-07.
- .3 Remove damaged, dented, defaced, defectively finished, or tool marked components and replace with new.

3.5 Metal Fabrications Schedule

- .1 Wall-mounted cubbies supports.
- .2 Exterior wood fence supports:
 - .1 Base plate, saddle, and anchor bolts.
- .3 Perimeter radiator enclosure metal supports.
- .4 Bench metal supports.
- .5 Steel gratings and support.
- .6 Steel handrails.
- .7 Service catwalk supports and anchors.

END OF SECTION

Rough Carpentry

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 The work of this section includes, but is not necessarily limited to, the following:
 - .1 Wood grounds, nailers, blocking and sleepers.

1.2 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Shop drawings:
 - .1 Clearly indicate details of construction, profiles, jointing, fastening and other related details.

1.3 Delivery, Storage, and Handling

- .1 When it is required that wood maintain dimensional stability and tolerances to ensure accurate installation of later work, store and install it only in dry areas, and where no further installation of moist materials is contemplated.

PART 2 - PRODUCTS

2.1 Wood Materials

- .1 General requirements:
 - .1 Except as indicated or specified otherwise lumber shall be softwood, S4S, moisture content not greater than 19% at time of installation, in accordance with following standards:
 - .1 CSA O141-05.
 - .2 NLGA-2014 Standard Grading Rules for Canadian Lumber.
- .2 Furring, blocking, nailing strips, grounds:
 - .1 Use S2S material.
 - .2 Dimension lumber sizes: in compliance with Section 12 of the NLGA-2014.
 - .3 Dimension lumber species and grades:
 - .1 Spruce-Pine-Fir.
 - .2 Light framing in accordance with NLGA-2014 Construction grade, S-Dry.
 - .3 Planks in accordance with NLGA-2014 No. 2 grade, S-Dry.
 - .4 Boards in accordance with NLGA-2014 No. 4 Common grade, S-Dry.

2.2 Panel Materials

- .1 Softwood plywood (CSP): in accordance with CSA O151-09.
- .2 Douglas Fir plywood (DFP): in accordance with CSA O121-08.

Rough Carpentry

2.3 Fastenings and Hardware

.1 General:

- .1 Provide fasteners of size and type indicated, acceptable to authorities having jurisdiction, and that comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 38 mm (1-1/2") into wood substrate.
- .2 Anchors to concrete and unit masonry: Capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing according to ASTM E488/E488M-22, conducted by a qualified independent inspection and testing company.
- .3 Use surface fastenings of following types, except where specific type is indicated.
 - .1 To hollow masonry, plaster and panel surfaces use 9 mm (11/32") expansion bolts or other acceptable anchor.
 - .2 To solid masonry and concrete use expansion bolts.
 - .3 To structural steel use bolts through drilled hole, or welded stud-bolts or power driven self-drilling screws, or welded stud-bolts.
- .4 Fastener materials:
 - .1 Hot-dip galvanized fasteners: in accordance with ASTM A153/A153M-09 Class A or B1 G185 and connectors meeting ASTM A653/A653M-13 Class G-185 sheet or better.
- .5 Hardware materials:
 - .1 Hot-dipped galvanized in accordance with ASTM A153/A153M-09, Class A or B1, and connectors in accordance with ASTM A653/A653M-13, Class G185.

2.4 Source Quality Control

- .1 Identify lumber by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.

PART 3 - EXECUTION

3.1 General

- .1 Layout work to accommodate work of others. Cut and fit accurately. Erect in position indicated. Align, level, square, plumb, and secure work permanently in place.
- .2 Bore holes true to line and to same size as bolts. Drive bolts into place for snug fit, and use plates or washers for bolt head and nut bearings. Turn up bolts and lag screws tightly when installed, and again just before concealed by other work or at completion of work.
- .3 Include in work of this section rough hardware such as nails, bolts, nuts, washers, screws, clips, and connectors required for complete and proper installations; and operating hardware required on work of this section for temporary use.
- .4 Do not attach work by wood plugs or blocking in concrete or masonry.

Rough Carpentry

- .5 Do not regard nailers, blocking, and such other fastening provision indicated as exact or complete. Install required provisions for fastening, located and secured to suit Place of the Work conditions, and adequate for intended support.
- .6 Verify that grounds required for fastening of components and equipment are located correctly, and sized for adequate support.

3.2 Equipment Backboard

- .1 Provide backboards for mounting equipment as required. Use 19 mm (3/4") Softwood Plywood.
- .2 Refer to Divisions 21, 22, and 23 and Divisions 26, 27, and 28 for requirements for electrical backboards.

3.3 Grounds, Blocking, Strapping, Furring, Sleepers and Nailers

- .1 Refer to Sections 09 22 00 and 09 29 00, for the installation of wood blocking and/or sheet metal backup for fastening of wall mounted accessories and casework/millwork.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - 1. Exterior wood framing and cladding for storage shed including roof and wall assemblies.
 - 2. Exterior fixed furniture including child-height wood table.
 - 3. Exterior wood fence assembly & supports.
 - 4. Wood deck assembly.
 - 5. Vapour barrier, roofing, membrane flashing, metal flashing, drains, & rainwater leaders for storage shed.
- .2 Provide labour, equipment and material for the complete installation of flashing, drains, and downspouts as indicated on Contract Documents.

1.2 Standards, Codes and Acts

- .1 CSA Standard O80 Series-97, Wood Preservation, Canadian Standards Association.
- .2 CSA Standard B111-1974, Wire Nails, Spikes and Staples, Canadian Standards Association.
- .3 CSA Standard O112-M1977 (R1999), Standard for Wood Adhesives, Canadian Standards Association.
- .4 CSA Standard O325-07, Construction Sheathing, Canadian Standards Association
- .5 CSA Standard O121-M1978, Douglas Fir Plywood, Canadian Standards
- .6 CSA STANDARDS O141-05, Softwood Lumber, Canadian Standards Association.
- .7 CSA Standard O153-M1980 (R1998), Poplar Plywood, Canadian Standards Association.
- .8 CAN/CGSB 51-34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction, Canadian General Standards Board.
- .9 A307-02 Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
- .10 ASTM A325M-00, Standard Specification for High-Strength Bolts for Structural Steel Joints, American Society for Testing and Materials.
- .11 Comply with the latest edition of CAN/ULC Z614.

Exterior Woodwork

.12 Grade lumber in accordance with rules and regulations of the National Lumber Grades Authority.

1.3 Tolerances

.1 Members shall be aligned within the following tolerances:

1. Wall construction tolerances:

Wall stud spacing	±6 mm
Wall plumb	±6 mm/3000 mm
Wall level	±6 mm/900 mm
Wall square	±10 mm/3000 mm
Variation in stud lengths	±3 mm
Individual stud out of plane	±3 mm
Straightness of Top and Bottom Plates	±6 mm/900 mm
Lap of top plates acting as chord transfers	±12 mm
Specified nail spacing	±6 mm
Maximum nail penetration into sheathing	3 mm
Maximum spacing between sheathing and supports	3 mm

2. Floor and Roof construction tolerances:

Joist spacing	±6 mm
Maximum spacing between sheathing and supports	3 mm mm
Overall floor level	±6 mm/3000 mm
Localized floor level	±6 mm/900 mm
Joist depth variation	±3 mm
Specified nail spacing	±6 mm
Maximum nail penetration into sheathing	3 mm
Truss spacing	±6 mm
Truss plumb	±6 mm/1200 mm
Truss bearing requirements	±6 mm ²
Truss construction tolerances	as per TPIC
Beam spacing	±6 mm
Nail spacing for built-up beams	±3 mm
Variation in individual beam depth of built-up beam	±3 mm
Beam bearing requirements	±3 mm
Beam level	±6 mm/3000 mm
Beam plumb	±3 mm
Chord and web bracing per individual truss design	requirements

1.4 Submittals

- .1 Submit shop drawings and product data in accordance with Section 01 33 00.
- .2 Show complete details, layout, member sizes, grades of materials, connection details, holes, finishes, erection sequence and the like. Show orientation, relation to appropriate grid lines and setting elevations for bases and bearing assemblies.
- .3 Coordinate all shop drawings with shop drawings of reinforced concrete, structural steel and other related work.

Exterior Woodwork

- .4 Furnish inspection company with a copy of each reviewed drawing.

1.5 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.

PART 2 - PRODUCTS

2.1 Materials

.1 Framing:

1. Moisture Content: All wood products shall be dry at time of delivery and installation. Framing Lumber: NLGA Spruce-Pine-Fir. Studs: Structural Light Framing, Grade No.1 / No. 2; Joists and Beams: Structural Joists and Planks, Grade No. 1 / No. 2.

.2 Hardware

1. Nails: CSA Standard B 111 - 1974:
2. For Structural Framing: Common Spiral Nails.
3. Galvanize Nails: for wall sheathing.
4. For Exterior Cladding: Galvanized Spiral Nails
5. Wood Screws: CSA Standard B35.4-1972, galvanized or cadmium plated.
6. Bolts Nuts and Washers: CAN/CSA-S16-01 and ASTM A 307, standard structural grade, hex heads and nuts. Galvanized where exposed to view in the finished building.
7. Anchor Bolts: to CSA Standard G40.20/G40.21 Grade [300W] unless otherwise noted.
8. Commercial-grade single cylinder keyed entry panic proof door knob set in brushed nickel finish.
9. Extra heavy mortised Tee zinc door hinges, 150mm long.
10. Hot dipped galvanizing: Galvanize steel exposed to weather to CAN/CSA G164-M92 (R1998), minimum zinc coating of 600 g/m².

.3 Sealants and vapour barrier:

1. Air Membrane Barrier:

- .1 Material: double layer, coated polyester, water and ultraviolet light resistant, vapour permeable air barrier.

Exterior Woodwork

- .2 Product: AirOutshield UV manufactured by SRP Canada Inc.
- 2. Seam Tape: As required at various joints, in accordance with Air Barrier membrane recommendation.
- 3. Transition Membrane: Baker "Blueskin" with associated primer and accessories or approved equal.
- 4. Sealants and Fasteners: Compatible with membrane and substrate in accordance with manufacturer's recommendation.
- 5. Sheathing Insulation Tape: No. Y - 8086, Contractor's Sheathing Tape, manufactured by 3M Canada Inc.
- .4 Roof
 - 1. Self-adhering granulated roofing membrane sheet: SBS modified bitumen membrane having a minimum thickness of 3.3mm (130 mils) and fibrous glass reinforcement meeting CGSB 37-GP-56M
 - .1 Product: Henry Low Slope or approved equivalent.
 - .2 Colour: White.
 - 2. Sheathing Plywood: CSA Standard O12, Douglas Fir.
- .5 Storage Shed Wall Assembly
 - 1. Sheathing Plywood: CSA Standard O12, Douglas Fir:
 - 2. Cladding boards: modified wood.
 - .1 Acceptable products:
 - 1. Kebony
 - 2. Accoya
 - 3. or approved equal by Thermory
 - .2 Surfaces: clear, dressed profile shapes with eased edges as indicated by drawings.
 - .3 Dimensions & sizes: refer to Material / Equipment / Product Tag Schedule.
 - 3. Z-girts and sub-girts: Preformed Z275 galvanized metal sheet, 1.22mm (18 gauge) minimum m base steel nominal thickness, notched for drainage, to ASTM A653/A653M-11, Grade A.
- .6 Fence

Exterior Woodwork

1. Cladding boards: modified wood.
 - .1 Acceptable products:
 1. Kebony
 2. Accoya
 3. or approved equal by Thermory
 - .2 Surfaces: clear, dressed profile shapes with eased edges as indicated by drawings.
 - .3 Dimensions & sizes: refer to Material / Equipment / Product Tag Schedule.
2. Z-girts and sub-girts: Preformed Z275 galvanized metal sheet, 1.22mm (18 gauge) minimum m base steel nominal thickness, notched for drainage, to ASTM A653/A653M-11, Grade A.
- .7 Deck
 1. Cladding: furfurylated American clear radiata pine modified wood.
 - .1 Product: Kebony clear 21 x 140 mm Step Clip profile shapes as indicated by drawings.
 - .2 Fastening system: Step Clip fastening strips.
- .8 Flashing
 1. Steel: To meet specified requirements of ASTM A446/A446M, Grade A.
 2. Steel sheet: Pre-finished Galvalume, "Regent Gray" by Vicwest, Flynn, Cascadia Metals or approved equivalent.
 - .1 Steel gauges:7
 1. Use 24 gauge; Parapet flashings, drip edges, base angle flashings, clip angles.
 2. Use 22 gauge; Corner and door flashing profiles for jamb head and sill conditions as indicated on drawings.
- .9 Fasteners: Use only nails, bolts, screws and other fasteners of the same metal and with the same finish as the metal being fastened to protect against corrosion. Use fasteners of a size suitable for the particular fastening condition and service. Use only approved nails, bolts, screws and other fasteners.
 1. Caulking: One or two part polysulphide.
- .10 Hardware

Exterior Woodwork

1. Storage shed door hinges
 2. Storage shed door lever set
 3. Storage shed wall standards: BK-100 series by Knappe and Vogt
 4. Storage shed shelf brackets: BK-103-22
- .11 Panel Materials
1. Per Section 06 10 53.
- .12 Shelving:
1. 19 mm particle board core
 - .1 Finish:
 1. Low Pressure Decorative Laminate, thermally fixed melamine resin impregnated decorative paper facing to ANI/NEMA LD3-2005.

PART 3 - EXECUTION

3.1 Work

- .1 Framing:
1. Conform to CSA Standard O86 and CAN/CSA-S16.
 2. Unless noted otherwise, timber construction shall conform to Part 9 of the Ontario Building Code.
 3. Joints and intersecting members shall be accurately fitted and made in true planes with adequate fastenings.
 4. Clusters of knots, splits and other strength reducing features shall be avoided at connections.
 5. Provide all connection material required for timber members including bases, shear connectors, bolts, nuts, washers, packing, baseplates and the like.
 6. Layout all work true to line and level, plumb and true. Accurately place supports and members in position and brace securely, to remain plumb and true until permanently fixed. Receive approval of all layout work by the Owner prior to commencement of construction.
 7. Ensure supports and members are capable of safely supporting imposed loads. Report any discrepancies immediately to the Consultant.

Exterior Woodwork

8. Make all cuts as required with clean sharp tools. Products may be pre-cut in shop and delivered to site ready for assembly.
 9. Receive approval of all woodwork prior to finishing.
- .2 Sealants and vapour barrier
1. Install vapour seal barriers continuously at exterior walls as indicated on Drawings to ensure:
 2. Install with membrane manufacturer's specifications and recommendations:
 3. That continuity of the air seal barrier system is maintained in the exterior walls enclosing the building.
 4. Prepare all surfaces to receive transition membrane as recommended by membrane manufacturer.
 5. Ensure compatibility of membrane materials with which they are in contact.

3.2 INSTALLATION

- .1 Framing
1. Provide moisture barrier specified under all wood products resting on concrete.
 2. Install sill seal between top of foundation wall and sill plate.
 3. Treat end and first 300mm of wood members meeting masonry or concrete at or below grade with 2 brush coats of preservative treatment.
 4. Nailing of framing and sheathing shall conform to or exceed requirements of Tables 9.23.3A and I9.23.3.B of the Code.
- .2 Air/Vapour Barrier:
1. Ensure that air/vapour barrier is continuous over inside of exterior wall studs, under sill plates, over top plates and over face of joist headers for full height of exterior walls and across underside of roof tie joists.
 2. Lap joints in air/vapour barrier over two studs. Lay lap over a bed of sealant in conformance with Section 07 90 00 at one stud and staple air/vapour barrier in place.
- .3 Flashing:
1. Install sheet metal exposed to view in straight lines, with junctions aligned and on same plane.

Exterior Woodwork

2. Install sheet metal to maximum runs of 2400 mm lengths except where conditions for securing dictates that shorter lengths are required, preferable, or as indicated on the drawings.
 3. Install sheet metal to prevent entry of water under service and weather conditions.
 4. Back paint, with two coats of bituminous paint at rate of 1L/sq.m., sheet metal that is not given pre-coated finish and that comes into contact with another kind of metal, or masonry or concrete.
 5. Install sheet metal with concealed fastenings. Exposed fastenings will be permitted only as approved when concealed fastenings are impossible.
 6. Fasten sheet metal, clips and other components in an approved manner, with fasteners weather tight and evenly and neatly located. Do not use pop rivets.
 7. Do not form joints or pockets that fail to drain water.
 8. Caulk all open sheet metal joints that do not mechanically provide weather tight construction, in accordance with Section 07920.
- .4 Roof
1. Install roofing elements on clean and dry surfaces, in accordance with the manufacturer's requirements and recommendations.
- .1 Fence and Cladding
2. Examine surfaces to receive the work of this Section and proceed only when conditions are satisfactory for a proper installation.
 3. Erect work plumb, level, square and to the required lines.
 4. Provide and fit in place all wood furring, strapping, grounds and blocking required to provide adequate properly placed fixing for all wood finishes, fitments, and as required for the work of other trades.
 5. All nails shall be long enough so that at least half their length penetrates into the second member. Splitting of wood members shall be minimized by staggering the nails in the direction of the grain and by keeping nails - well in from edges.
 6. Nail Pattern: Fasten each siding board 1/2" from top of face and 3/4" from bottom at each vertical strapping location. Align fasteners vertically.
 7. Prepare and pre-finish all wood cladding in a controlled environment to meet finishing requirements and allow to dry prior to installation.
 8. Follow finish manufacturer's recommendations with respect to installation of primer and finish coats.

Exterior Woodwork

9. Touch up finish after installation.

3.3 Erection

.1 Sub-framing:

1. Make adequate provision for erection stresses and for sufficient temporary bracing to keep the structural frame plumb and in true alignment until the completion of the entire frame including installation of the deck.
2. Report to the Project Manager every failure of the materials to come together properly before any measures are taken for correction.

.2 Joists:

1. Frame around all openings with double headers and trimmers wellspiked together. Provide 2" x 2" diagonal cross bridging at maximum of 8 foot centres. Secure bottom end after surface sheathing is installed. Anchor joists to plates or sills and adjacent parts of the structure in an approved manner.

.3 Sheathing

1. Apply sheathing diagonally over joists or rafters. Locate joints over bearing and distribute all over the roof area. Adequately secure each board to each joist with a minimum of three 65 mm 2 1/2" ringed or spiral nails.

END OF SECTION

Architectural Woodwork

PART 1- GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Work of this section includes architectural woodwork as set-out in the Millwork Schedule including, but not limited to, the following:
 - .1 Acrylic mirrors; PLMIR.
 - .2 Factory and site finishing of architectural woodwork.

1.2 Administrative Requirements

- .1 Coordination:
 - .1 Coordinate with other work for satisfactory and expeditious completion of the work of this section. Coordinate with partition accessories, electrical, communications, and finish components to ensure that proper provisions are made for the installation of the work of this section and for work by others.
 - .2 Where woodwork is to be fitted to other construction, check actual dimension of other construction by accurate field measurements before manufacturing woodwork; show recorded measurements on final shop drawings. Coordinate manufacturing schedule with construction progress to avoid delays in the Work.
 - .3 Provide forms, templates, anchors, sleeves, inserts and accessories required to be fixed to or inserted in the work of this section and set in place. Instruct applicable Subcontractors as to their locations.
 - .4 Provide cut-outs for raceways, sleeves, grommets and other manufactured accessories which are required for the work of this section and for work by others.
- .2 Conduct a pre-fabrication meeting in accordance with Section 01 31 19.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data for each type of Product and process proposed for use in the work of this section and incorporated into items of architectural woodwork.
- .3 Shop drawings:
 - .1 Submit shop drawings for the work of this section complying with the North American Architectural Woodwork Standards 4.0 requirements.
 - .2 Indicate quality standards and grades.
 - .3 Include full scale drawings of exposed-to-view edge conditions.
 - .4 Include plans, sections and large scale details, and indicate components and methods of assembly, fastenings, and other fabrication information required for the work of this section. Indicate assembly joint lines.

Architectural Woodwork

- .5 Include materials and their characteristics and finishes as applicable including the following:
 - .1 Panel core and material types, thicknesses, compliance with specified standards, special treatments.
 - .2 Adhesive types to be used and locations.
 - .3 Finishing requirements including North American Architectural Woodwork Standards 4.0 finish system number, sheen, and required application steps.
- .6 Submit coordination drawings indicating locations of concealed grounds, cut-outs, plates, and other required fabrications.
- .7 Show relation to adjoining construction, details of outside and inside corners and door openings.
- .8 Casework hardware, one unit of each type and finish.
- .4 Verification samples:
 - .1 Submit samples for purpose of verification of compliance with specified requirements.
 - .2 Submit 3 sets of 200 mm x 200 mm (8" x 8") samples, or 200 mm (8") long as applicable, of each specified Product, material and finish, including but not limited to the following:
 - .1 Shop finished materials, showing each type of finish and colour.
 - .2 Samples of each specified Product, in each specified colour and finish.
 - .3 Solid surfacing, in each specified colour and finish.
 - .4 Plastic laminates, in each specified colour and finish.
 - .5 Acrylic sheet (mirror) in specified tints and finishes, showing edge treatment.
 - .6 Solid wood edge, in each species required.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit maintenance and cleaning instructions for finishes requiring specific care, noting particularly those procedures or materials which will cause damage to finished surfaces to be included in maintenance manuals.
- .3 Maintenance materials:
 - .1 Deliver extra sets of hardware items for maintenance as follows:
 - .1 2 % of each type actually installed, but not less than 2 sets.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Manufacturers:

Architectural Woodwork

- .1 Architectural woodwork shall be manufactured by a firm having 5 years' experience, minimum, on work of similar size and quality.
 - .2 Shall be a member in good standing of the Architectural Woodwork Institute or the Architectural Woodwork Manufacturers Association of Canada or the Woodwork Institute.
 - .3 Solid surfacing fabricator: Fabrication to be performed by a solid surface manufacturer's certified fabricator. Submit certification letter prepared by the solid surfacing manufacturer.
- .2 Installers:
 - .1 Has successfully completed 2 architectural woodwork projects similar in scope, materials and design to this Project within the last 5 years.
 - .2 Quality standard:
 - .1 Work shall be in accordance with the North American Architectural Woodwork Standards 4.0, Custom Grade.

1.6 Delivery, Storage, and Handling

- .1 Protect architectural woodwork during transit, delivery, storage and handling to prevent damage, spoilage, and deterioration.
- .2 Do not deliver woodwork until painting, wet work, grinding, and similar operations that could damage, soil, or deteriorate architectural woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified under paragraph 1.7 Field Conditions.
- .3 The architectural woodwork manufacturer and the Contractor shall be jointly responsible to make certain that architectural woodwork is not delivered until the building and storage areas are sufficiently dry so that the architectural woodwork will not be damaged by excessive changes in moisture content.

1.7 Field Conditions

- .1 Environmental conditions:
 - .1 During storage and installation: Obtain and comply with North American Architectural Woodwork Standards 4.0 for optimum temperature and relative humidity conditions for woodwork during its storage and installation. Do not install woodwork until these conditions have been attained. Woodwork shall be acclimatized for a minimum of 72 hours prior to commencing woodwork installation.
 - .2 During finishing: Comply with Architectural Woodwork Standard's temperature and humidity requirements before, during, and after application of finishes.
 - .3 During service life of woodwork: Obtain and comply with woodwork manufacturer's advice for optimum temperature and humidity conditions.

1.8 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.

PART 2 - PRODUCTS

2.1 Sustainable Design Requirements

- .1 Wood products used in work of this section shall be Forestry Stewardship Council (FSC) Certified, with chain of custody verification, except for products made with recycled material.
- .2 Wood-based materials are to contain no added urea-formaldehyde.

2.2 Performance/Design Requirements

- .1 Casework integrity shall meet the minimum acceptance levels in accordance with SEFA 8-1999 as outlined in the North American Architectural Woodwork Standards 4.0 and additional or greater loading capacities as specified throughout the North American Architectural Woodwork Standards 4.0.
- .2 Maximum allowable adjustable shelf lengths shall comply with shelves assembly rules per the North American Architectural Woodwork Standards 4.0 based on shelf thickness indicated or scheduled.

2.3 Metal Materials

- .1 Stainless steel countertops: in accordance with Section 05 50 00.

2.4 Wood Materials

- .1 Lumber:
 - .1 Hardwood for concealed blocking and framing: Custom grade, any species that, when painted, will not show any defects.
 - .2 Moisture content: Provide kiln-dried (KD) lumber with moisture content range between 6% to 12% for interior architectural woodwork. Maintain temperature and relative humidity during fabrication, storage and finishing operations so that moisture content values for woodwork at time of installation do not exceed 5% to 10%.
 - .3 WD1A; Solid hardwood for transparent finish.
 - .1 Species: White Oak.
 - .2 Cut: Quarter.
- .2 Wood veneers:
 - .1 Allowable wood veneer face grade characteristics shall comply with North American Architectural Woodwork Standards 4.0 referenced grade and referenced standards.
 - .2 WD1; Hardwood veneer; for transparent finish:
 - .1 Species: White Oak.
 - .2 Veneer thickness: Minimum 1.0 mm (0.040") thick after sanding.
 - .3 Veneer cut: Quarter.
 - .4 Veneer leaf matching: Book.
 - .5 Veneer assembly matching: Balance.

Architectural Woodwork

- .6 Veneer end matching: Continuous.
- .7 Doors in pairs or sets:
 - .1 For openings with more than one door, including doors with mullions, door faces shall be matched as follows:
 - .1 Pair matched.
- .8 Transom and side panels:
 - .1 Fabricate matching panels with same construction, exposed surfaces, and finish specified for associated doors.
 - .2 Matching requirements: Continuous match.

2.5 Panel Materials

- .1 Panel material schedule; except where indicated otherwise:
 - .1 Thickness: 19 mm (3/4") minimum.
 - .2 Core panels:
 - .1 At veneered work: Particleboard, except at shelving use veneer core plywood.
 - .2 At plastic laminate and melamine work: Particle board.
 - .3 Plywood backing; countertops, backsplashes, and where indicated: Exterior grade plywood with no added urea-formaldehyde used in composition.
 - .4 Plywood backing; solid surface countertops: marine grade plywood.
 - .3 Maximum moisture content at time of installation: 10% to 12%.
- .2 Plywood:
 - .1 Veneer core plywood non telegraphing grain: Sanded good one side or good two sides (when both sides exposed or to receive applied finish materials) plywood:
 - .1 Hardwood plywood: in accordance with ANSI/HPVA HP-1-2009.
 - .2 Softwood plywood: to US Plywood Standard APA PS-1-09 Structural Plywood (with Typical APA Trademarks).
 - .2 Baltic Birch; exposed and semi-exposed: Birch facers and core veneers, type 2 hot press glue bond (E-1 rating meets European low formaldehyde emission standard), European Face Grade B - Premium grade on exposed faces (patch free clear faces, uniform white in colour), premium edge quality where cut to expose, free of gaps and defects.
 - .3 Marine grade plywood: 19 mm (3/4") nominal thickness, in accordance with CSA O121-08, marine grade DFP, sanded both sides.
- .3 WD2; Medium density fibreboard (MDF):
 - .1 To ANSI A208.2-2016, 720 kg/m³ (45 lbs/ft³) minimum density and as follows:
 - .1 Grade: Grade 130.
 - .2 Formaldehyde emission: No added urea-formaldehyde used in composition.
- .4 Particleboard:

Architectural Woodwork

- .1 In accordance with ANSI A208.1-2009, and as follows:
 - .1 Industrial grade:
 - .1 M-3i Medium density; between 640 - 800 kg/m³ (40 - 50 lb/ft³).
 - .2 Formaldehyde emission: No added urea-formaldehyde used in composition.

2.6 Plastic and Composite Materials

- .1 ML-1; Low pressure decorative laminate; melamine particleboard panels:
 - .1 Particleboard conforming to ANSI A208.1-2009, grade M3i, board consisting of 100% pre-consumer wood fibre containing no added urea-formaldehyde resins, 19 mm (3/4") minimum thickness with thermally fused melamine resin impregnated decorative paper facing to ANSI/NEMA LD 3-2005, complete with matching non-yellowing edge trim, unless otherwise noted.
 - .2 Colours: as selected by Contract Administrator.
- .2 PLAM-1; High pressure decorative laminate:
 - .1 General purpose grade: in accordance with ANSI/NEMA LD 3-2005, Horizontal General Purpose Grade (HGS).
 - .2 Colours, finishes, and patterns: to later selection by Contract Administrator.
 - .3 Acceptable manufacturers:
 - .1 Abet Laminati.
 - .2 Formica.
 - .3 Laminart.
 - .4 Nevamar.
 - .5 Wilsonart.
- .3 Solid surfacing sheet:
 - .1 Homogenous (not coated, laminated or composite construction), filled material containing methyl methacrylate.
 - .1 Acceptable Products:
 - .1 Refer to Material/Equipment/Product Tag Schedule.
 - .2 Substitutions: in accordance with Section 01 25 00.
 - .2 Nominal sheet thickness: 13 mm (1/2") minimum, unless otherwise indicated.
 - .3 Colours/patterns:
 - .1 SSM1: as selected by Contract Administrator from manufacturer's colour Group 3.
 - .2 SSM2: Custom colour as selected by Contract Administrator.
 - .2 Accessories:
 - .1 Joint adhesive: Manufacturer's standard adhesive to create inconspicuous, nonporous joints, with a chemical bond.
 - .2 Sealant: Mildew resistant sealant in accordance with Section 07 92 00.

Architectural Woodwork

.4 PLMIR; Acrylic sheet (mirror):

- .1 Acrylic sheet, minimum 3 mm (1/8") thick, and as indicated, complete with polished, rounded edges, and radiused corners.
- .2 Finish: Machine and edge relief.
- .3 Colour: as selected by Contract Administrator.
- .4 Acceptable Products:
 - .1 Refer to Material/Equipment/Product Tag Schedule.
 - .2 Substitutions: in accordance with Section 01 25 00.

2.7 Grilles; FLGR1A

- .1 Extruded aluminum bar grille:
 - .1 Acceptable Products:
 - .1 Refer to Material/Equipment/Product Tag Schedule.
 - .2 Substitutions: in accordance with Section 01 25 00.
 - .2 Blade spacing: 6.35 mm (1/4").
 - .3 Bar size: 2.38 mm (3/32").
 - .4 Finish: Anodized clear.

2.8 Change Tables; MCT1a, MCT1b

- .1 Dimension: 1511 mm x 952 mm x 597 mm (59-1/2" x 37-1/2" x 23-1/2") (w x h x d).
- .2 Acceptable Products:
 - .1 Refer to Material/Equipment/Product Tag Schedule.
 - .2 Substitutions: in accordance with Section 01 25 00.

2.9 Fasteners and Adhesives

- .1 Fasteners shall comply with North American Architectural Woodwork Standards 4.0.
- .2 Adhesives: Shall be used for intended purpose and manufacturer materials applications and installation, applied in accordance with manufacturer's written requirements and shall comply with the "adhesive usage guidelines" recommendations of North American Architectural Woodwork Standards 4.0

2.10 Hardware

- .1 Casework hardware; to be furnished and installed by the architectural woodwork manufacturer.
 - .1 Where casework hardware is not specified or indicated on drawings or scheduled, casework hardware shall comply with ANSI/BHMA Standards, latest edition, minimum grades, loading and other basic rules per the North American Architectural Woodwork Standards 4.0.
 - .2 Drawer slides: Heavy duty ball bearing slides, self-closing, full extension.
 - .1 Acceptable manufacturer: Richelieu.

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- .3 Hinges: Heavy duty, self-closing, 110 degree.
 - .1 Acceptable manufacturer: Blum.
- .4 Pulls; doors and drawers, except where otherwise indicated:
 - .1 Acceptable *Product*:
 - .1 Hafele 116.07.639.
- .5 Locks:
 - .1 Acceptable *Product*:
 - .1 Hafele SC Series.
- .6 Closet rods & brackets:
 - .1 Acceptable *Product*:
 - .1 Richelieu 'Steel Heavy Duty Round Closet Rods', diameter 34 mm.
- .7 Rubber bumpers:
 - .1 Acceptable *Product*:
 - .1 3M 'SJ Series'.
- .8 Pull-out waste receptacle:
 - .1 Acceptable *Product*:
 - .1 Hafele 503.70.332.

2.11 Finishes - Interior Architectural Woodwork

- .1 General: The entire finish of interior architectural woodwork is specified in this section, regardless of whether factory applied or applied after installation.
- .2 Preparations for finishing:
 - .1 Prior to finishing, exposed portions of woodwork shall have handling marks or effects of exposure to moisture removed with a thorough final sanding over surfaces of the exposed portions, using appropriate grit sandpaper, and shall be cleaned prior to applying sealer or finish. Sanding shall be completed just prior to stain or finishing application.
 - .2 Concealed surfaces of woodwork that might be exposed to moisture, such as those adjacent to exterior concrete or masonry walls, shall be back-primed.
 - .3 Comply with referenced quality standard in Part 1 for sanding, filling countersunk fasteners, sealing concealed surfaces and similar preparations for finishing of architectural woodwork, as applicable to each unit of work.
- .3 Finish for WD1; WD1A, and WD2:
 - .1 Comply with requirements indicated below for finish system, staining, and sheen.
 - .1 Sheen: Flat.
 - .2 Factory finish with transparent, Post Catalysed Lacquer in accordance with the North American Architectural Woodwork Standards 4.0, Section 5.
 - .1 Transparent finish: as indicated or scheduled.

Architectural Woodwork

- .1 Clear (natural).
- .2 Stain: Stain colour: as selected by Contract Administrator.

2.12 Fabrication

- .1 Fabricate woodwork to dimensions, profiles, and details indicated with openings and mortises pre-cut, where possible, to receive hardware and other items of work.
- .2 Complete fabrication, assembly, finishing, hardware application, and other work before shipment to maximum extent possible. Trial fit in shop and disassemble components only as necessary for shipment and installation. Where necessary, provide ample allowance for scribing, trimming, and fitting. Reassemble with concealed fasteners.
- .3 Provide woodwork, solid tops and other indicated materials with pre-cut openings, where possible, for hardware, appliances, plumbing fixtures, electrical work, telephone cut-outs and similar items. Locate openings accurately and Provide proper size and shape. Smooth edges of cut-outs and, where located in countertops, seal edges of cut-outs with a water-resistant coating.
- .4 Provide framing for architectural woodwork, complete with bracing and fastening devices as required for a rigid installation, and as required to sustain the imposed loads.
- .5 Reinforcing shown is minimum. Provide additional reinforcing as required to ensure a rigid assembly. Take responsibility for the stability of furniture and fitments.
- .6 Provide balancing sheets as required, and specified, complying with the North American Architectural Woodwork Standards 4.0.
- .7 Provide surface mount blocking and strapping necessary to support the work of this section. Such blocking shall not be exposed upon completion of work.
- .8 Prefinish work at the factory, except where specified or indicated otherwise.
- .9 Solid wood edging: No end grain shall be visible; mitre external corners; house internal corners.

2.13 Fabrication - Solid Surfacing

- .1 Fabricate components in shop to greatest extent practical to size and shape indicated, in accordance with reviewed shop drawings and manufacturer's written requirements.
- .2 Form joints between components using manufacturer's standard joint adhesive. Joints shall be inconspicuous in appearance and without voids. Attach 100 mm (4") wide solid surfacing material reinforcing strip under joints.
- .3 Provide holes and cut-outs as indicated or as required.
- .4 Rout and finish component edges to a smooth, uniform finish. Rout cut-outs then sand edges smooth. Repair or reject defective or inaccurate work.
- .5 Surfaces shall have a uniform finish.

PART 3 - EXECUTION

3.1 Preparation

- .1 Condition woodwork to field conditions in installation areas before installing. Ensure that field conditions have been provided as requested and specified.

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- .2 Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including back priming and removal of packing.
- .3 Provide grounds, nailers and other required fabrications which are to be built into other work when required.
- .4 Ensure that wall and ceiling variations are not in excess of 6.4 mm (1/4") in 3658 mm (144") and that floors are not in excess of 12.7 mm (1/2") in 3658 mm (144") of being plumb, level, flat, straight, square, of the correct size. Variations shall be corrected prior to installation of work of this section.
- .5 Report conditions contrary to requirements preventing proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.

3.2 Installation

- .1 Install woodwork to comply with North American Architectural Woodwork Standards 4.0 for same grade specified in Part 1 of this section for type of woodwork involved.
- .2 Install woodwork plumb, level, true, and straight with no distortions.
- .3 Scribe and cut woodwork to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.
- .4 Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where prefinished matching fastener heads are required, use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork and matching final finish where transparent finish is indicated.
- .5 Complete the finishing work specified in this section to whatever extent not completed at shop or before installation of woodwork.

3.3 Installation - Tolerances

- .1 Install to a tolerance of 3 mm in 2400 mm (1/8" in 8'-0") for plumb and level (including tops) and with no variations in flushness of adjoining surfaces unless otherwise acceptable in accordance with the North American Architectural Woodwork Standards 4.0.

3.4 Adjusting and Cleaning

- .1 Repair damaged and defective woodwork where possible to eliminate defects functionally and visually; where not possible to repair, replace woodwork.
- .2 Clean, lubricate, and adjust hardware.
- .3 Clean woodwork on exposed and semi-exposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

3.5 Protection

- .1 Protect architectural woodwork during remainder of construction period to ensure that work will be without damage or deterioration at time of acceptance.
- .2 Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, that ensure that woodwork is without damage or deterioration at time of Substantial Performance of the Work.

END OF SECTION

Self-Adhering Sheet Waterproofing

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Sheet waterproof membrane at vertical locations as indicated.

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting in accordance with Section 01 31 19.
 - .1 Independent inspection and testing company shall attend the pre-installation meeting.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Submit drawings showing locations of joints, section of entire system, section of each sleeve and penetration condition, flashing conditions and other fabrication information in accordance with Section 01 33 00.
- .4 Samples:
 - .1 Submit samples complete with manufacturer's labels intact, of materials to be used for the work of this section prior to commencement of work, allowing ample time for review and acceptance by Contract Administrator and independent inspection and testing company. Do not proceed with work of this section until samples are accepted.
- .5 Manufacturers' instructions:
 - .1 Submit Product manufacturer's standard and project specific installation details required to cover the full spectrum of waterproofing conditions applicable to the work of this section.

1.4 Quality Assurance

- .1 Qualifications:
 - .1 Subcontractor:
 - .1 Has adequate plant, equipment and skilled workers to perform the work expeditiously.
 - .2 Has successfully completed installations similar to that specified during a period of at least the immediate past 5 years.
 - .3 Has been approved in writing by the self-adhered waterproofing system manufacturer for the installation of specified Product.

Self-Adhering Sheet Waterproofing

1.5 Field Conditions

- .1 Apply only when air and surface temperatures are maintained above 4°C, have been so for 48 hours, and are not likely to fall lower until the work of this section is completed, unless otherwise approved.
- .2 The work of this section may proceed at temperatures below 4°C only with mutual documented agreement of independent inspection and testing company, manufacturer and applicator that, with materials and methods used, specified installation will be achieved.
- .3 Ensure application temperature and humidity recommended by material manufacturer are maintained before, during and after installation.
- .4 Provide forced air circulation or adequate natural ventilation during installation and curing periods for enclosed application.
- .5 Do not expose materials vulnerable to water or sun damage in quantities greater than can be installed the same day.
- .6 Install waterproofing on dry surfaces, free of snow and ice and during weather that will not introduce moisture into waterproofing system.

1.6 Delivery, Storage, and Handling

- .1 Package materials and identify on attached labels the manufacturer, contents and material specification number.
- .2 Store solvent-base liquids and surface conditioner away from excessive heat and open flame. Store surface conditioner at temperature above 5°C.
- .3 Pallets of waterproofing membrane shall not be double stacked.

1.7 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Waterproofing system shall provide watertight protection to prevent the passage of water under hydrostatic pressure.

2.2 Materials

- .1 Waterproofing membrane system; self-adhering polymeric waterproofing membrane:
 - .1 Thickness: 1.5 mm (1/16").
 - .2 Tensile strength: in accordance with ASTM D412-16(2021).
 - .1 Membrane: 2.24 MPa (325 psi) minimum.
 - .3 Elongation: in accordance with ASTM D412-16(2021).

Self-Adhering Sheet Waterproofing

- .1 Polymeric membrane: 300 percent minimum.
- .4 Water vapour transmission: in accordance with ASTM E96/E96M-13, Method B: 0.05 grains/ft²/hour maximum.
- .5 Water absorption: in accordance with ASTM D570-98(2010)e1, 0.1%, 72 hours maximum.
- .6 Resistance to hydrostatic head: equivalent to 70 m (230 ft) of water minimum.
- .7 Puncture resistance: in accordance with ASTM E154/E154M-08a(2019), 222 N (50 pounds) minimum.
- .8 Acceptable Products:
 - .1 Henry 'Blueskin WP 200'.
 - .2 Colloid Environmental Technologies Company (CETCO) 'Envirosheet', as distributed by DRE Industries Inc.
 - .3 GCP Applied Technologies 'Bituthene 3000' and 'Bituthene Low Temperature'.
 - .4 IKO 'AquaBarrier FP'.
 - .5 Soprema 'Colphene 3000'.
 - .6 W.R. Meadows 'Mel-Rol'.
- .2 Primer/surface conditioner: In accordance with membrane manufacturer's written installation requirements.
- .3 Bonding asphalt: Single component bonding asphalt. Use manufacturer's proprietary mastic.
- .4 Mastic; self-adhered membrane systems: Single component, utility grade, rubber based sealant. Use manufacturer's proprietary mastic.
- .5 Protection board adhesive: as recommended by waterproofing membrane system and protection board manufacturers.

PART 3 - EXECUTION

3.1 General

- .1 Comply with manufacturer's Product data, including Product application and installation requirements, as well as manufacturer's shipping and storage recommendations.
- .2 Examine conditions of substrates and other conditions under which the work of this section is to be performed and notify the Contract Administrator, in writing, of circumstances detrimental to the proper completion of the Work. Do not proceed with the work of this section until unsatisfactory conditions are corrected and are acceptable for compliance with manufacturer's written recommendations.

3.2 Preparation - Typical

- .1 Protect adjacent work areas and finish surfaces from damage or contamination from waterproofing Products during installation operations.

Self-Adhering Sheet Waterproofing

- .2 Soil substrates: Grade substrates shall consist of well-levelled soils without voids and debris, and compacted in accordance with Section 31 23 00 for uniform support and containment of waterproofing sheets.
- .3 Concrete surfaces shall be smooth, clean, dry and free of any foreign matter that would otherwise hinder either adhesion or regularity of waterproofing membrane installation.
- .4 Remove fins, ridges, and other protrusions levelled and smoothly finished to match monolithic concrete surface. Completely fill honeycomb, aggregate pockets, holes and other voids with non-shrink cementitious grout levelled and smoothly finished to match monolithic concrete surface.
- .5 Priming: in accordance with manufacturers written requirements.

3.3 Vertical Membrane Installation

- .1 Apply waterproofing membrane system in accordance with manufacturer's written requirements.
- .2 Inspect membrane thoroughly before placement of protection course and make any corrections or repairs as necessary. Patch tears and any inadequately lapped seams using the waterproofing membrane.

3.4 Protection Course

- .1 Protect waterproofing membrane installation to avoid damage from other trades and backfilling operations.
- .2 Adhere each board using waterproofing protection board adhesive. Apply an adequate number spots of adhesive for each board to ensure resistance to wind uplift and movement due to construction traffic in accordance with manufactures written requirements.
- .3 Press each board into intimate contact with the waterproofing membrane and slide into position tightly against the previous. Gaps shall be no larger than 6 mm (1/4").

3.5 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00.

END OF SECTION

Waterproofing Flashing Membrane

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Waterproofing flashing membrane (WPMC1) at concrete piers.

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting in accordance with Section 01 31 19.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.

1.4 Quality Assurance

- .1 Qualifications:
 - .1 Installers:
 - .1 Shall have 5 years' experience, minimum, in application of *Products*, systems and assemblies specified and with approval and training of *Product* manufacturers.
- .2 Mock-up:
 - .1 Construct typical waterproofing flashing membrane installation at concrete pier for review and approval of *Consultant*. Locate at the *Place of the Work* as part of final installation in location approved by *Consultant*.

1.5 Delivery, Storage, and Handling

- .1 Deliver, store and handle materials in accordance with manufacturer's written requirements.

1.6 Field Conditions

- .1 Install waterproofing flashing membrane in accordance with manufacturer's written requirements.

1.7 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.

PART 2 - PRODUCTS

2.1 Waterproofing Materials

- .1 General:
 - .1 Install only *Products* as supplied by one manufacturer for work of this section.

Waterproofing Flashing Membrane

- .2 Primer: as recommended by manufacturer.
- .3 Flashing membrane:
 - .1 Two-part, 100% solids, rapid curing, liquid-applied polyurethane modified methyl methacrylate (PUMA) membrane.
 - .2 Acceptable manufacturers/*Products*:
 - .1 Henry 'Pumadeq Flex 31MV Reinforced' with 'Pumadeq N-Fleece'.
 - .2 Sika Canada.
 - .3 Tremco.
 - .4 Substitutions: in accordance with Section 01 25 00.
- .4 Fleece:
 - .1 Polyester, non-woven, needle punch reinforcement.
 - .2 Acceptable manufacturers/*Products*:
 - .1 Henry 'Pumadeq N-Fleece'.
 - .2 Sika Canada.
 - .3 Tremco.
 - .4 Substitutions: in accordance with Section 01 25 00.
- .5 Wearcourse:
 - .1 Polyurethane modified methyl methacrylate (PUMA) coating broadcast with aggregate.
 - .2 Acceptable manufacturer/*Products*:
 - .1 Henry 'Pumadeq Grip 40'.
 - .2 Sika Canada.
 - .3 Tremco.
 - .4 Substitutions: in accordance with Section 01 25 00.

PART 3 - EXECUTION

3.1 Preparation

- .1 Examine surfaces to receive membrane to ensure they are smooth, dry, and free from conditions that will adversely affect execution, permanence, adhesion, or quality of work. Do not proceed with work until substrate and conditions for work are acceptable.
- .2 Concrete surfaces shall be cured in accordance with waterproofing manufacturers written requirements. Concrete finish shall be uniform, sound and free of scaling and laitance, frost, dust, dirt, oil, grease, curing compounds and other foreign matter detrimental to adhesion and curing of the membrane.

3.2 Installation - General

- .1 Apply waterproofing flashing membrane in accordance with manufacturer's written requirements.

Waterproofing Flashing Membrane

- .2 Reinforce flashing membrane with fleece and backcoat fleece with liquid flashing membrane on vertical surfaces.

3.3 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00.
- .2 Manufacturer's field review to be in accordance with Section 01 45 00.

END OF SECTION

Thermal Insulation

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Rigid insulation board.
- .2 Section excludes:
 - .1 Acoustic batt insulation: in accordance with Section 09 29 00.

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting in accordance with Section 01 31 19.
 - .1 Independent inspection and testing company shall attend the pre-installation meeting.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
 - .2 Submit data and installation instructions for materials and prefabricated devices, providing descriptions sufficient for identification at the Place of the Work.
 - .3 Submit data from manufacturer's or independent laboratory indicating compatibility and adhesive results of proposed materials.

1.4 Quality Assurance

- .1 Qualifications:
 - .1 Subcontractor:
 - .1 Has adequate plant, equipment and skilled workers to perform the work expeditiously.
 - .2 Has successfully completed installations similar to that specified during a period of at least the immediate past 5 years.

PART 2 - PRODUCTS

2.1 Insulation Materials

- .1 Rigid insulation board:
 - .1 Extruded polystyrene, closed-cell, smooth skin, in accordance with CAN/ULC S701.1-17, Type 4:
 - .2 Compressive Strength, ASTM D1621-16, 275 kPa (40 psi) minimum (measured at 5% deformation or at yield, whichever occurs first).
 - .3 Acceptable *Products*:

Thermal Insulation

- .1 DuPont 'Styrofoam Highload 40'.
- .2 Owens Corning 'Foamular 400'.
- .3 Soprema 'SOPRA-XPS 40'.

2.2 Accessories

- .1 Insulation fasteners: HDPE washer, zinc plated pin finish, pins purpose made to suit substrate material, 50 mm (2") minimum insulation holding diameter; direct fasten type, pin depth length to suit insulation thickness.
 - .1 For insulation equal or less than 150 mm (6") thick:
 - .1 Acceptable Products:
 - .1 ITW Construction Products Ramset 'InsulFast'.
 - .2 For insulation greater than 150 mm (6") and equal or less than 200 mm (8") thick:
 - .1 Acceptable Products:
 - .1 Hilti 'X-IE'.
 - .2 Adhesive for rigid insulation boards: Polymer modified liquid applied membrane, compatible with insulation to be applied, type as manufactured for the attachment of insulation.
 - .1 Acceptable Product:
 - .1 Henry Airbloc 21 or 230-21.

PART 3 - EXECUTION

3.1 Installation - General

- .1 Install insulation in accordance with manufacturer's written requirements applicable to products and applications indicated.
- .2 Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- .3 Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- .4 Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness. Where multiple layers of insulation boards/batts are required, offset outer layer insulation board/batt joints 150 mm (6") from underlying insulation layer(s).
- .5 Install attachment at rate as required to prevent displacement of insulation boards during construction operations.
- .6 Butt joints tightly and offset vertical joints to form an unbroken thermal envelope. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.
- .7 Apply insulation to ensure total and complete coverage of surfaces indicated to be insulated, and in direct contact with such surfaces.

Thermal Insulation

- .8 Ensure integrity and continuity of insulation at juncture with different types of materials and seal in an acceptable manner.
- .9 Do not cover insulation until it has been reviewed and accepted by Contract Administrator.

3.2 Installation - Below-Grade Rigid Insulation

- .1 On vertical surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written requirements.
- .2 On horizontal surfaces, loosely lay insulation units according to manufacturer's written requirements. Stagger end joints and tightly abut insulation units.

3.3 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00.
 - .1 Independent inspection and testing company shall:
 - .1 Perform inspection for completed work.
 - .2 Perform thickness verification.
- .2 Manufacturer's field review to be in accordance with Section 01 45 00.

3.4 Protection

- .1 Comply with manufacturer's written requirements respecting protection.
- .2 Protect polystyrene insulation from extended exposure to sunlight.
- .3 Repair damage resulting from performance of work of this section in manner acceptable to Contract Administrator.

END OF SECTION

Metal Flashing

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Supply and installation of prefinished steel flashings.

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting in accordance with Section 01 31 19.
 - .1 Independent inspection and testing company shall attend the pre-installation meeting.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Shop drawings:
 - .1 Submit shop drawings including the following:
 - .1 Plans, elevations, sections, and attachment details.
 - .2 Detail fabrication and installation layouts, expansion-joint locations, and key details. Distinguish between shop and field assembled work.
 - .3 Include identification of material, thickness, weight, and finish for each item and location in the work.
 - .4 Include details for forming, including profiles, shapes, seams, and dimensions.
 - .5 Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
 - .6 Include details of termination points and assemblies.
 - .7 Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contracting from fixed points.
 - .8 Include details of roof penetrations flashing.
 - .9 Include details of edge conditions, and counter flashings as applicable.
 - .10 Include details of special conditions.
 - .11 Include details of connections to adjoining work.
- .3 Samples:
 - .1 Submit full-size samples of each specified flashing material formed to detailed profile including corner, curb, cap, and parapet flashing, and coping including lock-joints and hold-down clips.
 - .2 Submit 2 - 50 mm x 50 mm (2" x 2") samples of each type of sheet metal material, colour and finish.

Metal Flashing

1.4 Quality Assurance

.1 Qualifications:

.1 Installers / applicators / erectors:

- .1 Installers: Shall have 5 years' experience, minimum, in application of Products, systems and assemblies specified and with approval of Product manufacturers.
- .2 Subcontractor: Shall be a member in good standing of the Canadian Roofing Contractors Association (CRCA) and Ontario Industrial Roofing Contractors Association (OIRCA), who has been a member for at least 5 years.
- .3 Sealant shall be applied by a Subcontractor of recognized standing, having preferably not less than 5 years of proven experience in this type of work, and who has the necessary equipment and skilled mechanics to carry out the work of this section satisfactorily and can substantiate this to satisfaction of Contract Administrator.

.2 Quality standards:

- .1 Quality of fabrication and installation of sheet metal work shall comply with recommendations published by Sheet Metal and Air Conditioning Contractors National Association.

1.5 Delivery, Storage, and Handling

- .1 Comply with AAMA CW-10 – Care and Handling of Architectural Aluminum from Shop to Site.
- .2 Keep materials and equipment free from debris, ice, snow and contaminants. Allow air to circulate around metal components, sheets and break shapes.
- .3 Protect holes, and reglets from water and ice during freezing weather.

1.6 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.

PART 2 - PRODUCTS

2.1 Prefinished Steel Flashing

- .1 Sheet steel: Commercial quality to ASTM A653/A653M-13 with Z275 designation zinc coating.
 - .1 Minimum thickness: 0.61 mm (0.0239") (24 gauge).

2.2 Prefinished Metal Finishes

- .1 Provide the following finish to exposed prefinished steel:
 - .1 Finish: factory prefinished CSSBI 10000 Series.

Metal Flashing

- .1 10000 Series (Polyvinylidene Fluoride - PVDF) will not visibly (within 10 metres to the unaided naked eye) crack, chip, or peel (lose adhesion) for thirty-five (35) years from date of application. This does not include minute fracturing that may occur during the normal fabrication process. 10000 Series (Polyvinylidene Fluoride - PVDF) will not chalk in excess of a number eight (8) rating, in accordance with ASTM D4214-07(2015) method D659 at any time for thirty (30) years; will not change colour more than five (5.0) Hunter ΔE units as determined by ASTM D2244-22 at any time for thirty (30) years.
- .2 Colour to later selection by Contract Administrator from manufacturer's full range.

2.3 Accessories

- .1 Isolation coating: to CAN/CGSB-1.108, bituminous type.
- .2 Sealants:
 - .1 Exposed sealants: Silicone in accordance with Section 07 92 00, colour as selected by Contract Administrator from manufacturer's full range.
 - .2 Concealed flashing sealants; hooked-type expansion joints with limited movement: Butyl sealant to ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied.
- .3 Cleats: of matching metal to flashing material, continuous, and of greater thickness than flashing material. Offset joints in cleats 305 mm (12") with joints in perimeter edge metal. Allow a 12.7 mm (1/2") gap between pieces.
- .4 Fasteners:
 - .1 Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
 - .2 General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head:
 - .1 Exposed screws: 38 mm (1-1/2") long minimum at 450 mm (18") on centre maximum. Heads matching colour of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM washer under heads of exposed fasteners.
 - .2 Blind fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - .3 Cleat fasteners: Corrosion-resistant barbed angular ring or screw shank nail; length to achieve approximately 32 mm (1-1/4") penetration into nailer.
 - .3 Fasteners for prefinished galvanized steel sheet: Series 300 stainless steel or hot dip galvanized steel to ASTM A153/A153M-09 and ASTM A653/A653M-13 Class G185.
 - .4 Fasteners for galvanized steel sheet: Series 300 stainless steel or hot dip galvanized steel to ASTM A153/A153M-09 and ASTM A653/A653M-11 Class G185.
 - .5 Fasteners and plates to meet the requirements of FM 4470-12 for wind uplift and corrosion resistance.

Metal Flashing

- .5 Flexible flashing membrane; high temperature grade for use at locations where membrane is not protected by insulation:
 - .1 Description:
 - .1 Thickness: 0.76 mm (30 mils) minimum.
 - .2 Self-adhesive grade rubberized membrane backed by high density polyethylene.
 - .3 Primer for substrate.
 - .4 High temperature grade to resist softening at 105°C (220°F) minimum.
 - .2 Acceptable Products:
 - .1 Henry 'Blueskin PE 200 HT'.
 - .2 Firestone 'Clad-Gard SA'.
 - .3 GCP Applied Technologies 'Ultra'.
 - .4 Soprema 'Lastobond Shield HT'.
- .6 Flexible flashing membrane; standard temperature grade for use at locations where membrane is protected by material with insulating properties:
 - .1 Description:
 - .1 Thickness: 1 mm (40 mils) minimum.
 - .2 Self-adhesive grade rubberized membrane backed by high density polyethylene.
 - .3 Primer for substrate.
 - .2 Acceptable Products:
 - .1 Henry 'Blueskin Roof RF200'.
 - .2 GCP Applied Technologies 'Ice & Water Shield'.
 - .3 Soprema 'Lastobond Shield'.

2.4 Fabrication

- .1 Fabricate metal flashings and other sheet metal work in accordance with applicable SMACNA "Architectural Sheet Metal Manual (Seventh Edition) details and as indicated.
- .2 Form pieces in 3048 mm (10 ft) maximum lengths. Make allowance for expansion at joints.
- .3 Sealed joints: Form non-expansion but movable joints in metal to accommodate sealant.
- .4 Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" and by FMG Loss Prevention Data Sheet 1-49 for application, and of greater thickness of metal being secured.
- .5 Hem exposed edges on underside 12.7 mm (1/2"). Mitre and seal corners with butyl sealant.
- .6 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .7 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

Metal Flashing

- .8 Provide 25.4 mm (1") gap between drip edges and wall finish material to redirect water runoff away from walls.
- .9 Provide 25.4 mm (1") minimum overlap between bottom of wood blocking or flashing anchorage support and edge of drip or termination of flashing.

PART 3 - EXECUTION

3.1 Flexible Flashing Underlayment Installation

- .1 Apply primer to concrete masonry and precast concrete substrates.
- .2 Install in a consecutive weatherboard method starting at bottom or base of wall and working up.
- .3 Provide minimum of 50 mm (2") side laps and 75 mm (3") end laps.
- .4 Cut to manageable lengths, position membrane for alignment, remove protective poly-film and firmly apply pressure to assure adhesion.
- .5 Eliminate wrinkles or gaps, roll entire membrane surface (including seams) with a counter top or "J-roller" to ensure full contact and adhesion.
- .6 Seal membrane terminations, heads of mechanical fasteners, masonry tie fasteners, around penetrations, duct work, electrical and other apparatus extending through the air barrier membrane and around the perimeter edge of membrane terminations.
- .7 Flashing membrane shall be applied in weatherboard fashion starting at bottom of base of wall and working up, in and around the full perimeter of openings, to provide water tight protection and according to the following procedures:
 - .1 Apply the first strip horizontally immediately below the sill, cut it sufficiently long to extend past each side of the window, so that it projects even with the vertical jamb flashing to be applied later. Turn sill flashing up 50 mm (2") at ends of sill.
 - .2 Sill flashing shall overlap wall membrane. Overlap jamb at head flashing membrane in the same manner.

3.2 Roof Flashing Installation

- .1 Install sheet metal work in accordance with SMACNA Architectural Sheet Metal Manual - Seventh Edition - 2012.
- .2 Provide watertight flashing installing capable of resisting specified uplift pressures in accordance with roofing specifications, thermally induced movement and exposure to weather.
- .3 Provide minimum 10% slope for drainage towards roof at parapet locations, with minimum 2% sloped to drain at remaining flashing locations.
- .4 Provide continuous cleats for attachment of flashings at exterior face of wall and fasten at 150 mm (6") spacing and not less than 2 fasteners per cleat.
- .5 Provide radius (3-piece) copings for curved wall condition unless otherwise indicated.
- .6 Prefabricate corner copings in 610 mm (24") x 610 mm (24") shop fabricated and connected one pieces sections.

Metal Flashing

- .7 Concealed fastenings and cleats, from view except where exposed flashings are accepted by Contract Administrator prior to installation.
 - .1 Roof side fastening of copings shall be accomplished using either cleats or exposed colour matched screws with EDPM backed metal washers fastened through oversized holes in coping to allow for thermally induced movement and spaced at maximum spacing of 610 mm (24") centre to centre and not less than 2 fasteners per section of coping.
- .8 Flash joints using S-lock forming tight fit over hook strips/cleats; unless otherwise indicated.
- .9 Install surface mounted flared joint true and level, and caulk top of reglet with sealant at reglets.
- .10 Insert metal flashings to other materials and flashings to form weather-tight junction.
- .11 Provide prefinished metal flashing over equipment curbs which are covered with roofing membrane.
- .12 Expansion provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 3048 mm (10 ft) and provide uniform joint spacing with no joints allowed within 610 mm (24") of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 25.4 mm (1") deep, filled with butyl sealant concealed within joints.
- .13 Install flexible flashing membrane in accordance with manufacturer's written installation requirements.

3.3 Installation of Roof Accessories

- .1 Incorporate devices to which roofing and flashing may be secured.
- .2 Install work to ensure that roofing and flashings will be properly applied to maintain building envelope weather-tight.

3.4 Installation Tolerances

- .1 Shim and align sheet metal flashing and trim within installed tolerance of 6 mm in 6 m (1/4 inch in 20 feet) on slope and location lines as indicated and within 3.2 mm (1/8") offset of adjoining faces and of alignment of matching profiles.

3.5 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00.
 - .1 Independent inspection and testing company shall perform inspection of completed work.
 - .2 The work of this section will be inspected and tested in conjunction with inspection and testing of roofing work.

3.6 Adjusting and Cleaning

- .1 Remove deposits, stains or protections and wash metals left unpainted and exposed to view as recommended by manufacturer of metal or paint finish.

Metal Flashing

3.7 Protection

- .1 Advise Contractor of required procedures for surveillance and protection of flashings and sheet metal work during construction to ensure that work will be without damage or deterioration other than natural weathering.

END OF SECTION

Sprayed Fire-Resistive Materials (SFRM)

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Sprayed fire-resistive materials.

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting in accordance with Section 01 31 19.
 - .1 Independent inspection and testing company shall attend the pre-installation meeting.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 ULC or cUL design number, brand names and descriptive catalogue data of Products to be used in the work of this section.
 - .2 Include complete test report in cases where references are not published by testing laboratories, and where authority having jurisdiction has approved significant changes from tested assembly on basis of an engineering study; study calculations shall accompany report.

1.4 Quality Assurance

- .1 Qualifications:
 - .1 Installers:
 - .1 Shall have 5 years' experience, minimum, in application of Products, systems and assemblies specified and with approval and training of Product manufacturers.
- .2 Materials and applied systems shall have full acceptance by authority having jurisdiction.

1.5 Delivery, Storage, and Handling

- .1 Store fireproofing materials in weathertight enclosure raised clear of the ground so they are protected from moisture.
- .2 Store materials in original undamaged sealed container with manufacturer's labels and seals intact to show the approval of Underwriters' Laboratories of Canada.
- .3 Discard any material which has come into contact with moisture prior to actual use.

1.6 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.

Sprayed Fire-Resistive Materials (SFRM)

PART 2 - PRODUCTS

2.1 Materials

- .1 Materials shall be listed in accordance with CAN/ULC S101-14 achieve required fire protection rating.
 - .1 At Contractor's option, use either type of sprayed fire-resistive materials specified, but use only one type throughout the Work.
- .2 Products shall be asbestos free.
- .3 Water, bonding agents, binders, accessories, cleaning solvents, aggregates and sealers shall be in accordance with base material manufacturer's recommendation.
- .4 Metal lath or non-metallic fibre mesh: as recommended by applied fireproofing manufacturer for application to painted surfaces.

2.2 Cementitious Fireproofing (Wet-Mix)

- .1 Description: Wet-mix spray-applied fire resistive materials (SFRM) consisting of factory mixed dry formulation of gypsum or Portland cement binders and lightweight mineral or synthetic aggregates mixed with water to form slurry for conveyance and application.
- .2 Acceptable Products; standard density:
 - .1 AD Fire Protection Systems 'Southwest Fireproofing Type 5GP'.
 - .2 GCP Applied Technologies 'Monokote MK-6'.
 - .3 Isolatek International 'Cafco 300'.
- .3 Acceptable Products; medium density:
 - .1 AD Fire Protection Systems Inc. 'Southwest Fireproofing Type 5MD'.
 - .2 GCP Applied Technologies 'Z-106 G'.
 - .3 Isolatek International 'Cafco 400'.

2.3 Mineral-Fibre Fireproofing (Dry-Mix)

- .1 Description: Dry-mix spray-applied fire resistive materials (SFRM) consisting of factory mixed dry formulation of Portland cement, inorganic binders combined with sprayed-applied mineral wool, conveyed in a dry state by pneumatic equipment and mixed with water at the nozzle, forming a slurry which is then applied to the substrate.
- .2 Acceptable Products:
 - .1 Isolatek International 'Cafco Blaze-Shield DCF'.
 - .2 Isolatek International 'Cafco Blaze-Shield II'.

PART 3 - EXECUTION

3.1 Preparation

- .1 Review locations of exposed/non-exposed fireproofed surfaces with Contract Administrator prior to application.

Sprayed Fire-Resistive Materials (SFRM)

- .2 Prepare substrate in accordance with the written requirements of the manufacturer of the sprayed fireproofing material to achieve required fire protection.
- .3 Mechanically fasten metal lath or non-metallic fibre mesh to painted surfaces to receive applied fireproofing in accordance with manufacturer's recommendations.

3.2 Application

- .1 Apply sprayed-applied fireproofing in accordance with the written requirements of the manufacturer of the sprayed fireproofing material, and as specified herein and in accordance with listed assembly.
- .2 Apply by the contour method in one or more coats of sufficient thickness to achieve the fire ratings as required.
- .3 Repair sprayed-applied fireproofing damaged by others after completion of the work of this section. Costs for damage shall be borne by the responsible party. Coordinate work with other sections.
- .4 Install the sprayed-applied fireproofing so that any movement of building structure acting alone or together does not tear, rupture, delaminate, puncture or perforate spray-applied fireproofing.

3.3 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00, supplemented as follows:
 - .1 Independent inspection and testing company shall attend the pre-installation meeting.
 - .2 Independent inspection and testing will be carried out on finished installation to verify, at random, densities and minimum thicknesses of sprayed fire resistant materials.
- .2 Manufacturer's field review to be in accordance with Section 01 45 00.

3.4 Protection

- .1 Protect during installation any adjacent finished surfaces from contamination and damage due to the work under this section.
- .2 Protect completed work, vulnerable corners, edges, and surfaces liable to be damaged due to construction activities. Provide wood cover strips and sheet material as required to prevent damage.

END OF SECTION

Joint Firestopping and Smoke Seals

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Materials installed in joints to restrict the spread of fire and smoke.
 - .1 Joints in or between fire-resistance-rated constructions.
- .2 Section excludes:
 - .1 Firestopping and smoke seals, for mechanical, electrical and communications penetrations of fire resistant assemblies, and firestopping and smoke seals within their respective assemblies. Refer to Divisions 21, 22, and 23 and Divisions 26, 27, and 28.

1.2 Administrative Requirements

- .1 Coordination:
 - .1 Coordinate joint firestopping and smoke seal work with Section 01 33 00, paragraph 1.8 Project Firestopping Manual and Coordination.
 - .2 Coordinate with other sections to assure that pipes, conduit, cable, and other items that penetrate fire rated construction, have been permanently installed prior to installation of firestop assemblies.
 - .3 Schedule the Work to assure that penetrations and other construction that conceals penetrations are not erected prior to the installation of firestop and smoke seals.
- .2 Conduct a pre-installation meeting in accordance with Section 01 31 19.
 - .1 Representatives for mechanical and electrical work and independent inspection and testing company shall attend pre-installation meeting.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets: Submit data and installation instructions for Products providing descriptions sufficient for identification at the Place of the Work.
 - .1 Materials list of Products proposed for use in the work of this section; complying with listed systems designs.
 - .2 Listing agency's detailed drawing showing joint assemblies and firestopping materials, identified with listing agency's name and number or designation, fire rating achieved, and date of listing.
- .3 Certificates:
 - .1 Submit the following certification documents with closeout submittals:
 - .1 Manufacturer's certification: Submit manufacturer's certification that installed firestopping and smoke seal Products are suitable for the use indicated and comply with specified requirements.

Joint Firestopping and Smoke Seals

- .2 Installation certification: Installer shall submit certification that all joint firestopping system installations are completed and that installations comply with listed systems designs.
- .4 Submit fire resistance rating test listings for firestopping and smoke seal systems.
- .3 Shop drawings:
 - .1 Submit drawings indicating fire resistance rated assembly number, required temperature, hose stream, and flame rating, material thicknesses, installation methods and materials of firestopping and smoke seals, primers, supports, damming materials as applicable, reinforcements, anchorages, fastenings and methods of installation for each condition to be encountered.
 - .2 Designate on shop drawings static and dynamic joint systems, relative positions, expansion and control joints in rated slabs and walls, and firestopping details.
 - .3 Engineered shop drawings; for engineering judgements:
 - .1 Where Project conditions require modification to an accredited third party testing agency's listed system design to address a particular firestopping condition that is not covered by a listed system, submit engineered shop drawings detailing the modifications to the listed system design as an engineering judgment or equivalent fire-resistance-rated assembly, for each Project location and condition.
 - .2 Submit the manufacturer's engineering judgment identification number and shop drawing details prepared by a professional engineer. The engineering judgment submittal shall include both Project name, Project location, and Subcontractor's name who will install firestop system as described in engineering judgement shop drawings.
 - .3 Provide complete details of specific application of listed system and its modifications upon which the engineered judgement is based upon.
 - .4 For perimeter fire barrier systems:
 - .1 Submit engineered shop drawings for engineering judgements covering perimeter fire barrier systems. Identify each cladding assembly type in contact with each perimeter fire barrier system.
- .4 Manufacturers' instructions:
 - .1 Manufacturer of Products proposed for use in work of this section shall prepare firestopping manual scheduling products to be used for each assembly and installation required in the Work.
 - .1 Coordinate with project firestopping manual specified under Section 01 33 00.
 - .2 Manual shall include manufacturer's Product data sheets as specified under paragraph 1.3.2.
 - .3 Firestopping manual shall be submitted within 4 weeks of Contract award.

1.4 Quality Assurance

- .1 Qualifications:

Joint Firestopping and Smoke Seals

- .1 Installers: Shall have 5 years' experience, minimum, in application of Products, systems and assemblies specified and with approval, training and certification of Product manufacturers.
 - .1 Submit proof of manufacturer's installer certification for each installer of firestopping and smoke sealant systems.
 - .1 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.
 - .2 Applicator shall designate a single individual as Project foreperson who shall be present at the Place of the Work at all times throughout the work of this section when the work of this section is being performed.

1.5 Delivery Storage, and Handling

- .1 Deliver materials to Place of the Work in manufacturer's unopened containers, containing classification label, with labels intact and legible at time of use.
- .2 Store materials in accordance with manufacturer's recommendations with proper precautions to ensure fitness of material when installed.
- .3 Do not use damaged or adulterated materials and materials exceeding their expiry date.

1.6 Field Conditions

- .1 Comply with manufacturer's requirements relative to temperature and humidity conditions, before, during and after installation.

1.7 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.

PART 2 - PRODUCTS

2.1 Manufacturers

- .1 General: Manufacturers of firestopping and smoke seal system Products and installation specialists for the work of this section are limited to applicable assemblies as required for the Work and having listing mark on packaging.
- .2 Subject to compliance with requirements, provide products by one of the following:
 - .1 3M Canada Inc.
 - .2 Hilti Canada Corp.
 - .3 NUCO Inc.
 - .4 STI Firestop.
 - .5 Tremco Commercial Sealants & Waterproofing.

Joint Firestopping and Smoke Seals

2.2 Performance/Design Requirements

- .1 Firestop and smoke sealant systems shall consist of material, or combination of materials installed to retain integrity of fire-rated construction by effectively impeding spread of flame, smoke, and/or hot gasses through perimeter joint or gaps, construction joints, or at perimeter fire containment in or adjacent to fire-rated barriers.
- .2 Smoke sealants applied over firestopping materials or combination smoke seal/firestop seal material shall form air tight barriers to prevent passage of gas and smoke.
- .3 Fire-resistance rating of firestopping system shall be equivalent to rating of adjacent floor, wall or other fire separation assembly.
- .4 Firestopping system at fire rated assemblies with assembly STC rating requirements shall provide STC rating equal to STC rating of fire rated assembly.
- .5 Confirm locations of exposed/non-exposed firestopping/smoke seal surfaces with Contract Administrator prior to application.
- .6 Provide movement capability at movement joints in accordance with design requirements for movement joint.
- .7 Head-of-wall joints; with dynamic designation:
 - .1 Joint assemblies shall permit vertical movement allowing wall to move independent of structure due to forces including, but not limited to, live loads, dead loads, thermal expansion/contraction, and wind sway. Such movement shall not damage the wall assembly or its fire protection components.
 - .1 Provide head-of-wall joints with dynamic designation.
- .8 Regulatory requirements:
 - .1 Joint firestop systems shall be listed in accordance with CAN/ULC-S115-11 and shall achieve required fire resistance rating in accordance with building code.
 - .2 Proposed firestopping and smoke seal materials and methods shall conform to applicable governing codes having local jurisdiction.

2.3 Materials

- .1 Single source responsibility for firestopping and smoke seal materials:
 - .1 Obtain firestopping and smoke seal materials from single manufacturer for each different Product required.
 - .2 Manufacturer shall instruct applicator in procedures for each material.
- .2 Firestopping and smoke seal systems shall conform to the following:
 - .1 VOC content not to exceed 250 gm/litre minus water.
 - .2 Asbestos-free materials and systems capable of maintaining an effective barrier against flame, smoke and gasses in compliance with requirements of CAN/ULC-S115-11 and not to exceed opening sizes for which they are intended.
 - .3 Provide firestopping materials and systems with fire-resistance rating not less than the fire-resistance rating of applicable adjacent assembly.
 - .4 Listed in accordance with CAN/ULC-S115-11.

Joint Firestopping and Smoke Seals

- .5 Use only joint firestop systems that have been tested by an accredited third party testing agency for specific fire-rated construction conditions conforming to construction assembly type, joint type and fire-rating requirements for each separate instance.
 - .1 Where there is no specific third party tested and classified firestop system for a particular firestop configuration, submit engineered shop drawings.
- .6 For joints in fire-separations, provide listed systems designs for the joint firestop and smoke seal systems as required by building code to maintain the integrity of the fire separations.
- .7 Products shall be compatible with abutting dissimilar membranes, architectural coatings, finishes at floors, walls and ceilings. Check with requirements of Agreement, Drawings, Schedules, and Specifications and manufacturer of selected materials being installed.
- .3 Smoke sealants for overhead and vertical joints shall be non-sagging; sealants for floors shall be self-levelling.
- .4 Smoke seal sealant colour at exposed locations: Grey. (Red will not be accepted).

PART 3 - EXECUTION

3.1 Preparation

- .1 Examine sizes, anticipated movement and conditions to establish correct thickness and installation of back-up materials.
- .2 Prepare surfaces in accordance with manufacturer's written specifications and to requirements of listed system designs.

3.2 Installation

- .1 Install joint firestopping and smoke seal systems in accordance with manufacturer's written requirements and in compliance with listed system designs. Products and installation requirements must comply with listed system designs.
- .2 For materials that will remain exposed after completing the Work, finish to achieve smooth, uniform surfaces. Tool or trowel exposed surfaces.
- .3 Notify Contract Administrator when random completed installations are ready for review, as directed by Contract Administrator, prior to concealing or enclosing firestopping and as applicable, smoke seals.
- .4 Protect materials from damage on surfaces subjected to traffic.

3.3 Identification and Documentation

- .1 Provide documentation for each joint firestop system application addressed. This documentation is to identify each joint location on the entire Project.
- .2 Documentation for installed joint firestop systems is to include:
 - .1 Sequential location number.
 - .2 Project name.
 - .3 Date of installation.

Joint Firestopping and Smoke Seals

- .4 Detailed description of joint firestop system location.
- .5 Listed firestop system design number or engineered judgment number.
- .6 Type of joint.
- .7 Width of joint.
- .8 Overall length of joint.
- .9 Number of sides addressed.
- .10 Hourly rating of firestop joint system to be achieved.
- .11 Installers name.

3.4 Field Quality Control

- .1 Conduct quality control to be in accordance with Section 01 45 00.
 - .1 Field tests and inspections:
 - .1 Examine completed firestop joint installations to ensure proper installation before concealing or enclosing areas. Keep areas of work accessible until inspections are completed.
 - .2 Inspection consultant to review installation of the work of this section and to perform random tests to verify its completion in accordance with the requirements of the Agreement, Drawings, Schedules, and Specifications.
 - .3 Give at least 48 hours notice before operations commence, and arrange for a pre-job conference with Contractor, installer, independent inspection and testing company, manufacturer, and Contract Administrator present.
 - .4 Independent inspection and testing company shall examine installed firestopping in accordance with ASTM E2393-20a. Independent inspection and testing company shall examine firestopping and shall determine, in general, that firestopping has been installed in accordance with requirements of the Agreement, Drawings, Schedules, and Specifications and in compliance with each listed firestop system design.
 - .5 Representatives of the manufacturer(s) shall have access to the Work. Contractor shall provide assistance and facilities for such access in order that the manufacturer(s) representative(s) may properly perform its function.
- .2 Manufacturer's field review to be in accordance with Section 01 45 00.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Joint sealants – interior locations.
- .2 Section excludes:
 - .1 Tiling control joint sealants.
 - .2 Glazing system assembly sealants.
 - .3 Fluid-applied flooring sealants.
 - .4 Mechanical and electrical sealants.
 - .5 Acoustic sealants.

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting in accordance with Section 01 31 19.
 - .1 Independent inspection and testing company shall attend the pre-installation meeting.
 - .2 The following items shall be addressed at the pre-installation meeting:
 - .1 Analysis of the work and weather conditions.
 - .2 Shape factor of the joint.
 - .3 Recommendations for priming joints.
 - .4 Inspection of surfaces and joints.
 - .5 Compatibility of materials.
 - .6 Backing materials.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
 - .2 Submit manufacturer's and Product name for each sealant which will be used in the Work prior to commencing the Work.
 - .3 For Products specified to comply with SWR Institute Sealant Validation Program, provide written confirmation from SWRI of Product compliance.
- .3 Samples:
 - .1 Submit "wet sample" sealant colour samples for each sealant Product and colour.
- .4 Test and evaluation reports:

Joint Sealants

- .1 Test sealant in contact with samples of materials to be sealed to verify adhesion will be achieved in accordance with Field Quality Control paragraphs in Section 07 92 00, and no staining of the material will result. Prepare sample joints at the Place of the Work of each type of sealant for each joint condition.
 - .1 Submit test results to Contract Administrator prior to application of sealants.
- .2 Test sealant in contact with samples of porous materials to be sealed to ensure that no staining of the material will result in accordance with ASTM C1248-22.
 - .1 Submit test results to Contract Administrator prior to application of sealants.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 00.
 - .1 Include manufacturer's warranties.
- .2 Maintenance instructions:
 - .1 Submit maintenance instructions for all items for incorporation into the operation and maintenance manuals.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Subcontractor:
 - .1 Shall have 5 years' experience, minimum, in application of Products, systems and assemblies specified.
 - .2 Installer to comply with quality assurance articles referenced in ASTM C1193-16 for installation of joint sealants.
- .2 Mock-up:
 - .1 Submit 2440 mm (96") long sealant joint mock-up.

1.6 Field Conditions

- .1 Conform to sealant manufacturer's specifications and recommendations.
- .2 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° C (40° F).
 - .2 When joint substrates are wet.
 - .3 Where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
 - .4 Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranties:

Joint Sealants

- .1 For silicone sealants applied to porous substrates, provide Product non-stain sealant warranty for period of 20 years, against migrating, bleeding into, or staining abutting materials.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Interior sealants shall have a VOC limit of 50 g/L maximum, unless otherwise specified, and comply with South Coast Air Quality Management District (SCAQMD) Rule 1168, Adhesive and Sealant Applications.
- .2 Joint sealants:
 - .1 Shall perform as air tight and water-tight joints.
 - .2 Defects shall include, but are not limited to:
 - .1 Staining from abutting materials or filler.
 - .2 Migrating, bleeding into, or staining abutting materials.
 - .3 Unsightly surface deformation.
 - .4 Excessive colour change, chalking, or dust pick-up.
 - .5 Failing adhesively or cohesively where maximum elongation is less than 25% of designed width of exposed joints.
 - .6 Hardening to more than 25% over specified hardness.

2.2 Sealants

- .1 General:
 - .1 Colours: Sealant colours shall match colours of adjacent materials, as selected and approved by Contract Administrator.
 - .1 Colours: shall be selected from manufacturer's full range of colours.
 - .2 In accordance with ASTM C920-14 and other requirements indicated for each liquid-applied chemically curing sealant, including those referencing ASTM C920-14 classifications for type, grade, class, and uses.
 - .3 For sealants to be applied to porous substrates:
 - .1 Provide products that have undergone testing in accordance with ASTM C1248-22 and have not stained porous joint substrates indicated for Work.
 - .4 Sealant supplied shall not exude any material(s) which travel into adjacent materials, or travel onto surfaces of adjacent materials; causing damage, or attracting soiling, which becomes apparent during the service life of the building.
- .2 Interior general sealants:
 - .1 VOC limit: Maximum 50 g/L, unless otherwise indicated.
 - .2 Interior sealant; at joints with painted gypsum board: one-component paintable acrylic or polyurethane sealant, in accordance with ASTM C834-10; Type OP, Grade -18° C, zero VOC.

Joint Sealants

- .3 Interior sealant; gap filler: at movement paintable joints in vertical surfaces: One-component polyurethane sealant in accordance with the following: ASTM C920-11, Type M or S, Grade NS, Class 25.
 - .1 Acceptable Products:
 - .1 Master Builders Solutions Canada 'MasterSeal NP100'.
 - .2 Sika 'Sikaflex 15LM'.
 - .3 Substitutions: in accordance with Section 01 25 00.
- .4 Interior sealant; at movement joints in vertical surfaces: one-component polyurethane sealant in accordance with the following: ASTM C920-14, Type M or S, Grade NS, Class 25.
 - .1 Acceptable Products:
 - .1 Master Builders Solutions Canada 'MasterSeal NP1'.
 - .2 Sika 'Sikaflex 15LM'.
 - .3 Tremco, Inc. 'Dymonic 100'.
 - .4 Substitutions: in accordance with Section 01 25 00.
- .5 Interior sealant, mildew resistant one part silicone sealant in accordance with the following: ASTM C920-14, Type S, Grade NS, Class 25.
 - .1 Acceptable Products:
 - .1 DOWSIL '786'.
 - .2 Momentive 'Sanitary SCS1700 Sealant'.
 - .3 Sika 'Sikasil GP'.
 - .4 Tremco, Inc. 'Tremsil 200'.

2.3 Accessories

- .1 General: Provide joint sealants, primers, backings, and fillers that are compatible with one another and with joint substrates and other sealants or joint fillers specified and approved for applications indicated under joint sealant scheduled and under conditions of service and application as demonstrated by joint sealant manufacturer based on proven test results and field experience. When incompatible, inform Contract Administrator and change to compatible type acceptable to Contract Administrator.
- .2 Cylindrical sealant backings: Provide joint backings that meet ASTM C1330-02, Type O (open-cell polyurethane), or Type B (non-absorbent bi-cellular backing materials with surface skin), sized 25 percent or greater than joint opening with proper density to control sealant depth and profile. Follow joint sealant manufacturer's recommendations with backing selections for optimum joint sealant performance, in accordance with the following schedule:
 - .1 Use open cell foam with non-absorbing closed cell skin (Sof-Rod) for vertical joints; round shape for open joints and triangular shape for angular joints.
 - .2 Use closed cell foam for horizontal joints.

Joint Sealants

- .3 Bond-breaker tape: Polyethylene tape or other approved plastic tape as recommended by joint sealant manufacturer to prevent 3-sided joint adhesion to rigid, inflexible joint fillers or joint surfaces at back of joint where such adhesion would restrict proper sealant movement or result in sealant failure.
- .4 Masking tape: Non-staining, non-absorbent and compatible with joint sealants and adjacent surfaces.
- .5 Sealant primers: Use primers only as recommended by sealant manufacturer where required to enhance adhesion of sealant to specific joint substrates indicated and as determined for use from pre-construction mock-up testing. Select primers in consultation with sealant manufacturer and manufacturer of substrate material which do not have a detrimental effect on sealant adhesion or in-service performance.
- .6 Cleaners for nonporous surfaces:
 - .1 Provide non-staining, chemical cleaners of type which are acceptable to manufacturer of sealant and sealant backing material, which are not harmful to substrates and adjacent nonporous materials, and which do not leave oily residues or otherwise have a detrimental effect on sealant adhesion or in-service performance.
 - .2 Provide cleaner conditioner required for glass and glazed surfaces as recommended by sealant manufacturer.

PART 3 - EXECUTION

3.1 Manufacturer's Recommendations

- .1 Unless specified otherwise herein, comply with the recommendations and directions of the manufacturer whose materials are being used in the work of this section.

3.2 Preparation

- .1 Protect adjacent work areas and finished surfaces from damage during joint sealant installation.
- .2 Clean and prepare joint surfaces and substrates of substance that could impair the bond of joint sealants immediately before installing joint sealants.
- .3 Provide a dry, dust-free and cleaned substrate for optimum results.
- .4 Clean porous joint surfaces by using heavy-duty brushing, light abrasive, mechanical abrading or combination of these methods to produce a clean, sound surface for optimum bond with joint sealants per manufacturer's recommendations.
- .5 Clean non-porous surfaces using the two-cloth wipe method as referenced in ASTM C1193-16 and outlined by joint sealant manufacturer's written requirements.
- .6 Prepare rusting or scaling surfaces using abrasive cleaning methods as recommended by joint sealant manufacturer prior to joint sealant installation. Remove and neutralize efflorescence, mould, mildew and algae prior to joint sealant installation.
- .7 Prepare finish-coated surfaces per joint sealant manufacturer's specific recommendations.
- .8 Test materials for indications of staining or poor adhesion before any sealing is commenced. Submit reports in writing to Contract Administrator of results.

Joint Sealants

3.3 Masking

- .1 Where necessary to prevent contamination or marring surfaces of adjacent materials, mask areas adjacent to joints with masking tape prior to priming or sealing application. Remove tape immediately after joint has been completed and an initial set achieved.

3.4 Installation

- .1 Install in accordance with joint sealant manufacturer's installation written requirements for products, primers and applications indicated unless more stringent project-specific instructions or requirements apply.
- .2 Apply joint sealants for continuous waterproof sealant joint protection. Lap vertical joints over horizontal joints as recommended by sealant manufacturer. Comply with installation recommendations in ASTM C1193-16 for use of joint sealants as applicable to each specific sealant installation.
- .3 Install sealant primers only when recommended by sealant manufacturer and demonstrated at pre-construction tests after joint surface preparation has been completed and when surfaces are verified as clean and dry. Allow any primer installation to completely dry or cure prior to installation of backing or joint sealants. Primer is mandatory for gun applied sealants.
- .4 Install joint sealants using proven techniques that comply with the following and in proper sequence with installation of primers and backings.
 - .1 Using proper joint sealant dispensing equipment, place sealants by pushing sealant beads into opening to fully wet-out joint sealant substrates. Fill sealant joint opening to full and proper configuration.
 - .2 Provide uniform cross-sectional shapes and depths in relation to joint width for optimum sealant movement capability per joint sealant manufacturer's written requirements.
- .5 Joint sealant tooling is required for non-sag joint sealant installations. Immediately after placing fresh sealants and before skinning or curing begins, tool sealants using metal spatulas designed for this purpose in accordance with manufacturer's recommendations. Provide a smooth, uniform sealant finish, eliminating air pockets and ensuring good contact for optimum sealant adhesion within each side of the joint opening.
 - .1 Provide concave joint configuration as indicated per figure 5-A in ASTM C1193-16 unless otherwise indicated.
 - .2 Use tooling agents that are approved in writing by sealant manufacturer and that do not discolour sealants or adjacent surfaces.
 - .3 Remove excess sealant from surfaces adjacent to joint openings using metal spatula, promptly cleaning any sealant residue from adjacent finished surfaces. Remove masking after joint sealant is installed.
- .6 Allow single-component sealants to fully cure before adhesion testing is performed as recommended by joint sealant manufacturer as outlined in Field Quality Control paragraphs in Section 07 92 00.
- .7 Match approved sealant mock-up for colour, finish and overall aesthetics. Remove, refinish or re-install work not in compliance with the Agreement, Drawings, Schedules, and Specifications.

Joint Sealants

- .8 When surfaces of adjacent materials are to be painted, perform sealant work before these surfaces are painted.
- .9 Check form release agent used on concrete for compatibility with primer and sealant. If they are incompatible inform Contract Administrator and change primer and sealant to compatible type, or clean concrete to sealant manufacturer's acceptance.
- .10 Install joint backing material, filler strips, gaskets, bond breakers and similar type material of comparable performance characteristics. Install bond breaker tape or packing over asphalt impregnated fibre board as recommended by sealant manufacturer.
- .11 Where joints are 12.7 mm (1/2") or deeper, insert backing material in continuous uniform compression with setback from finished face of adjoining materials equal to required depth of sealant (width/depth ratio) as specified herein.
- .12 On horizontal traffic surfaces, support joint filler against vertical movement which might result from traffic loads, including foot traffic.
- .13 Install bond breaker tape in bottom of joints in lieu of sealant backing where proper depth cannot be obtained when backing is installed.
- .14 Maintain correct sealant depth. Sealant depth shall be 1/2 the width of the joint, maximum depth shall be 12.7 mm (1/2"), minimum depth shall be 6 mm (1/4"). Comply with manufacturer's written recommendations.
- .15 Fillet bead sealant joints to be sized to provide proper contact area with substrates, in accordance with manufacturer's written recommendations.
- .16 Apply sealants using pressure-operated guns fitted with suitable nozzles in accordance with manufacturer's directions. Apply sealants in such manner as to ensure good adhesion to sides of joints and to completely fill voids in joints.
- .17 Apply sealants so that surfaces of joints are smooth, full bead, free from ridges, wrinkles, sags, air pockets and embedded impurities. Tool sealant surfaces to produce a smooth surface.
- .18 Install sealant with exterior face of sealant set back 10 mm (3/8") from face of adjacent materials at building movement joints, unless otherwise indicated.
- .19 Do not apply sealants to areas where installation of paints, coatings or flooring is in progress. Apply sealants after such work is complete and fully cured.

3.5 Interior Sealant Schedule

- .1 Include in work of this section sealants to seal open joints in surfaces exposed to view, and to make building weather-tight and air-tight, as applicable, as indicated, and as otherwise specified, except where specified under the work of other sections.
- .2 Install sealant to:
 - .1 Movement and control joints on exposed insitu concrete walls.
 - .2 Interior control and expansion joints in floor and wall surfaces.
 - .3 Raked out joints at junctions of masonry with concrete walls and columns, and at intersection of masonry walls and partitions where joint reinforcement is installed.
 - .4 Perimeters of exterior and interior door and window frames.

Joint Sealants

- .5 Joints at tops of non-load bearing masonry walls at the underside of insitu concrete.
- .6 Exposed interior control joints in gypsum board.
- .7 Millwork junctions with walls.
- .3 Mildew resistant sealant at wet areas:
 - .1 Perimeter joints of wet fixtures such as:
 - .1 Urinals.
 - .2 Water closets.
 - .3 Janitor sinks.
 - .2 Counter/wall junctions at countertops.

3.6 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00.
 - .1 Inspection and testing:
 - .1 Field-adhesion testing: Installer to keep daily log of sealant installation recording self-performed field-adhesion test at each elevation of the project and as follows:
 - .1 Record field adhesion testing on digital video camera and submit to Contract Administrator.
 - .2 Document and perform field adhesion testing in accordance with manufacturer's recommended field-adhesion requirements and submit written reports co-signed by sealant manufacturer's representative. Coordinate with Section 01 45 00.
 - .3 Perform 5 field adhesion tests for the first 300 m (1000 lineal feet) and one test in each 300 m (1000 lineal feet) of sealant joint length thereafter. One (1) test per floor height and per elevation is also recommended. When the sealant is used to weatherseal between 2 dissimilar substrates, the sealant adhesion to each side of the joint should be individually tested.
 - .4 Field test joint sealants in accordance with Method A, Field-Applied Sealant Joint Hand-Pull Tab, in Appendix X-1 in ASTM C1193-16 and in compliance with manufacturer's specific recommendations.
 - .5 Evaluation: In compliance with joint sealant manufacturer, joint sealants tested and not indicating adhesive failure within the substrates are considered satisfactory results. For joint sealants that fail to adhere to the substrate, clean, re-install and then re-test until satisfactory results are obtained.
 - .2 Manufacturer's field review to be in accordance with Section 01 45 00.
 - .3 Provide manufacturer's field service consisting of periodic site visits by manufacturer or their distributor representative for observation of joint sealant application.

Joint Sealants

3.7 Adjusting and Cleaning

- .1 Remove droppings and clean off excess sealant or sealant residue adjacent to sealant joint installations as the work progresses by methods approved by joint sealant manufacturer before material achieves initial set.
- .2 Do not damage adjacent surfaces with harmful removal techniques and protect finished surfaces beyond those that have been masked.
- .3 Remove and replace damaged joint sealants.
- .4 Remove temporary coverings and masking protection from adjacent work areas upon completion.

3.8 Protection

- .1 Protect installed sealants during and after final curing from damage resulting during construction.

END OF SECTION

Steel Doors and Frames

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Hollow metal doors and panels (steel doors).
 - .2 Insulated metal doors (insulated steel doors).
 - .3 Metal frames (steel frames, transom frames).
 - .4 Metal frames (steel frames for screens, sidelights assemblies).

1.2 Administrative Requirements

- .1 Coordination:
 - .1 Cooperate fully with finish hardware distributor's representative during preparation of shop drawings and execution of shop fabrication.
 - .2 Coordinate installation of doors and frames with installation of hardware specified in Section 08 71 00.
- .2 Conduct a pre-installation meeting in accordance with Section 01 31 19.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Submit copy of NAAMM-HMMA 840-17 standard.
- .3 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .4 Shop drawings:
 - .1 Include details of each door and frame type, finish hardware types and locations, frame profiles, door and frame elevations, mitre details, fire protection rating, glazing preparation details and anchor details and locations.
 - .2 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and in door schedule.
 - .3 Electrified hardware requirements and preparations shall be clearly indicated on shop drawings.
- .5 Samples:
 - .1 Submit cut-away sample door, with provision for lockset and hinge, and corner section of frame.

1.4 Quality Assurance

- .1 Qualifications:
 - .1 Manufacturers:

Steel Doors and Frames

- .1 Provide doors and frames manufactured by a firm specializing in the design and production of hollow metal steel doors and frames.
- .2 Manufacturer shall be a member in good standing of the Canadian Steel Door Manufacturers Association (CSDMA).

1.5 Delivery, Storage, and Handling

- .1 Inspect materials thoroughly upon receipt and report immediately discrepancies, deficiencies and damages, in writing, to Supplier.
- .2 Note damages incurred during shipment on carriers' bill of lading and report immediately, in writing, to Supplier.
- .3 Store materials properly on planks, out of water and covered to protect from damage from adverse weather conditions. Remove wet packaging immediately.
- .4 Remove wrappings or coverings from doors upon receipt at the Place of the Work, and store in a vertical position, spaced with blocking to permit air circulation between them.

1.6 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranties:
 - .1 System:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 The warranty is a total system warranty, and includes hardware, sealants, hanging and fitting, and finishing.
 - .3 Duration: 2 years.
 - .2 Glass and glazing: in accordance with Section 08 80 00.

PART 2 - PRODUCTS

2.1 Manufacturers

- .1 All Steel Doors 2000 Ltd.
- .2 Apex Industries Inc.
- .3 Artek Door (1985) Ltd.
- .4 Daybar Industries Ltd.
- .5 Fleming-Baron Door Products.
- .6 M.J. Daley Manufacturing Co. Ltd.
- .7 Trillium Steel Doors Limited.
- .8 Vision Hollow Metal Limited.

2.2 Performance/Design Requirements

- .1 Exterior insulated metal doors shall be tested to meet an operable U-value of 0.450.
- .2 Fire rating requirements:

Steel Doors and Frames

- .1 Fire rated labelled doors and frames: tested in accordance with CAN/ULC-S104-15 and listed by a nationally recognized agency having a factory inspection service and shall be constructed as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.
- .2 Install fire labelled steel door and frame products in accordance with NFPA 80-2013, except where indicated otherwise.
- .3 Doors and frames shall function as intended, including but not limited to:
 - .1 Be in true alignment.
 - .2 Operate and swing freely, smoothly, and easily.
 - .3 Remain stationary at any point.
 - .4 Close evenly and tightly against stops without binding.
 - .5 Latch positively when doors are closed with moderate force.

2.3 Materials

- .1 Steel:
 - .1 Fabricated from tensioned levelled steel in accordance with ASTM A924/A924M-22a, galvanized in accordance with ASTM A653/A653M-13, Commercial Steel CS, Type B.
 - .2 Steel shall be free of scale, pitting, coil breaks, surface blemishes, buckles, waves, and other defects.
 - .3 Minimum sheet thickness; uncoated steel sheet: in accordance with Appendix 1 of ANSI/NAAMM HMMA 861-14 "Guide Specifications for Commercial Hollow Metal Doors and Frames".
 - .4 Finish: Minimum Galvanneal coating designation ZF120 (A40).
- .2 Door core materials:
 - .1 Honeycomb: Structural small cell 25 mm (1") maximum kraft paper 'honeycomb'. Weight: 36.3 kg (80 lb) per ream (minimum). Density: 16.5 kg/m³ (1.03 pcf) minimum, sanded to required thickness.
 - .2 Polyisocyanurate: Closed cell, faced board, thermal value: in accordance with ASTM C1289-22.
- .3 Adhesives:
 - .1 Heat resistant, single component, polyurethane reactive (water) hot melt, thermoset adhesive.
 - .2 Rigid insulation cores: Heat resistant, epoxy resin based, low viscosity, contact cement.
 - .3 Lock seam doors: fire resistant, resin reinforced polychloroprene, high viscosity sealant-adhesive.
- .4 Primer: rust inhibitive for touch-up.
- .5 Finishing hardware: in accordance with Section 08 71 00.
- .6 Miscellaneous:

Steel Doors and Frames

- .1 Door silencers: single stud rubber or neoprene type.
- .2 Exterior top caps: Rigid polyvinylchloride extrusion.
- .3 Frame thermal breaks: Rigid polyvinylchloride extrusion.
- .4 Channel glazing stops and glazing trim: formed channel of minimum 0.81 mm (0.032") (20 gauge) steel, 15.9 mm (5/8") high.

2.4 Fabrication - General

- .1 Fabricate steel doors, frames, transoms, sidelights and borrowed lights as applicable, to the design and dimensions indicated. Take field measurements where coordination with adjoining work is necessary.
- .2 Fabricate steel doors and frames to be rigid, neat in appearance and free from defects, warp, wave or buckle with all corners square unless otherwise indicated.
- .3 Operating clearances:
 - .1 Provide clearance at floor with allowance made for indicated finish flooring materials.
 - .2 Clearances for Fire-Rated Doors: As required by NFPA 80-2013.
 - .3 Clearances for Non-Fire-Rated Doors: Not more than 3 mm (1/8") at jambs and heads, except not more than 6 mm (1/4") between pairs of doors. Not more than 19 mm (3/4") at bottom.
- .4 Drill and tap or reinforce for mortised or surface mounted hardware in accordance with accepted hardware schedule, ANSI A115, NFPA 80-2013, or manufacturers recommendations.
- .5 Countersink exposed fasteners unless otherwise shown. Use flat or oval head screws.
- .6 Reinforce components to resist stresses imposed by hardware in use.
- .7 Allow for anticipated expansion and contraction of frames and supports.
- .8 Fit elements at intersections and joints accurately together, in true planes, and plumb and level.
- .9 Weld continuously at joints exposed to view or at joints through which air or water could penetrate from the exterior of building to the interior.
- .10 Perform welding in accordance with CSA W59-18.
- .11 Mortise, reinforce, drill and tap to receive hardware and security devices using templates provided by respective Supplier.
- .12 Touch up finish damaged during fabrication.
- .13 Prepare doors or frames to receive seals where seals are indicated.
- .14 Attach labels to suit required fire-protection ratings.

2.5 Fabrication - Steel Doors and Panels

- .1 Fabricate steel doors and panels to a thickness of 45 mm (1-3/4"), unless indicated otherwise.
- .2 Heavy duty doors and panels; honeycomb core:

Steel Doors and Frames

- .1 Face sheets fabricated from: 1.34 mm (0.053") (16 gauge) steel.
- .2 Longitudinal edges continuously welded the full height of the door, filled and ground smooth with no visible seams.
- .3 Interior and non-insulated doors and panels:
 - .1 Face sheets fabricated from 1.06 mm (0.042") (18 gauge) steel.
 - .2 Honeycomb core.
 - .3 Longitudinal edges mechanically interlocked.
 - .1 Adhesive assisted with edge seams visible.
- .4 Fabricate of composite metal face construction with each face formed from flush sheet steel without visible seams, free of scale, pitting, coil brakes, buckles and waves.
- .5 Formed edges shall be true and straight with minimum radius for the thickness of steel used.
- .6 Lock and hinge edges shall be bevelled 3 mm in 50 mm (1/8" in 2") unless hardware or door swing dictates otherwise.
- .7 Top and bottom of doors shall be provided with inverted, recessed, 1.34 mm (0.053") (16 gauge) steel end channels, welded to each face sheet at 50 mm (2") on centre maximum.
- .8 Prior to shipment, mark each door with an identification number as shown on the approved submittal drawings.
- .9 Exterior doors shall be provided with factory installed flush PVC top caps. Fire labelled exterior doors shall be provided with factory installed flush steel top caps.
- .10 Blank, reinforce, drill and tap doors for mortised, templated hardware. Locate hardware to manufacturer's standard unless indicated otherwise.
- .11 Holes 12.7 mm (1/2") and larger shall be factory prepared.
- .12 Glazing:
 - .1 For glazing materials up to and including 8 mm (5/16") thick, doors shall be provided with 0.81 mm (0.032") (20 gauge) steel glazing trim and snap-in glazing stops.
 - .2 For glazing materials greater than 8 mm (5/16") thick, doors shall receive 0.81 mm (0.032") (20 gauge) steel trim and screw fixed glazing stops. Screws shall be #6 x 32 mm (1-1/4") oval head Tek™ (self-drilling) type at 305 mm (12") on centre maximum.
 - .3 Glazing trim and stops shall be accurately fitted (within 0.39 mm (0.015") tolerance), butted at corners, with removable glazing stops located on the 'push' side of the door.
- .13 Where indicated in schedule, prepare doors and panels for installation of fire-rated door grilles. If required to meet door grille manufacturer's rated design, provide reinforcement around door grille opening.

2.6 Fabrication - Steel Frames

- .1 General: Applicable to frames, transom panel frames, sidelights, and window assemblies.

Steel Doors and Frames

- .2 Interior and non-thermally broken frames; welded:
 - .1 Fabricated from: 1.34 mm (0.053") (16 gauge) steel.
 - .2 Supplied set-up and welded (SUW).
- .3 Factory assembled frame product shall be square, free of defects, warps or buckles.
- .4 Set-up and welded corner joints (SUW):
 - .1 Profile welded–punch mitred, continuously welded on inside of the profile faces, rabbets, returns and soffit intersections, with exposed faces filled and ground to a smooth, uniform seamless surface, as defined in the CSDMA - "Recommended Specifications for Commercial Steel Door and Frame Products".
- .5 Set-up and welded joints at mullions, sills and center rails:
 - .1 Coped accurately, butted and tightly fitted.
 - .2 At intersecting flush profile faces, securely weld, fill and grind to flush, smooth, uniform, seamless surface.
 - .3 At intersecting recessed profile faces, securely weld to concealed reinforcements, with exposed hairline face seams.
 - .4 At other intersecting profile elements make exposed face seams to hairline tolerance.
- .6 Where required due to site access, when required for co-ordination or installation, or shipping limitations, frame product shall be fabricated in sections for splicing in the field.
 - .1 Field spliced jambs, heads and sills shall be provided with 1.34 mm (0.053") (16 gauge) steel splice plates securely welded into one section, extending 100 mm (4") minimum each side of splice joint.
 - .2 Field splices at closed sections (mullions or center rails) shall be 1.34 mm (0.053") (16 gauge) steel splice angles securely welded to the abutting member. Face of splice angle shall extend 100 mm (4") minimum into closed sections when assembled.
 - .3 Field splice joints shall be welded, filled and ground to present a smooth uniform surface by the installation company responsible for installation after assembly.
- .7 On factory assembled frame product, provide 2 temporary steel shipping bars welded to the base of the jambs or mullions to maintain alignment during shipping and handling. Remove shipping bars prior to anchoring of frames to floor.
- .8 Each door opening shall be prepared for single stud door silencers. Silencers shall be shipped loose for installation by installer, after finish painting.
 - .1 Single interior doors: 3 at strike jamb.
 - .2 Weather-stripped doors: None required.
 - .3 Sound, light, or smoke sealed doors: None required.
 - .4 Transom panels: 2 at each jamb.
- .9 Prior to shipment, mark each frame with an identification number as shown on the approved submittal drawings.

Steel Doors and Frames

- .10 Provide mullions and transom bars of closed construction type. For fixed condition, attach members to frame with butt-welded joints. For removable condition, attach members with removable mullion anchors.
- .11 Conceal fastenings unless otherwise indicated.
- .12 Anchor frames to floor by 1.34 mm (0.053") (16 gauge) thick angle clips, welded to frame and Provide with 2 holes for floor anchorage.
- .13 Grind welded corners to a flat plane, fill with metallic paste filler and sand to uniform smooth finish.
- .14 Protect strike and hinge reinforcements using guard boxes welded to frames at masonry construction.
- .15 Reinforce head of frames wider than 1220 mm (48").
- .16 Brace frame units to prevent distortion in shipment and protect finish.

2.7 Hardware Reinforcements and Preparations

- .1 Door and frame product shall be blanked, reinforced, drilled and tapped at the factory for fully templated mortise hardware only, in accordance with the approved hardware schedule and templates provided by the hardware supplier.
- .2 Door and frame products shall be factory blanked and reinforced only for mortised hardware that is not fully templated.
- .3 Where surface mounted hardware, anchor hinges, thrust pivots, pivot reinforced hinges, or non-templated hardware are required frame product shall be reinforced only, with drilling and tapping done by field installation.
- .4 Templated holes 12.7 mm (1/2") diameter and larger shall be factory prepared, except mounting and through bolt holes, which shall be by installation on site. Templated holes less than 12.7 mm (1/2") diameter shall be factory prepared only when required for the function of the device (for knobs, levers, cylinders, thumb or turn pieces) or when these holes over-lap function holes.
- .5 Hinge reinforcements shall be 3.12 mm (0.123") (10 gauge) steel minimum, high frequency type shall be provided.
- .6 Frames shall be prepared for 114 mm (4.5") standard weight hinges minimum unless otherwise indicated.
- .7 Doors and frames in excess of 2450 mm (96") rabbet height shall be prepared for 114 mm (4.5") heavy weight 4.6 mm (0.180") hinges minimum.
- .8 Lock, strike and flush bolt reinforcements shall be 1.34 mm (0.053") (16 gauge) steel minimum, with extruded tapped holes that provide equivalent number of threads as 2.36 mm (0.093") (12 gauge).
- .9 Reinforcements for surface mounted hardware, concealed closers and holders and flush bolts shall be 1.06 mm (0.042") (18 gauge) steel minimum.
- .10 Reinforcements are not required for surface applied hardware supplied with thru-bolts and spacers or sex-bolts.
- .11 Provide hardware mortises on perimeter frame members to be grouted in masonry or concrete partitions with 0.66 mm (0.026") (22 gauge) steel grout guards.

Steel Doors and Frames

.12 Electrified hardware:

- .1 Where electrically or electronically operated hardware is specified on the schedules or details or the final approved schedule and templates provided by the hardware supplier, hardware enclosures and/or junction boxes, where indicated on the templates, shall be provided and inter-connected with CSA approved 12.7 mm (1/2") diameter conduit and connectors.
- .2 Refer to electrical documents for general electrical rough-in details. At door locations indicated in electrical documents as requiring rough-in only of electrical (ie. where no electrically or electronically operated hardware is specified in the hardware schedule), provide enclosures, boxes, and conduit to permit future installation of devices without removal of grout, demounting of frames, or installation of exposed conduits.
- .3 Frames:
 - .1 Frames with electrified devices shall include electrical connection boxes sized to accommodate devices specified in Section 08 71 00. At time of frame manufacture, electrical connection boxes shall be supplied by Divisions 26, 27, and 28 for installation into frame by work of this section.
 - .2 Frame electrical connection boxes shall be positioned flush to edge of frame face return. Clearance shall be maintained to allow wall material to be consistently applied for length of frame member. Frame connection boxes shall be welded in place and positioned to allow necessary clearance for electrical trade to install conduit and connection components, with conduit layout in a manner that takes conduit up to ceiling in an uninterrupted configuration and to accommodate wire installation.
- .4 Doors:
 - .1 Doors with electrified devices shall be manufactured to include wire raceway in door panel to accommodate electrified devices, such as electric hinge, power transfer units, electrified locks, electrified door closures and electrified exit devices. Construction of raceways shall provide a continuous conduit or channel between entry and exit points to accommodate wire installation after door manufacture.
 - .2 Doors with electrified locks may require extended space to accommodate plug-type connection components or wire collection space. Coordinate with work of Section 08 71 00 and obtain hardware templates for electrified hardware clearly indicated on reviewed shop drawings and prior to door manufacture.

2.8 Frame Anchorage

- .1 Frame products shall be provided with anchorage appropriate to floor, wall and frame construction.
- .2 Each wall anchor shall be located immediately above or below each hinge reinforcement on the hinge jamb and directly opposite on the strike jamb.
- .3 Frame products for installation in new masonry walls shall be provided with steel adjustable wall anchors of the T-strap, stirrup or wire, 1.34 mm (0.053") (16 gauge) minimum or 3.96 mm (0.156") diameter wire. Straps shall be not less than 50 mm (2") x 254 mm (10") in size, corrugated and/or perforated.

Steel Doors and Frames

- .4 Frame products installed in steel stud and drywall partitions shall be provided with 0.81 mm (0.032") (20 gauge) steel snap-in or "Z" stud type anchors.
- .5 Jamb of frames in previously placed concrete, masonry or structural steel shall be punched and dimpled to accept machine bolt anchors, 6.4 mm (1/4") diameter, located not more than 150 mm (6") from the top and bottom of each jamb. Anchor preparations and guides shall also be located immediately above or below the intermediate hinge reinforcing and directly opposite on the strike jamb. Each preparation shall be provided with 1.34 mm (0.053") (16 gauge) anchor bolt guides.
- .6 Anchor bolts and expansion shell anchors for the above preparations shall be provided by the installation company.
- .7 Where frame product is installed prior to construction of the adjacent wall, each jamb shall be provided with 1.34 mm (0.053") (16 gauge) steel floor anchors. Each anchor shall be provided with 2 holes for mounting to the floor and shall be securely welded to the inside of the jamb profile.
- .8 On sidelights or windows exceeding 3 m (9'-10") in width, installed in stud partitions, channel extensions shall be provided from the top of the frame assembly to the underside of the structure above. Extensions shall be fabricated from 2.36 mm (0.093") (12 gauge) steel formed channels, mounting angles and adjusting brackets, with mounting angles welded to the inside of frame head. Formed channels, adjusting brackets and fasteners shall be shipped loose. Channels shall be mechanically connected to mounting angles and adjusting brackets with supplied fasteners, on site, by contractor responsible for installation.

2.9 Sizes and Tolerances

- .1 Widths of door openings shall be measured from inside of frame jamb rabbet with a tolerance of ± 1.6 mm ($+0.063$ ").
- .2 Heights of door openings shall be measured from the finished floor (exclusive of floor coverings) to the head rabbet of the frame with a tolerance of ± 1.2 mm (± 0.047 ").
- .3 Unless finishing hardware dictates otherwise, doors shall be sized so as to fit the above openings and allow a 3 mm (1/8") clearance at jambs and head. A clearance of 19 mm (3/4") between the bottom of the door and the finished floor (exclusive of floor coverings) shall be provided. Tolerances on door sizes shall be ± 1.2 mm (± 0.047 ").
- .4 Manufacturing tolerances on formed frame profiles shall be ± 0.8 mm (± 0.031 ") for faces, door stop heights and jamb depths. Tolerances for throat openings and door rabbets shall be ± 1.6 mm (± 0.063 ") and ± 0.4 mm (± 0.016 ") respectively. Hardware cut-out dimensions shall be as per template dimensions, ± 0.4 mm ($+0.015$ ").

2.10 Hardware Locations

- .1 Hardware preparations in frame product shall be as noted below and locations on doors shall be adjusted for clearances specified in paragraph 2.9 of this section.
- .2 Top of upper hinge preparation for 114.3 mm (4.5") hinges shall be located 180 mm (7.5") down from head, transom mullion or panel as appropriate. The top of the bottom hinge preparation for 114.3 mm (4.5") hinges shall be located 310 mm (12.625") from finished floor as defined in paragraph 2.9 of this section. Intermediate hinge preparations shall be spaced equally between top and bottom cutouts.

Steel Doors and Frames

- .3 Strike preparations for unit, integral, cylindrical and mortise locks and roller latches shall be centered 1033 mm (40-5/16") from finished floor. Strikes for deadlocks shall be centered at 1220 mm (48") from finished floor. Strikes for panic or fire exit hardware shall be located as per device manufacturer's templates.
- .4 Push and/or pulls on doors shall be centered 1070 mm (42") from finished floor.
- .5 Preparations not noted above shall be as per hardware manufacturer's templates.
- .6 Hardware preparation tolerances shall comply with the ANSI A115 standards.

PART 3 - EXECUTION

3.1 Examination

- .1 Provide necessary grounds, bracing and strapping for fitting and adequate for securing of the work.
- .2 Cooperate with work of other sections to ensure fastenings set by others are provided and located, their work is installed to their specifications and that those responsible for back priming are notified in sufficient time for them to schedule work.

3.2 Installation - Steel Doors and Frames

- .1 Set frame product plumb, square, aligned, without twist at correct elevation in accordance with NAAMM-HMMA 840-1708 11 13.
- .2 Fire labelled product shall be installed in accordance with NFPA 80-2013.
- .3 Frame product installation tolerances:
 - .1 Plumbness tolerance, measured through a line from the intersecting corner of vertical members and the head to the floor, shall be ± 1.6 mm ($\pm 1/16$ ").
 - .2 Squareness tolerance, measured through a line 90° from one jamb at the upper corner of the product, to the opposite jamb, shall be ± 1.6 mm ($\pm 1/16$ ").
 - .3 Alignment tolerance, measured on jambs, through a horizontal line parallel to the plane of the wall, shall be ± 1.6 mm ($\pm 1/16$ ").
 - .4 Twist tolerance, measured at face corners of jambs, on parallel lines perpendicular to the plane of the wall, shall be ± 1.6 mm ($\pm 1/16$ ").
- .4 Brace frame product rigidly in position while building-in. Remove temporary steel shipping jamb spreaders. Install temporary wood spreaders at mid-point of frame rabbet height to maintain frame widths. Remove wood spreaders after product has been built-in.
- .5 Provide vertical support at center of head for openings exceeding 1250 mm (48") in width.
- .6 Secure anchorages and connections to adjacent construction.
- .7 Adjust operable parts for correct clearances and function.
- .8 Steel surfaces shall be kept free of grout, tar or other bonding materials or sealers.
- .9 Remove grout or other bonding material from products immediately following installation.

Steel Doors and Frames

- .10 Provide appropriate anchorage for floor and wall construction. Each wall anchor shall be located immediately above or below each hinge reinforcement on the hinge jamb and directly opposite the strike jamb. On each jamb, install 2 anchors for openings up to and including 1525 mm (60") high and install 1 anchor for each additional height of 760 mm (30") of height or fraction thereof, except as indicated below. Frames placed in previously placed concrete, masonry or structural steel shall be Provided with anchors located not more than 150 mm (6") from top and bottom of each jamb, and intermediate anchors at 660 mm (26") on centre maximum.
- .11 Secure frames set in previously constructed concrete or masonry openings by countersunk expansion bolts at same centres as for adjustable Tee wall anchors. Reinforce frame at fastening location to prevent indentation of frame by fastening device.
- .12 Fill and grind smooth "punch and dimpled" frame installations.
- .13 Prior to site touch-up, exposed surfaces of galvaneal steel to be finished shall be cleaned to remove foreign matter. Refer to paint manufacturers recommendations for additional information and requirements of Section 09 91 00.
- .14 Touch-up exposed field welds shall be finished to present a smooth uniform surface and with a rust inhibitive primer.
- .15 Touch-up exposed surfaces that have been scratched or otherwise marred during shipment, installation, and handling shall be with a rust inhibitive primer.
- .16 Finish paint in accordance with Section 09 91 00.
- .17 Install door silencers.
- .18 Properly fasten units and secure in place with concealed fixings wherever possible. Include grounds and furring where required.
- .19 Make allowance for deflection to ensure structural loads are not transmitted to frames.
- .20 Adjust operable parts for correct clearances and function.

3.3 Installation - Finishing Hardware

- .1 Install finishing hardware in accordance with ANSI A115.1G-1994, manufacturers' templates and instructions, and Section 08 71 00.

3.4 Adjusting and Cleaning

- .1 Adjust doors to swing freely, smoothly and easily, to remain stationary at any point, to close evenly and tightly against stops without binding, and to latch positively when doors are closed with moderate force.
- .2 Adjust hardware so that latches and locks operate smoothly and without binding, and closers act positively with the least possible resistance in use. Lubricate hardware if required by Supplier's requirements.
- .3 Adjust doors equipped with closers to close doors firmly against anticipated wind and building air pressure, and to enable doors to be readily opened as suitable for function, location, and traffic.
- .4 Clean hardware after installation in accordance with Supplier's requirements.

END OF SECTION

Interior Aluminum Screen and Door Frames

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Interior aluminum framing system.

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting in accordance with Section 01 31 19.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Samples:
 - .1 Partition sample to show basic construction, glazed sections, door frames, trim, and finishes.
 - .2 Submit cut-away sample of each type of door, to show stile and rail construction, core, cross banding, door face finish and edges.
 - .3 Submit 3 sets of samples minimum 300 mm (12") x 300 mm (12") of veneers showing full range of grain variation, finish and patterns proposed for wood specified.
- .4 Shop drawings:
 - .1 Submit shop drawings for the work of this section.
 - .2 Clearly indicate fabrication details, plans, elevations, hardware, and installation details.
 - .3 Indicate door location using numbering system per door schedule, size, and hand of each door, elevation of each door type; construction type core and edge construction not covered in product data; and special blocking requirements.
 - .4 Indicate dimensions and locations of factory machining criteria for hardware, extent of hardware blocking.
 - .5 Indicate doors to be factory finished and finish requirements including veneer matching.
 - .6 Indicate electrified hardware requirements and preparations.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit operation and maintenance data for incorporation into maintenance manual.

Interior Aluminum Screen and Door Frames

.3 Maintenance materials:

- .1 Submit minimum 2% extra snap-in trim, stops, clips, and other components for each colour, pattern, and finish specified.

1.5 Quality Assurance

.1 Qualifications:

- .1 Installers: Shall have 5 years' experience, minimum, in application of Products, systems and assemblies specified and with training of Product manufacturers.

.2 Mock-ups:

- .1 Provide 3000 mm x 3000 mm (118" x 118") mock-up for each system specified.

1.6 Delivery, Storage, and Handling

- .1 Package or crate, and brace products to prevent damage during shipment and handling. Label packages and crates, and protect finish surfaces from environmental conditions where required.

1.7 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.

PART 2 - PRODUCTS

2.1 Manufacturers/Products

- .1 Basis of design:
 - .1 Partition Components Incorporated 'PC350 Elite'.
- .2 Subject to compliance with requirements, provide products by the following acceptable alternate manufacturer/*Product*:
 - .1 CRL US Aluminum 'CRL 487 Series'.
 - .2 Komandor 'Aurora System'.
 - .3 Specialty Product Hardware (SPH) 'Moodwall P2'.

2.2 Performance/Design Requirements

- .1 Design system to accommodate glass and glazing as specified or indicated.
- .2 Performance duty level:
 - .1 Doors shall meet the requirements of ANSI/WDMA I.S. 1A-13 for Extra Heavy Duty Performance Level.

Interior Aluminum Screen and Door Frames

2.3 Materials

- .1 Extruded aluminum: Controlled alloy billets of 6063 T5, to assure compliance with tight dimensional tolerances and maintain colour uniformity.

2.4 Frame and Door System

- .1 Provide frames with the following characteristics:
 - .1 Rectilinear design.
 - .2 45 mm (1-3/4") face profile.
 - .3 Snap on trim: 45 mm (1-3/4") aluminum.
 - .4 1.8 mm (0.070") rabbet wall thickness.
- .2 Exposed aluminum surfaces:
 - .1 Polyester finish: to AAMA 603.8-98, multiple-stage electrostatic applied thermoset polyester finish, baked.
 - .1 Colour: to later selection by the Contract Administrator.
 - .1 Standard colour from the manufacturer's full range.

2.5 Fabrication

- .1 Pre-machine jambs and prepare for hardware, with concealed reinforcement plates, drilled and tapped as required and fastened within frame with concealed screws.
- .2 Fabricate components to allow secure installation without exposed fasteners.

PART 3 - EXECUTION

3.1 Installation

- .1 Provide manufacturer's information and templates required for installation of work of this section, and assist or supervise, or both, the setting of anchorage devices, and construction of other work incorporated with products specified in this section in order that they function as intended.
- .2 Install work in accordance with manufacturers' requirements and recommendations, true, tightly fitted, and level or flush to adjacent surfaces, as suitable for installation. Adjust components to allow for irregularities in adjacent construction and relate accurately to finished ceiling and floor coverings.
- .3 Install frames plumb and square, securely anchored to substrates with fasteners recommended by frame manufacturer.
- .4 Use concealed installation clips to assure that splices and connections are tightly butted and properly aligned.
- .5 Secure clips to main structural components and not to snap-in or trim members.
- .6 Do not use screws or other fasteners that will be exposed to view when installation is complete.
- .7 Fit joints and junction between components tightly and in true planes, conceal joints where possible.

Interior Aluminum Screen and Door Frames

3.2 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00 and as follows:
- .2 Manufacturer's field review to be in accordance with Section 01 45 00.

3.3 Adjusting and Cleaning

- .1 Verify under work of this section that installed products function properly, and adjust them accordingly to ensure satisfactory operation.
- .2 Refinish damaged or defective Work so that no variation in surface appearance is discernible.

END OF SECTION

Flush Wood Doors

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Solid core doors with wood veneer.
 - .2 Factory finishing wood doors.

1.2 Administrative Requirements

- .1 Coordination:
 - .1 Coordinate installation of doors with installation of frames specified in other Sections and hardware specified in Section 08 71 00.
 - .2 Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Submit shop drawings for the work of this section complying with the North American Architectural Woodwork Standards 4.0 requirements.
 - .2 Indicate door location using numbering system per door schedule, size, and hand of each door, elevation of each door type; undercuts, bevelling, construction type core and edge construction not covered in product data; and special blocking requirements.
 - .3 Indicate dimensions and locations of factory machining criteria for hardware, extent of hardware blocking.
 - .4 Indicate dimensions and locations of cut-outs including trim for openings.
 - .5 Indicate door face finish requirements including veneer matching.
 - .6 Indicate doors to be factory finished and finish requirements.
 - .7 Indicate electrified hardware requirements and preparations.
- .4 Selection samples:
 - .1 Submit 3 sets of samples for initial selection purposes of actual veneers showing full range of grain variation, colour and matching, natural characteristics reflecting wood cut and species, manufacturing characteristics for each wood species specified. Submit samples as many times as required until approved by Contract Administrator. First submission to include one set of samples per Contract Administrator request plus one set lighter in tone and one set darker in tone.
- .5 Verification samples:

Flush Wood Doors

- .1 Submit cut-away sample of each type of door, to show stile and rail construction, core, cross banding, door face finish and edges.
- .2 Submit solid lumber frames for light openings, minimum 150 mm (6") long, for each material, type and finish required.

1.4 Quality Assurance

- .1 Qualifications:
 - .1 Manufacturer shall be a member in good standing of the Architectural Woodwork Institute or the Architectural Woodwork Manufacturers Association of Canada or the Woodwork Institute.
- .2 Quality standard:
 - .1 Work shall be in accordance with the North American Architectural Woodwork Standards 4.0, Custom Grade.

1.5 Delivery, Storage, and Handling

- .1 Doors shall be marked with door numbers used on shop drawings in the top hinge cavity created by the machining for hinges.
- .2 Identify doors with labels. Package with resilient packaging.
- .3 Store doors flat at the Place of the Work in piles with bottom face on bottom of pile. Protect from moisture by placing water resistant material under skids supporting piles. Cover top of piles and provide air at sides of piles.
- .4 Deliver the wood doors only after the building is closed and dry and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period. Do not receive the doors in a damp area. Do not drag the doors on the ground, floor or across one another.

1.6 Field Conditions

- .1 Environmental conditions:
 - .1 During storage and installation: Obtain and comply with wood door manufacturer's instructions for optimum temperature and relative humidity conditions for wood doors during its storage and installation. Do not install wood doors until these conditions have been attained.
 - .2 During finishing: Comply with wood door manufacturer's temperature and humidity requirements before, during, and after application of finishes.
 - .3 During service life of woodwork: Obtain and comply with wood door manufacturer's advice for optimum temperature and humidity conditions.

1.7 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranties:
 - .1 System:
 - .1 Labour, materials, and workmanship for work of this section.

Flush Wood Doors

- .2 The warranty is a total system warranty, and includes hardware, sealants, hanging and fitting, and finishing.
- .3 Duration: 2 years.
- .2 Glass and glazing: in accordance with Section 08 80 00.

PART 2 - PRODUCTS

2.1 Manufacturers

- .1 Baillargeon by Masonite Architectural.
- .2 Lambton Doors.
- .3 Masonite Architectural.
- .4 VT Industries.
- .5 Substitutions: in accordance with Section 01 25 00.

2.2 Sustainable Design Requirements

- .1 Wood products used in work of this section shall be Forestry Stewardship Council (FSC) Certified, with chain of custody verification, except for products made with recycled material.
- .2 Wood-based materials are to contain no added urea-formaldehyde.

2.3 Performance/Design Requirements

- .1 Flush wood doors shall meet the minimum acceptance levels in accordance with the North American Architectural Woodwork Standards 4.0.
- .2 Doors and frames shall function as intended, including but not limited to:
 - .1 Be in true alignment.
 - .2 Operate and swing freely, smoothly, and easily.
 - .3 Remain stationary at any point.
 - .4 Close evenly and tightly against stops without binding.
 - .5 Latch positively when doors are closed with moderate force.
 - .6 No delamination.
 - .7 No telegraphing of core construction in face panels exceeding 0.254 mm (0.01") in a 75 mm (3") span, and warp exceeding 3 mm (1/8") in a 1066 mm (42") x 2133 mm (84") section.

2.4 General

- .1 Single-source manufacturing and fabrication responsibility: Engage a qualified Manufacturer to assume undivided responsibility for wood doors specified in this section, including fabrication and finishing except where site finishing is specified.

Flush Wood Doors

2.5 Door Construction

- .1 Door construction, industry abbreviations and types to North American Architectural Woodwork Standards 4.0.
- .2 Performance duty level:
 - .1 Doors shall meet the requirements of ANSI/WDMA I.S. 1A-13 for Extra Heavy Duty Performance Level unless otherwise indicated or scheduled.
- .3 Solid particleboard core, veneer faced, non-fire rated wood door construction:
 - .1 Type PC-5, particle board core to ANSI A208.1-2009 LD-2 (529 kg/m³ - 529 kg/m³ (28 lbs/ft³-33 lbs/ft³) density).
- .4 Bonding:
 - .1 Bond stiles and rails to core; abrasive sand core assembly to achieve uniform thickness prior to lamination of door faces.
- .5 Panel edge types:
 - .1 Wood veneer faced doors for transparent finish:
 - .1 For vertical edges (stiles) and exposed horizontal edges (rails). (Exposed horizontal edges are those edges that can be viewed from floors above.):
 - .1 Solid wood edgeband to match face veneer, face and crossbands are covered.
 - .2 For unexposed horizontal edges (rails):
 - .1 Non-rated doors: Minimum 25 mm (1") structural composite lumber.
- .6 Blocking:
 - .1 Provide hardware blocking for doors as follows:
 - .1 Non-rated doors: Structural composite lumber for hardware blocking.
 - .2 HB-1, minimum 125 mm (5") wide, full door width, top-rail blocking for closure devices or flush bolts or for sliding door hardware.
 - .3 HB-2, minimum 125 mm (5") wide, full door width, bottom-rail blocking for doors with protection plates, concealed door seals, automatic bottoms, pivots or floor bolts.
 - .4 HB-4, minimum 125 mm (5") wide x 250 mm (10") high blocking for doors with mortise locks and pockets.
 - .5 HB-5, minimum 125 mm (5") wide x 250 mm (10") high blocking for hinges.
 - .6 HB-6, minimum 125 mm (5") wide, full door width, mid-rail blocking for fire exit devices.
 - .7 HB-7, minimum 125 mm (5") wide, full door height, for doors with continuous type hinges.
- .7 Thickness:
 - .1 45 mm (1-3/4") minimum unless otherwise indicated or scheduled.

Flush Wood Doors

2.6 Veneer Faced Doors For Transparent Finish

- .1 Veneer face grade: Allowable wood veneer face grade characteristics shall comply with North American Architectural Woodwork Standards 4.0 referenced grade and referenced standards.
 - .1 A.
- .2 Veneer thickness: Minimum 1.0 mm (0.040") thick after sanding.
- .3 Veneer species: White Oak.
- .4 Veneer cut: Rift.
- .5 Veneer leaf matching: Book.
- .6 Veneer assembly matching: Running.

2.7 Accessories

- .1 Wood glass stops: Solid hardwood, species to match face finish, and referenced quality standard.
- .2 Finishing hardware: in accordance with Section 08 71 00.

2.8 Fabrication

- .1 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. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 - .1 Clearances: Refer to Part 3 for clearance tolerances.
 - .2 Fit doors for automatic door bottoms.
 - .3 Bevel non-fire-rated doors 3-1/2 degrees (1/8 inch in 2 inches) at lock and hinge edges.
- .2 Fabricate doors with hardware blocking as specified in Part 2 of this Section.
- .3 Factory machine doors for finish hardware that is not surface applied. Do not machine for surface hardware. Locate hardware to comply with Door and Hardware Institute (DHI) "Recommended Locations for Architectural Hardware for Flush Wood Doors (latest edition). Comply with final reviewed hardware schedules, door and frame shop drawings and hardware templates.
- .4 Electrified hardware: Where electrically or electronically operated hardware is specified on the schedules or details or the final approved schedule and templates provided by the hardware supplier, doors with electrified devices shall be manufactured to include wire raceway in door panel to accommodate electrified devices, such as electric hinge, power transfer units, electrified locks, electrified door closures and electrified exit devices. Construction of raceways shall provide a continuous conduit or channel between entry and exit points to accommodate wire installation after door manufacture.
- .5 Factory cut and trim openings.

2.9 Factory Finishing

- .1 Finish work in factory in accordance with North American Architectural Woodwork Standards 4.0 and referenced quality standard.

Flush Wood Doors

- .2 Prior to finishing, handling marks or effects of exposure to moisture removed with a thorough final sanding over surfaces of the exposed portions, using appropriate grit sandpaper, and shall be cleaned prior to applying sealer or finish. Sanding shall be completed just prior to stain or finishing application.
- .3 Comply with requirements indicated below for finish system, staining, and sheen.
 - .1 Sheen range measurements in accordance with North American Architectural Woodwork Standards 4.0:
 - .1 Satin.
 - .2 Factory finish with transparent, Post Catalysed Lacquer in accordance with the North American Architectural Woodwork Standards 4.0.
 - .1 Transparent finish:
 - .1 Clear (natural).
 - .4 Seal top and bottom door edges.

PART 3 - EXECUTION

3.1 Examination

- .1 Provide necessary grounds, bracing and strapping for fitting and adequate for securing of the work.

3.2 Installation - General

- .1 Execute installation and assembly at the Place of the Work using skilled forces under supervision of a competent joinery foreperson.
- .2 Install work plumb, level and straight, and fasten it securely to backing to support itself and anticipated superimposed loads.
- .3 Build into construction as indicated, or specified in other sections of this specification, or both.
- .4 Adequately fasten units and secure in place with concealed fixings wherever possible. Include grounds and furring where required.

3.3 Installation - Doors

- .1 Align and fit doors in frames with uniform clearances 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:
 - .1 Provide clearances as follows except where more stringent clearance is required or indicated.
 - .2 Provide 3.18 mm (1/8") maximum clearance between door and frame at heads, jamps, and between pairs of doors.
 - .3 Provide minimum 6 mm (1/4") clearance from bottom of door and top of floor finish and maximum clearance of 9.5 mm (3/8").

Flush Wood Doors

- .2 Seal top and bottom edges of wood doors if they are cut to fit, in accordance with door manufacturer's warranty requirements.
- .3 Pilot drill screw and bolt holes.

3.4 Installation - Finishing Hardware

- .1 Install finishing hardware in accordance with Section 08 71 00.

3.5 Adjusting and Cleaning

- .1 Adjust doors to swing freely, smoothly and easily, to remain stationary at any point, to close evenly and tightly against stops without binding, and to latch positively when doors are closed with moderate force.
- .2 Adjust hardware so that latches and locks operate smoothly and without binding, and closers act positively with the least possible resistance in use. Lubricate hardware if required by Supplier's requirements.
- .3 Ensure that doors equipped with closers operate to close doors firmly against anticipated wind and building air pressure, and to enable doors to be readily opened as suitable for function, location and traffic.
- .4 Clean hardware after installation in accordance with Supplier's requirements.

END OF SECTION

Architectural Access Panels

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Architectural access panels.
 - .1 Refer to Architectural drawings for locations and sizes.

1.2 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Indicate locations, types, and sizes of access panels.

1.3 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit operation and maintenance data for rolling grilles for incorporation into operations and maintenance manuals.

1.4 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - .1 System:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 The warranty is a total system warranty, and includes hardware, operators, finishing, delivery, hanging, fitting, and refinishing of door and hardware.
 - .3 Duration: 2 years.

PART 2 - PRODUCTS

2.1 Architectural Access Panels

- .1 Acceptable Product:
 - .1 Acudor Acorn 'BP58 Bauco Plus Access Doors'.
 - .2 Acudor Acorn 'DW-5040'.
 - .3 Bauco Products Incorporated (APS - Access Panel Solutions) 'Bauco Plus II' access panels.
- .2 Description:

Architectural Access Panels

- .1 Maximum gap between door and frames: 1.5 mm (1/16").
- .2 Door: Aluminum frame with gypsum board inlay and structural nylon corner elements. Door is to be taped and finished to match surrounding surface.
- .3 Frame: Recessed aluminum frame provides edge similar to drywall bead against which wall or ceiling surface can be finished. Finish edge flush with gypsum board in accordance with trim tolerances specified in Section 09 29 00.
- .4 Materials: Extruded Aluminum Alloy 6063-T6. 12.7 mm (1/2") or 15.9 mm (5/8") gypsum board inlay, thickness shall be consistent with thickness of surrounding gypsum board. Fibreglass reinforced nylon. Zinc-plated screws, stainless steel springs and retaining wire.
- .5 Hinge: concealed, two point pin hinge, non corroding, as suggested by manufacturer.
- .6 Latch: Screwdriver cam latch (standard).
- .7 Finish:
 - .1 Finish gypsum board to Level 4 in accordance with Section 09 29 00.
 - .2 Paint completed installation in accordance with Section 09 91 00.

PART 3 - EXECUTION

3.1 Access Panels for Drywall

- .1 Locations to be reviewed and confirmed by Contract Administrator.
- .2 Install in accordance with manufacturer's written requirements.
- .3 Install before drywall has been taped and finished.
- .4 Fasten frame to drywall with standard drywall fasteners.

END OF SECTION

Aluminum Entrances

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Aluminum entrances.

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting in accordance with Section 01 31 19.
 - .1 Independent inspection and testing company shall attend the pre-installation meeting.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Submit engineered shop drawings.
 - .2 Further to requirements of Section 01 33 00, indicate system dimensions, framed opening requirements and tolerances, adjacent construction, anticipated deflection under load, affected related work, weep drainage network, expansion and contraction joint location and details, field welding, coordination with hardware and electrical requirements.
 - .3 Identify and describe material types being supplied, wall thicknesses of extrusions, and shapes including connections and grades, dimensions and tolerances (minimum and maximum), attachments, reinforcing, anchorage and locations of fastenings, and provisions for thermal and structural movement between components of this section and adjacent materials.
 - .4 Include description of materials, metal finishing specifications, and other pertinent information.
 - .5 Design loads, typical reactions and support movement allowances, both vertical and horizontal, shall be placed on the shop drawings.
 - .6 Shop drawings shall clearly indicate the specification of materials and, where applicable, indicate installation methods and coordination with other sections.
 - .7 Submit framing member structural and physical characteristics, calculations, dimensional limitations, special installation requirements.
- .4 Samples:
 - .1 Submit samples of frame, sill and mullion sections, sill flashing and accessories, fasteners for connection of frame to opening, glazing tape, glass retainers, glazing gaskets, screening and frame, spandrel panels and each finish material and any other material, as requested.

Aluminum Entrances

- .2 Samples of colour and finish prepared as specified on respective metal components for both extrusion and sheet.
- .3 Identify samples as to treatment, thickness, alloy, framing composition, colour, manufacture, performance standard and portion of the work to which they apply.
- .4 Fabrication shall not proceed without written acceptance of samples from Contract Administrator.
- .5 Test reports:
 - .1 Submit valid laboratory test reports, prepared by an independent laboratory, verifying that proposed system has been tested by an independent laboratory and achieved performance values that meet the specified performance criteria.

1.4 Closeout Submittals

- .1 Closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for incorporation into the operation and maintenance manuals.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Installers / applicators / erectors:
 - .1 Company:
 - .1 Has adequate plant, equipment, and skilled workers to perform the work expeditiously.
 - .2 Has successfully completed installations similar to that specified during a period of at least the immediate past 5 years.
 - .2 Provide at least one trade specialist who shall be thoroughly trained and experienced in skills required, be completely familiar with referenced standards and requirements of this work, and personally direct installation performed under this section.
 - .1 Foreperson experience: Shall have 10 years' experience, minimum, as glazing mechanic.
 - .2 Typical glazing mechanic experience: Shall have 3 years' experience, minimum, as glazers.
 - .3 Welding: Perform welding of structural components only by fabricators certified by Canadian Welding Bureau to CSA Welding qualification codes; CSA W47.1-19 for welding of steel, and CSA W47.2-11(R2020) for welding of aluminum.

1.6 Delivery, Storage, and Handling

- .1 Store parts in a dry place and permit natural ventilation over their finished surfaces.
- .2 Store materials in locations protected from damage of other trades.

Aluminum Entrances

- .3 Under conditions of high humidity or cold temperatures, supply heating or forced air ventilation to prevent accumulation of surface moisture.
- .4 Mark components to show location on building and on drawings.
- .5 Protect finishes with strippable coating that will not mar, nor deface finish on removal, or a similar method designed to afford an equivalent amount of protection. Leave protected coating intact until damage risk is past or immediately prior to final cleaning.
- .6 Stacking should be done to prevent bending pressure or abrasion of finished surfaces.
- .7 Brace and protect frame units to prevent distortion and damage in shipment and handling.
- .8 Provide methods for lifting or hoisting units into place without causing damage.

1.7 Field Conditions

- .1 Comply with requirements of Product manufacturers.

1.8 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - .1 System:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 The warranty is a total system warranty, and includes hardware, operators, finishing, delivery, hanging, fitting, and refinishing of doors, framing, and hardware.
 - .3 Duration: 2 years.
 - .2 Glass and glazing: in accordance with Section 08 80 00.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Air Leakage; except entrance doors: Air leakage through the work shall not exceed 0.3 L/s/m² (0.06 cfm/ft²) of glazing area when tested in accordance with ASTM E283-04 at test pressure of 300 Pa (6.24 psf).
- .2 Water Penetration (other than entrance doors): No water penetration shall occur when the work is tested in accordance with ASTM E331-00, amended to prohibit water from passing through interior glazing seals or frame joints, at a test pressure of 300 Pa (6.24 psf).
- .3 Fabricate mullions to ensure under specified loads a maximum deflection of 1/175 of mullion span or 19 mm (3/4"), whichever is less.
- .4 Design and size components to withstand dead and live loads caused by pressure and suction of wind, acting normal to plane of system as calculated in accordance with building code.
- .5 Design and size components to withstand sway displacement as calculated in accordance with building code.
- .6 Provide system to accommodate, without damage to components or deterioration of seals:

Aluminum Entrances

- .1 Movement within system,
 - .2 Movement between system and perimeter framing components,
 - .3 Dynamic loading and release of loads,
 - .4 Deflection of structural support framing,
 - .5 Shortening of building concrete structural columns,
 - .6 Creep of concrete structural members,
 - .7 Mid-span slab edge deflection.
- .7 Maintain continuous air barrier throughout assembly, primarily in line with inside pane of glass and heel bead of glazing compound.
 - .8 Position thermal insulation to exterior of air barrier.
 - .9 Ensure no vibration harmonics, wind whistles, noises caused by thermal movement, thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system occur.

2.2 Materials

- .1 Aluminum extrusions: Aluminum Association alloy AA6063-T5 or T6 temper for framing.
- .2 Sheet aluminum: aluminum sheet, 0.92 mm (0.04") minimum thickness.
 - .1 Aluminum alloy:
 - .1 AA5005H14 Anodizing Quality.
- .3 Fasteners: aluminum or Type 304 stainless steel, finished to match adjacent material.
- .4 Isolation coating: alkali resistant bituminous paint or epoxy solution.
- .5 Glazing gaskets: fully resilient, shim type butyl glazing tape or EPDM glazing gasket.
- .6 Glass and other glazing materials: Refer to Section 08 80 00.
- .7 Silicone Sealant: One component, chemical curing; capable of water immersion without loss of properties: cured Shore A Durometer hardness of 15 to 25 to ASTM D2240-15(2021), colour as selected by Contract Administrator, where exposed, to ASTM C920-14.

2.3 Entrance Doors

- .1 Exterior doors (narrow stile):
 - .1 Acceptable Products:
 - .1 Alumicor 'Thermaporte 7700 – 100A'.
 - .2 Kawneer '360 Insulclad'.

2.4 Manual Door Hardware

- .1 Door hardware; hinges, closers, thresholds, push/pulls, locks, exit hardware, and as indicated: supplied by Section 08 71 00 for installation by this section.
- .2 Door jambs and head shall be weatherstripped with metal backed pile weather-stripping.
- .3 Door sills shall be weatherstripped with door sweeps.

Aluminum Entrances

- .4 Finish hardware to match door finish unless otherwise indicated.
- .5 Threshold: continuous type, 100 mm (4") wide, extruded aluminum.

2.5 Finishes

- .1 Exposed aluminum surfaces; where indicated: Mill finished aluminum.
- .2 Exposed aluminum surfaces; anodized to AAMA 611-20:
 - .1 Clear anodized to AA Designation AA-M12C21A31 or AA-M12C22A31 (Class II).

2.6 Fabrication

- .1 Make allowances for deflection of structure. Ensure that structural loads are not transmitted to aluminum work.
- .2 Provide structural steel reinforcement for strength, stiffness and connections.
- .3 Fit intersecting members to flush hairline weathertight joints and mechanically fasten together, except where indicated otherwise.
- .4 Conceal fastenings from view. Exposed fastenings where indicated.
- .5 Form cut-outs, recesses, mortising or milling for finishing hardware to templates supplied. Reinforce with aluminum or galvanized steel plates.
- .6 Field apply isolation coating to aluminum in contact with dissimilar metals and/or cementitious materials.
- .7 Fabricated assemblies shall make required clearances other assemblies and for deflection of structure.

PART 3 - EXECUTION

3.1 Installation

- .1 Install work of this section plumb, square, level, free from warp, twist and superimposed loads.
- .2 Secure work in required position. Do not restrict thermal movement.
- .3 Install hardware in accordance with templates.
- .4 Adjust operable parts for correct function.
- .5 Isolate from cementitious materials.

3.2 Glazing

- .1 Glaze aluminum windows at exterior using insulating glazing units in accordance with Section 08 80 00.

3.3 Sealants

- .1 Seal between frame members and adjacent construction as a part of the work of this section and in accordance with Section 07 92 00.

3.4 Hardware

- .1 Install in accordance with manufacturer's installation requirements.

Aluminum Entrances

- .2 Accurately locate and adjust hardware to meet manufacturer's requirements. Use special tools and jigs as recommended.
- .3 Set, fit and adjust hardware according to manufacturer's directions, at heights later directed by Contract Administrator. Hardware shall operate freely. Protect installed hardware from damage and paint spotting.
- .4 Powered hardware:
 - .1 Power wiring will be supplied and installed by electrical work installer including conduit, boxes and other electrical appurtenances, including connections and terminations. Be responsible for ensuring that all wiring work is done in accordance with the Suppliers wiring diagrams and directions.
 - .2 Arrange for testing and commissioning of system by the distributor of the system. Submit a copy of reports to the Contract Administrator.

3.5 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00.
- .2 Manufacturer's field review shall be in accordance with Section 01 45 00.

3.6 Adjusting and Cleaning

- .1 Cleaning on completion of installation:
 - .1 Remove deposits which affect appearance or operation of units.
 - .2 Remove protective materials.
 - .3 Clean interior and exterior surfaces by washing with clear water; or with water, and soap or detergent; followed by a clear water rinse.
 - .4 Clean and restore stained metal surfaces in accordance with manufacturer's recommendations. Replace if cleaning is impossible.
 - .5 Final cleaning is specified in Section 01 77 00.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Supply and off-load to place in a clean, dry, and secure room at the Place of the Work, which has been designated for storage of all finish hardware specified including necessary fastening devices.
 - .2 Supply all finish hardware required and not supplied under other Sections.
 - .3 Check and verify hardware information on door and frame shop drawings, prior to fabrication.
 - .4 Packaging, labelling, provision of installation instructions, templates, fixings and similar items, and delivery to the Work site.
 - .5 Give assistance at the Place of the Work to organize hardware storeroom and supply qualified staff to correctly categorize, mark, and arrange each item in groups to enable efficient dispensing in specified hardware groups for each door to installation trades.
 - .6 Provide qualified staff at the Place of the Work promptly to assist installation trades subsequent to being requested and to ensure that hardware is being correctly installed.
 - .7 Upon completion of installation of hardware, hardware Supplier shall arrange and conduct, in company of Contract Administrator and Contractor, inspections to verify that all hardware is installed and functioning satisfactorily, and where necessary shall recommend adjustments of such items as closer arms, valves, door holders and latch and locksets. Report comments in writing to Contract Administrator and Contractor.
 - .8 Supply temporary locking cylinders and keys for construction purposes. Locks used for Contractor security shall be keyed as required to conform to building operations' security requirements.

1.2 Administrative Requirements

- .1 Coordination:
 - .1 Coordinate work of this section to ensure information and material is promptly provided, to ensure orderly and expeditious progress of the Work, and to comply with schedule for completion.
 - .2 Within 3 weeks of Contract Award, submit confirmed orders to manufacturers/Suppliers to Contract Administrator.
 - .3 Assist Contractor to organize hardware storeroom and supply qualified staff to correctly categorize, mark, and arrange each item in groups to enable efficient dispensing in specified hardware groups for each door to installation trades.
 - .4 Coordinate the work of this section to ensure supplied hardware can function as required and can be installed within the particular details of the door and frame assemblies. Hardware that cannot be installed or will not function as intended will be replaced at no cost to the Owner.

Finish Hardware

- .2 Conduct a pre-installation meeting in accordance with Section 01 31 19.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Schedules and samples:
 - .1 Prepare and submit for review, a finish hardware schedule with technical product data sheets for use in the Work. List type, selected manufacturer's name and number, location, mounting heights and finish of hardware, and complete cross reference to door schedule.
 - .2 The indication or omission of a hardware component on the hardware schedule does not remove the responsibility of this section to ensure that all hardware can be installed and will function as intended.
 - .3 Submit samples of complete line of hardware and finishes. Identify samples indicating hardware item numbers used in the Finish Hardware Schedule, manufacturer's numbers, names, types, finishes, sizes and indication of door location(s). Approved samples will be retained for comparisons and returned upon completion of the Work.
 - .4 Prepare and submit for review, a keying schedule recognizing Owner requirements which shall be determined after award of Contract.
- .4 Templates:
 - .1 Submit for distribution, 3 copies of templates, template information, installation instructions and details necessary to enable preparation for, and installation of finish hardware in accordance with Door Hardware Institute recommended procedures. Submit templates arranged and marked coincident with specified hardware designations.
 - .2 Submit promptly when requested, the foregoing information in 3-ring plastic hard-covered binders suitably identified.
 - .3 In lieu of 1.3.4.1 arrange for the issue by each hardware manufacturer, the manufacturer's standard book of template drawings, at the option of door and frame manufacturers.
- .5 Jigs:
 - .1 Submit template jigs for each component to be recessed to enable installation trades to prepare doors to preclude misalignment and improper fit.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Instruct the Owner's designated representative in proper care and preventative maintenance of hardware to assure longevity of operation.

Finish Hardware

- .2 Submit maintenance data for cleaning and maintenance of finish hardware.
- .3 Submit to building maintenance staff prior to date of Substantial Performance of the Work, two sets of wrenches for door closers, locksets and fire exit hardware.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Supplier:
 - .1 Shall have 5 years' experience, minimum, in Products, systems and assemblies specified and with approval of Product manufacturers.
 - .2 Finish Hardware Supplier's project manager shall be directed involved in the day to day management of the project and shall be an accredited Architectural Hardware Consultant (AHC).

1.6 Delivery, Storage, and Handling

- .1 Package each item of hardware individually, complete with trim and necessary fastenings, and accessories, including wrenches, keys, and other appurtenances required to ensure correct installation. Mark each item as to contents and appropriate use in specified groups.
- .2 All items of hardware subject to handling when installed shall be submitted with an easily removable covering to protect against scratches, abrasions, coating with dissimilar finish materials on adjacent surfaces, and tarnishing.

1.7 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - .1 Manufacturer's standard extended warranties.
 - .2 Labour, materials, and workmanship for work of this section.
 - .1 Duration: 2 years.
 - .3 Closers:
 - .1 Duration: 5 years.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Comply with codes and requirements of governing authorities, and as specified.
- .2 Provide hardware items with characteristics to meet specified fire ratings, and conform to exit requirements of governing authorities.

2.2 Materials

- .1 Finish hardware: in accordance with Finish Hardware Schedule.

PART 3 - EXECUTION

3.1 Examination

- .1 Before furnishing any hardware, carefully check Agreement, Drawings, Schedules, and Specifications, verify door swings, door and frame materials and operating conditions, and assure that hardware will fit work to be attached.
- .2 Check shop drawings and frame and door lists affecting hardware type and installation, and verify to correctness thereof, or advise of required revisions. Check that doors, frames and panels requiring additional support are reinforced.
- .3 Point out special requirements to installer. Make final adjustment of hardware, in particular closer arms, valves and locksets, to work properly.

3.2 Installation

- .1 Install in accordance with manufacturer's written installation requirements. Refer also to installation requirements indicated, and specified in other sections of specifications.
- .2 Accurately locate and adjust hardware to meet manufacturer's written requirements. Use special tools and jigs as recommended.
- .3 Locate door stops to contact doors 75 mm (3") from latch edge.
- .4 Refer to Section 08 14 00 with respect to factory preparation for hardware for wood doors. Install wood doors and applicable hardware, including hinges.
- .5 Take delivery of finishing hardware and install, except hardware specified as part of work of another section. Check each item as received.
- .6 Set, fit and adjust hardware according to manufacturer's directions, at heights later directed by Contract Administrator. Hardware shall operate freely. Protect installed hardware from damage and paint spotting.
- .7 Sound and weather seals:
 - .1 Install seals to continuously seal entire perimeter of doors. Secure in place with non-ferrous screws, in accurate alignment.
 - .2 Maintain integrity of seal at head of doors fitted with closers. Adapt seals as required to achieve specified performance.
- .8 Pre-drill kickplates and doors prior to installation of kickplates. Apply with water-resistant adhesive and countersunk stainless steel screws.
- .9 Set thresholds on two continuous beads of polyurethane caulking fastened with a minimum of 4 countersunk screws.
- .10 At wood doors, use screw attachment for exit devices and closers except as follows:
 - .1 Use through-bolt attachment for exit devices and closers at mineral core doors.

3.3 Electrified Hardware

- .1 Install electronic components, security components such as magnetic locks, sentronic hold open devices door status switches, card readers, processors, transformers, and other electric devices.

Finish Hardware

- .2 Power wiring will be supplied and installed by Electrical Divisions 26, 27, and 28 including conduit, boxes and other electrical appurtenances, including connections and terminations. Be responsible for ensuring that all wiring work is done in accordance with the Suppliers wiring diagrams and directions.
- .3 Arrange for testing and commissioning of system by the distributor of the system. Submit a copy of reports to the Contract Administrator.

3.4 Keying

- .1 Permanent keying shall match the current system at the existing building by Medeco Biaxial. City of Toronto, Corporate Security shall provide the master key levels for the building.
- .2 Key hierarchy and related work of this section shall be designed by a Medeco authorized locksmith. Work shall include creation and/or addition to current key levels for the existing building.
- .3 Provide design to City of Toronto, Corporate Security for final review and acceptance prior to commencing work. Provide one key for each different level and sublevel to verify functionality of the system

3.5 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00.
- .2 Field tests and inspections:
 - .1 Inspect the installation of finish hardware on an agreed frequency.
 - .2 Advise in writing of work being performed that will prejudice the installation or correct operation of items of hardware.
 - .3 Ensure items have been installed complete with required trim and accessories, and fastenings are adequately secured and approved. Ensure closer arms, valves, holder devices, locksets and latchsets are correctly adjusted.

3.6 Adjusting and Cleaning

- .1 Adjust doors to swing freely, smoothly and easily, to remain stationary at any point, to close evenly and tightly against stops without binding, and to latch positively when doors are closed with moderate force.
- .2 Adjust hardware so that latches and locks operate smoothly and without binding, and closers act positively with the least possible resistance in use. Lubricate hardware if required by Supplier's requirements.
- .3 Ensure that doors equipped with closers operate to close doors firmly against anticipated wind and building air pressure, and to enable doors to be readily opened as suitable for function, location and traffic.
- .4 Clean hardware after installation in accordance with Supplier's requirements.

END OF SECTION



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Project#: P00055018

**SCHEDULE OF FINISHING HARDWARE
FOR
METRO HALL EARLY YEARS CHILD CARE CENTRE RENO
55 JOHN ST
TORONTO, ON, M5V 3C6
CANADA**

PROJECT CONSULTANT: GEOFF MAINPRIZE, AHC/CDC

gmainprize@trillium.group

HARDWARE DETAILER: CODY HAYES

chayes@trillium.group

Start Date: 09-Feb-2023

Revised:

Finish Code	BMHA Code	Description
C10	612	Satin Bronze, Clear Coated
C10B*	613*	Dark Oxidized Satin Bronze, Oil Rubbed*
C14	618	Bright Nickel Plated, Clear Coated
C15	619	Satin Nickel Plated, Clear Coated
C19	622	Flat Black Coated
C20	623	Light Oxidized Statuary Bronze, Clear Coated
C20	690	Dark Bronze Painted
C20A	624	Dark Oxidized Statuary Bronze, Clear Coated
C26	625	Bright Chromium Plated
C26D	626	Satin Chromium Plated
C27	627	Satin Aluminum, Clear Coated
C28 or AL	628	Satin Aluminium, Clear Anodized
C28 or AL	689	Aluminum Painted
C2G	603	Zinc Plated
C3	605	Bright Brass, Clear Coated
C32	629	Bright Stainless Steel
C32D	630	Satin Stainless Steel
C4	606	Satin Brass, Clear Coated
C5	609	Satin Brass, Blackened, Satin Relieved, Clear Coated
C9	611	Bright Bronze, Clear Coated
CP	600	Primed For Painting
EAD	EAD	Brass Painted
EB	EB	Dark Bronze Painted
ED	ED	Black Painted
EN	EN	Aluminum Painted
K29	K29	Black Anodized Aluminum
K40	K40	Dark Bronze Aluminum

*This finish will vary in colour from item to item and will wear according to use.

Note: The base material (brass, bronze, steel, aluminium) determines which finishes are available (eg, aluminium finishes are only available on products made of aluminium)

1 SGL DOOR D001-1

FROM CORRIDOR 001 TO
CORRIDOR C101S

RHR

1000mm x 2185mm x 45mm

FRAME TYPE: F1

DOOR TYPE: B

HOLLOW METAL DOOR / HOLLOW METAL FRAME

TRR 3/4 HR Fire Label

1 EACH ELECTRONIC POWER TRANSFER-ELECTROLYNX	EL-CEPT C32D
3 EACH HINGES	TA786 5 X 4.5 NRP C15
1 EACH WIRING HARNESS	QC-C306 44IN HARNESS 8PIN/4PIN DBL CONNECTOR
1 EACH WIRING HARNESS	QC-C1500P 15FT HARNESS X 8PIN/4PIN SGL CONNECTOR
1 EACH CARD READER BY OTHERS	BY SECURITY VENDOR
1 EACH MORTISE LATCH RETRACTION EXIT DEVICE	12-55-56-8906J C32D ETB RHR L/C
1 EACH MORTISE CYLINDER	BASE BUILDING KEYWAY
1 EACH KEYING	GMK TO BUILDING SYSTEM
2 EACH WALL MOUNTED PUSH BUTTON	CM-60/4
1 EACH LOW VOLTAGE WIRING FOR ADO COMPONENTS	PULL STRINGS BY OTHERS
1 EACH AUTOMATIC OPERATOR INSTALLATION	POWER, BLOCKING, DEVICE BOXES AND PULL STRINGS BY OTHERS
1 EACH AUTOMATIC OPERATOR	SW200-51-CL-OS w/SILVER ARM
1 EACH RECTIFIER	CX-5024
1 EACH 24VAC FUSED TRANSFORMER 40VA	CX-TRX-4024
1 EACH KICKPLATE	GSH80A 8in x 1.5in LDW x TAPE x 630
1 EACH CONCEALED OVERHEAD STOP	1-436 630
1 ROLL GASKETING	S44BL21
1 EACH DOOR CONTACT SWITCH BY OTHERS	DOOR CONTACT SWITCH BY OTHERS
1 EACH POWER SUPPLY	BPS-24-1 1 AMP
1 EACH SWITCHING RELAY	CX12 SWITCHING RELAY

1 SGL DOOR D001-2	ENTRANCE	RHR
1000mm x 2135mm x 45mm		
FRAME TYPE: F1		
DOOR TYPE: B		
HOLLOW METAL DOOR / HOLLOW METAL FRAME		
TRR 3/4 HR Fire Label		
1 EACH ELECTRONIC POWER TRANSFER-ELECTROLYNX		EL-CEPT C32D
3 EACH HINGES		TA786 5 X 4.5 NRP C15
1 EACH WIRING HARNESS		QC-C306 44IN HARNESS 8PIN/4PIN DBL CONNECTOR
1 EACH WIRING HARNESS		QC-C1500P 15FT HARNESS X 8PIN/4PIN SGL CONNECTOR
1 EACH CARD READER BY OTHERS		BY SECURITY VENDOR
1 EACH MORTISE LATCH RETRACTION EXIT DEVICE		12-55-56-8906J C32D ETB RHR L/C
1 EACH MORTISE CYLINDER		BASE BUILDING KEYWAY
1 EACH KEYING		GMK TO BUILDING SYSTEM
2 EACH WALL MOUNTED PUSH BUTTON		CM-60/4
1 EACH LOW VOLTAGE WIRING FOR ADO COMPONENTS		PULL STRINGS BY OTHERS
1 EACH AUTOMATIC OPERATOR INSTALLATION		POWER, BLOCKING, DEVICE BOXES AND PULL STRINGS BY OTHERS
1 EACH AUTOMATIC OPERATOR		SW200-51-CL-OS w/SILVER ARM
1 EACH RECTIFIER		CX-5024
1 EACH 24VAC FUSED TRANSFORMER 40VA		CX-TRX-4024
1 EACH KICKPLATE		GSH80A 8in x 1.5in LDW x TAPE x 630
1 EACH CONCEALED OVERHEAD STOP		1-436 630
1 ROLL GASKETING		S44BL21
1 EACH DOOR CONTACT SWITCH BY OTHERS		DOOR CONTACT SWITCH BY OTHERS
1 EACH POWER SUPPLY		BPS-24-1 1 AMP
1 EACH SWITCHING RELAY		CX12 SWITCHING RELAY

1 SGL DOOR D010	ELEVATOR LOBBY	RHR
1000mm x 2135mm x 45mm		
FRAME TYPE: F1		
DOOR TYPE: B		
HOLLOW METAL DOOR / HOLLOW METAL FRAME		
TRR 3/4 HR Fire Label		
1 EACH ELECTRONIC POWER TRANSFER-ELECTROLYNX		EL-CEPT C32D
3 EACH HINGES		TA786 5 X 4.5 NRP C15
1 EACH WIRING HARNESS		QC-C306 44IN HARNESS 8PIN/4PIN DBL CONNECTOR
1 EACH WIRING HARNESS		QC-C1500P 15FT HARNESS X 8PIN/4PIN SGL CONNECTOR
1 EACH CARD READER BY OTHERS		BY SECURITY VENDOR
1 EACH MORTISE LATCH RETRACTION EXIT DEVICE		12-55-56-8906J C32D ETB RHR L/C
1 EACH MORTISE CYLINDER		BASE BUILDING KEYWAY
1 EACH KEYING		GMK TO BUILDING SYSTEM
2 EACH WALL MOUNTED PUSH BUTTON		CM-60/4
1 EACH LOW VOLTAGE WIRING FOR ADO COMPONENTS		PULL STRINGS BY OTHERS
1 EACH AUTOMATIC OPERATOR INSTALLATION		POWER, BLOCKING, DEVICE BOXES AND PULL STRINGS BY OTHERS
1 EACH AUTOMATIC OPERATOR		SW200-51-CL-OS w/SILVER ARM
1 EACH RECTIFIER		CX-5024
1 EACH 24VAC FUSED TRANSFORMER 40VA		CX-TRX-4024
1 EACH KICKPLATE		GSH80A 8in x 1.5in LDW x TAPE x 630
1 EACH CONCEALED OVERHEAD STOP		1-436 630
1 ROLL GASKETING		S44BL21
1 EACH DOOR CONTACT SWITCH BY OTHERS		DOOR CONTACT SWITCH BY OTHERS
1 EACH POWER SUPPLY		BPS-24-1 1 AMP
1 EACH SWITCHING RELAY		CX12 SWITCHING RELAY

1 SGL DOOR D011

VESTIBULE 011

RHR

1000mm x 2177mm x 45mm

FRAME TYPE: -

DOOR TYPE: J

PC350 ALUMINUM / PC350 ALUMINIUM

NOTE:

ALL REQUIREMENTS BY PC350 EXCEPT ADD THE FOLLOWING:

- | | |
|--|--|
| 3 EACH HINGES BY OTHERS | BY FRAME SUPPLIER |
| 1 EACH DOOR PULLS BY OTHERS | DOOR PULLS BY OTHERS |
| 2 EACH WALL MOUNTED PUSH BUTTON | CM-60/4 |
| 1 EACH LOW VOLTAGE WIRING FOR ADO COMPONENTS | PULL STRINGS BY OTHERS |
| 1 EACH AUTOMATIC OPERATOR INSTALLATION | POWER, BLOCKING, DEVICE BOXES AND PULL STRINGS BY OTHERS |
| 1 EACH AUTOMATIC OPERATOR | SW200-51-CL-IS w/SILVER ARM |
| 1 LOT GASKET BY OTHERS | BY FRAME SUPPLIER |
-

1 SGL DOOR D101S	ENTRANCE	LH
1000mm x 2440mm x 45mm		
FRAME TYPE: F3		
DOOR TYPE: A		
ALUMINUM DOOR / ALUMINUM FRAME		
4 EACH HINGES		TA786 5 X 4.5 C15
1 EACH CARD READER BY OTHERS		BY SECURITY VENDOR
1 EACH MORTISE STOREROOM LOCKSET		8204 LNL C32D
1 EACH ELECTRIC STRIKE		HES 4500C 630
1 EACH LIP EXTENSION		4501-1/2 BLK
1 EACH INSTALL ELECTRIC STRIKE		FRAME CUTOUT NOT INCLUDED
1 EACH LOW VOLTAGE WIRING FOR ADO COMPONENTS		PULL STRINGS BY OTHERS
1 EACH AUTOMATIC OPERATOR INSTALLATION		POWER, BLOCKING, DEVICE BOXES AND PULL STRINGS BY OTHERS
1 EACH AUTOMATIC OPERATOR DRIVESHAFT EXTENSION		BESAM SW200 3/4 INCH DRIVESHAFT EXTENSION
1 EACH AUTOMATIC OPERATOR		SW200-51-CL-IS SURFACE APPLIED BOTTOM LOAD w/SILVER ARM
1 EACH RECTIFIER		CX-5024
1 EACH 24VAC FUSED TRANSFORMER 40VA		CX-TRX-4024
1 EACH FLOOR STOP		GSH209 C32D
1 LOT GASKET BY OTHERS		BY FRAME SUPPLIER
1 EACH DOOR CONTACT SWITCH BY OTHERS		DOOR CONTACT SWITCH BY OTHERS
1 EACH SWITCHING RELAY		CX12 SWITCHING RELAY
2 EACH WAVE SENSOR - DOUBLE GANG - STAINLESS		CM-325/42/S/W

1 SGL DOOR DC102	OFFICE C102	RH
1000mm x 2185mm x 45mm		
FRAME TYPE: F3		
DOOR TYPE: A		
WOOD DOOR / PC350 ALUMINIUM		
NOTE:		
ALL REQUIREMENTS BY PC350 EXCEPT ADD THE FOLLOWING:		
3 EACH HINGES BY OTHERS		BY FRAME SUPPLIER
1 EACH MORTISE OFFICE LOCKSET		8205 LNL L/C C32D
1 EACH MORTISE CYLINDER		BASE BUILDING KEYWAY
1 EACH KEYING		GMK TO BUILDING SYSTEM
1 EACH FLOOR STOP		GSH209 C32D
1 LOT GASKET BY OTHERS		BY FRAME SUPPLIER

1 SGL DOOR DC104

MEETING ROOM C104

RH

1000mm x 2185mm x 45mm

FRAME TYPE: F3

DOOR TYPE: A

WOOD DOOR / PC350 ALUMINIUM

3 EACH HINGES BY OTHERS

BY FRAME SUPPLIER

1 EACH MORTISE OFFICE LOCKSET

8205 LNL L/C C32D

1 EACH MORTISE CYLINDER

BASE BUILDING KEYWAY

1 EACH KEYING

GMK TO BUILDING SYSTEM

1 EACH FLOOR STOP

GSH209 C32D

1 LOT GASKET BY OTHERS

BY FRAME SUPPLIER

1 SGL DOOR DC105

PRESCHOOL ACTIVITY 1

RH

1000mm x 2185mm x 45mm

FRAME TYPE: F3

DOOR TYPE: F

WOOD DOOR / HOLLOW METAL FRAME

NOTE:

ALL REQUIREMENTS BY PC350 EXCEPT ADD THE FOLLOWING:

3 EACH HINGES

TA786 5 X 4.5 C15

1 EACH MORTISE CLASSROOM LOCKSET

8237 LNL C32D

1 EACH MORTISE CYLINDER

BASE BUILDING KEYWAY

1 EACH KEYING

GMK TO BUILDING SYSTEM

1 EACH CONCEALED OVERHEAD STOP

1-436 630

1 ROLL GASKETING

S44BL21

1 EACH FINGER GUARD

NGP 2248A 82"

1 SGL DOOR DC105A PRESCHOOL 1 STORAGE C105A RH

915mm x 2185mm x 45mm

FRAME TYPE: F1

DOOR TYPE: A

WOOD DOOR / HOLLOW METAL FRAME

3 EACH CONCEALED BEARING HINGE	TA714 4.5 X 4 C15
1 EACH MORTISE STOREROOM LOCKSET	8204 LNL C32D
1 EACH MORTISE CYLINDER	BASE BUILDING KEYWAY
1 EACH KEYING	GMK TO BUILDING SYSTEM
1 EACH KICKPLATE	GSH80A 8in X 34.5in TAPE C32D
1 EACH CONCEALED OVERHEAD STOP	1-336 630
1 ROLL GASKETING	S44BL21
1 EACH FINGER GUARD	NGP 2248A 82"

1 SGL DOOR DC106-1 PRESCHOOL WASHROOM C106 LH

965mm x 1200mm x 45mm

FRAME TYPE: -

DOOR TYPE: A

WOOD DOOR / HOLLOW METAL FRAME

2 EACH CONCEALED BEARING HINGE	TA714 4.5 X 4 C15
1 EACH FLOOR STOP	GSH209 C32D
1 ROLL GASKETING	S44BL21
1 EACH FINGER GUARD	NGP 2248A 82"
1 EACH GATE LATCH	H601 C15

1 SGL DOOR DC106-2 PRESCHOOL WASHROOM C106 RH

965mm x 1200mm x 45mm

FRAME TYPE: -

DOOR TYPE: A

WOOD DOOR / HOLLOW METAL FRAME

2 EACH CONCEALED BEARING HINGE	TA714 4.5 X 4 C15
1 EACH FLOOR STOP	GSH209 C32D
1 ROLL GASKETING	S44BL21
1 EACH FINGER GUARD	NGP 2248A 82"
1 EACH GATE LATCH	H601 C15

1 SGL DOOR DC107 PRESCHOOL ACTIVITY 2 C107 LH

1000mm x 2185mm x 45mm

FRAME TYPE: F3

DOOR TYPE: F

WOOD DOOR / HOLLOW METAL FRAME

- | | |
|----------------------------------|------------------------|
| 3 EACH HINGES | TA786 5 X 4.5 C15 |
| 1 EACH MORTISE CLASSROOM LOCKSET | 8237 LNL C32D |
| 1 EACH MORTISE CYLINDER | BASE BUILDING KEYWAY |
| 1 EACH KEYING | GMK TO BUILDING SYSTEM |
| 1 EACH CONCEALED OVERHEAD STOP | 1-436 630 |
| 1 ROLL GASKETING | S44BL21 |
| 1 EACH FINGER GUARD | NGP 2248A 82" |
-

1 SGL DOOR DC107A PRESCHOOL 2 STORAGE C107A LH

915mm x 2185mm x 45mm

FRAME TYPE: F1

DOOR TYPE: A

WOOD DOOR / HOLLOW METAL FRAME

- | | |
|----------------------------------|-------------------------------|
| 3 EACH CONCEALED BEARING HINGE | TA714 4.5 X 4 C15 |
| 1 EACH MORTISE STOREROOM LOCKSET | 8204 LNL C32D |
| 1 EACH MORTISE CYLINDER | BASE BUILDING KEYWAY |
| 1 EACH KEYING | GMK TO BUILDING SYSTEM |
| 1 EACH KICKPLATE | GSH80A 8in X 34.5in TAPE C32D |
| 1 EACH FLOOR STOP | GSH209 C32D |
| 1 ROLL GASKETING | S44BL21 |
| 1 EACH FINGER GUARD | NGP 2248A 82" |
-

1 SGL DOOR DC108 INFANT VESTIBULE C108A LH

1000mm x 2185mm x 45mm

FRAME TYPE: F1

DOOR TYPE: F

WOOD DOOR / HOLLOW METAL FRAME

3 EACH CONCEALED BEARING HINGE	TA714 4.5 X 4 C15
1 EACH MORTISE CLASSROOM LOCKSET	8237 LNL C32D
1 EACH MORTISE CYLINDER	BASE BUILDING KEYWAY
1 EACH KEYING	GMK TO BUILDING SYSTEM
1 EACH CONCEALED OVERHEAD STOP	1-436 630
1 ROLL GASKETING	S44BL21
1 EACH FINGER GUARD	NGP 2248A 82"

1 SGL DOOR DC108A INFANT VESTIBULE C108A LH

1000mm x 2185mm x 45mm

FRAME TYPE: F3

DOOR TYPE: F

WOOD DOOR / HOLLOW METAL FRAME

3 EACH CONCEALED BEARING HINGE	TA714 4.5 X 4 C15
1 EACH MORTISE CLASSROOM LOCKSET	8237 LNL C32D
1 EACH MORTISE CYLINDER	BASE BUILDING KEYWAY
1 EACH KEYING	GMK TO BUILDING SYSTEM
1 EACH CONCEALED OVERHEAD STOP	1-436 630
1 ROLL GASKETING	S44BL21
1 EACH FINGER GUARD	NGP 2248A 82"

1 SGL DOOR DC108A-E INFANT VESTIBULE C108A RHR

1000mmpulls by ` x 2032mm x 45mm

FRAME TYPE: -

DOOR TYPE: J

ALUMINUM DOOR / ALUMINUM FRAME

NOTE:

ALL REQUIREMENTS BY ALUMINUM SUPPLIER EXCEPT ADD THE FOLLOWING:

1 EACH ELECTRONIC POWER TRANSFER-ELECTROLYNX	EL-CEPT C32D
3 EACH HINGES BY OTHERS	BY FRAME SUPPLIER
3 EACH HINGES	TA386 5 X 4.5 C32D NRP
1 EACH WIRING HARNESS	QC-C1500P 15FT HARNESS X 8PIN/4PIN SGL CONNECTOR
1 EACH CARD READER BY OTHERS	BY SECURITY VENDOR
1 EACH NARROW STILE RIM ELEC LATCH RETRACTION EXIT DEVICE	55-56-AD8506J C32D LESS TRIM RHR
1 EACH MORTISE CYLINDER	BASE BUILDING KEYWAY
1 EACH KEYING	GMK TO BUILDING SYSTEM
1 EACH DOOR PULLS BY OTHERS BY DOOR SUPPLIER	DOOR PULLS BY OTHERS
2 EACH WALL MOUNTED PUSH BUTTON	CM-60/4
1 EACH LOW VOLTAGE WIRING FOR ADO COMPONENTS	PULL STRINGS BY OTHERS
1 EACH AUTOMATIC OPERATOR INSTALLATION	POWER, BLOCKING, DEVICE BOXES AND PULL STRINGS BY OTHERS
1 EACH AUTOMATIC OPERATOR	SW200-51-CL-OS w/SILVER ARM
1 EACH RECTIFIER	CX-5024
1 EACH 24VAC FUSED TRANSFORMER 40VA	CX-TRX-4024
1 EACH CONCEALED OVERHEAD STOP	1-436 630
1 LOT GASKET BY OTHERS	BY FRAME SUPPLIER
1 EACH THRESHOLD	CT87 X 42" AL
1 EACH DOOR CONTACT SWITCH BY OTHERS	DOOR CONTACT SWITCH BY OTHERS
1 EACH POWER SUPPLY	BPS-24-1 1 AMP
1 EACH SWITCHING RELAY	CX12 SWITCHING RELAY

1 SGL DOOR DC108B INFANT SLEEP ROOM C108B LH

915mm x 2185mm x 45mm

FRAME TYPE: F1

DOOR TYPE: F

WOOD DOOR / HOLLOW METAL FRAME

3 EACH CONCEALED BEARING HINGE	TA714 4.5 X 4 C15
1 EACH MORTISE PASSAGE SET	8215 LNL C32D
1 EACH FLOOR STOP	GSH209 C32D
1 ROLL GASKETING	S44BL21
1 EACH FINGER GUARD	NGP 2248A 82"

1 SGL DOOR DC108C INFANT WASHROOM RH

915mm x 1200mm x 45mm

DOOR TYPE: A

WOOD DOOR / HOLLOW METAL FRAME

2 EACH CONCEALED BEARING HINGE	TA714 4.5 X 4 C15
1 EACH KICKPLATE	GSH80A 8in X 34.5in TAPE C32D
1 EACH FLOOR STOP	GSH209 C32D
1 ROLL GASKETING	S44BL21
1 EACH FINGER GUARD	NGP 2248A 82"
1 EACH GATE LATCH	H601 C15

1 SGL DOOR DC109 TODDLER ACTIVITY 1 C109 LH

1000mm x 2185mm x 45mm

FRAME TYPE: F3

DOOR TYPE: F

WOOD DOOR / PC350 ALUMINIUM

NOTE:

ALL REQUIREMENTS BY PC350 EXCEPT ADD THE FOLLOWING:

3 EACH HINGES BY OTHERS	BY FRAME SUPPLIER
1 EACH MORTISE CLASSROOM LOCKSET	8237 LNL C32D
1 EACH MORTISE CYLINDER	BASE BUILDING KEYWAY
1 EACH KEYING	GMK TO BUILDING SYSTEM
1 EACH CONCEALED OVERHEAD STOP	1-436 630
1 LOT GASKET BY OTHERS	BY FRAME SUPPLIER
1 EACH FINGER GUARD	NGP 2248A 82"

1 SGL DOOR DC109A	TODDLER 1 STORAGE C109A	LHR
915mm x 2185mm x 45mm		
FRAME TYPE: F1		
DOOR TYPE: A		
WOOD DOOR / HOLLOW METAL FRAME		
3 EACH CONCEALED BEARING HINGE	TA714 4.5 X 4 C15	
1 EACH MORTISE STOREROOM LOCKSET	8204 LNL C32D	
1 EACH MORTISE CYLINDER	BASE BUILDING KEYWAY	
1 EACH KEYING	GMK TO BUILDING SYSTEM	
1 EACH SURFACE OVERHEAD STOP	55-336 652	
1 ROLL GASKETING	S44BL21	
1 EACH FINGER GUARD	NGP 2248A 82"	

1 SGL DOOR DC110-1	TODDLER WASHROOM	RH
915mm x 1200mm x 45mm		
FRAME TYPE: -		
DOOR TYPE: A		
WOOD DOOR / HOLLOW METAL FRAME		
2 EACH CONCEALED BEARING HINGE	TA714 4.5 X 4 C15	
1 EACH KICKPLATE	GSH80A 8in X 34.5in TAPE C32D	
1 EACH FLOOR STOP	GSH209 C32D	
1 ROLL GASKETING	S44BL21	
1 EACH FINGER GUARD	NGP 2248A 82"	
1 EACH GATE LATCH	H601 C15	

1 SGL DOOR DC110-2	TODDLER WASHROOM	LH
915mm x 1200mm x 45mm		
FRAME TYPE: -		
DOOR TYPE: A		
WOOD DOOR / HOLLOW METAL FRAME		
2 EACH CONCEALED BEARING HINGE	TA714 4.5 X 4 C15	
1 EACH KICKPLATE	GSH80A 8in X 34.5in TAPE C32D	
1 EACH FLOOR STOP	GSH209 C32D	
1 ROLL GASKETING	S44BL21	
1 EACH FINGER GUARD	NGP 2248A 82"	
1 EACH GATE LATCH	H601 C15	

1 SGL DOOR DC111 TODDLER ACTIVITY 2 C111 RH

1000mm x 2185mm x 45mm

FRAME TYPE: F3

DOOR TYPE: F

WOOD DOOR / HOLLOW METAL FRAME

- | | |
|----------------------------------|------------------------|
| 3 EACH CONCEALED BEARING HINGE | TA714 4.5 X 4 C15 |
| 1 EACH MORTISE CLASSROOM LOCKSET | 8237 LNL C32D |
| 1 EACH MORTISE CYLINDER | BASE BUILDING KEYWAY |
| 1 EACH KEYING | GMK TO BUILDING SYSTEM |
| 1 EACH CONCEALED OVERHEAD STOP | 1-436 630 |
| 1 ROLL GASKETING | S44BL21 |
| 1 EACH FINGER GUARD | NGP 2248A 82" |
-

1 SGL DOOR DC111A TODDLER STORAGE 2 C111A RHR

915mm x 2185mm x 45mm

FRAME TYPE: F1

DOOR TYPE: A

WOOD DOOR / HOLLOW METAL FRAME

- | | |
|----------------------------------|-------------------------------|
| 3 EACH CONCEALED BEARING HINGE | TA714 4.5 X 4 C15 |
| 1 EACH MORTISE STOREROOM LOCKSET | 8204 LNL C32D |
| 1 EACH MORTISE CYLINDER | BASE BUILDING KEYWAY |
| 1 EACH KEYING | GMK TO BUILDING SYSTEM |
| 1 EACH KICKPLATE | GSH80A 8in X 34.5in TAPE C32D |
| 1 EACH CONCEALED OVERHEAD STOP | 1-436 630 |
| 1 ROLL GASKETING | S44BL21 |
| 1 EACH FINGER GUARD | NGP 2248A 82" |
-

1 SGL DOOR DC112

JANITOR C112

LHR

915mm x 2185mm x 45mm

FRAME TYPE: F1

DOOR TYPE: A

HOLLOW METAL DOOR / HOLLOW METAL FRAME

3 EACH CONCEALED BEARING HINGE	TA714 4.5 X 4 C15
1 EACH MORTISE STOREROOM LOCKSET	8204 LNL C32D
1 EACH MORTISE CYLINDER	BASE BUILDING KEYWAY
1 EACH KEYING	GMK TO BUILDING SYSTEM
1 EACH KICKPLATE	GSH80A 8in X 34.5in TAPE C32D
1 EACH SURFACE OVERHEAD STOP	55-336 652
1 ROLL GASKETING	S44BL21

1 SGL DOOR DC113

LAUNDRY AND TOY WASH C113 RH

915mm x 2185mm x 45mm

FRAME TYPE: F3

DOOR TYPE: F

WOOD DOOR / HOLLOW METAL FRAME

3 EACH CONCEALED BEARING HINGE	TA714 4.5 X 4 C15
1 EACH MORTISE CLASSROOM LOCKSET	8237 LNL C32D
1 EACH MORTISE CYLINDER	BASE BUILDING KEYWAY
1 EACH KEYING	GMK TO BUILDING SYSTEM
1 EACH KICKPLATE	GSH80A 8in X 34.5in TAPE C32D
1 EACH FLOOR STOP	GSH209 C32D
1 ROLL GASKETING	S44BL21

1 SGL DOOR DC114

SERVERY C114

RH

1000mm x 2185mm x 45mm

FRAME TYPE: F3

DOOR TYPE: F

WOOD DOOR / HOLLOW METAL FRAME

3 EACH CONCEALED BEARING HINGE	TA714 4.5 X 4 C15
1 EACH MORTISE CLASSROOM LOCKSET	8237 LNL C32D
1 EACH MORTISE CYLINDER	BASE BUILDING KEYWAY
1 EACH KEYING	GMK TO BUILDING SYSTEM
1 EACH DOOR CLOSER	1431 UO EN - SURFACE MOUNTED
1 EACH KICKPLATE	GSH80A 8in x 1.5in LDW x TAPE x 630
1 EACH FLOOR STOP	GSH209 C32D
1 ROLL GASKETING	S44BL21

1 SGL DOOR DC114A

PANTRY C114A

RH

915mm x 2185mm x 45mm

FRAME TYPE: F1

DOOR TYPE: A

HOLLOW METAL DOOR / HOLLOW METAL FRAME

3 EACH CONCEALED BEARING HINGE	TA714 4.5 X 4 C15
1 EACH MORTISE PASSAGE SET	8215 LNL C32D
1 EACH FLOOR STOP	GSH209 C32D
1 ROLL GASKETING	S44BL21

1 SGL DOOR DC115 BARRIER FREE WASHROOM C115 RH

1000mm x 2185mm x 45mm

FRAME TYPE: F1

DOOR TYPE: A

HOLLOW METAL DOOR / HOLLOW METAL FRAME

3 EACH CONCEALED BEARING HINGE	TA714 4.5 X 4 C15
1 EACH MORTISE STOREROOM LOCKSET	8204 LNL C32D
1 EACH MORTISE CYLINDER	BASE BUILDING KEYWAY
1 EACH KEYING	GMK TO BUILDING SYSTEM
1 EACH ELECTRIC STRIKE	HES 4500C 630
1 EACH BARRIER FREE WASHROOM CONTROL KIT	KIT INCLUDES: CM-AF500, CM-400/8, CX-MDC, CX-33, 2 x CM-45/4, CX-MDC, CX-33, CX-WC11
1 EACH INSTALL ELECTRIC STRIKE	FRAME CUTOUT NOT INCLUDED
1 EACH LOW VOLTAGE WIRING FOR ADO COMPONENTS	PULL STRINGS BY OTHERS
1 EACH AUTOMATIC OPERATOR INSTALLATION	POWER, BLOCKING, DEVICE BOXES AND PULL STRINGS BY OTHERS
1 EACH AUTOMATIC OPERATOR	SW100-51-IS-CLEAR w/BLACK ARM
1 EACH RECTIFIER	CX-5024
1 EACH 24VAC FUSED TRANSFORMER 40VA	CX-TRX-4024
1 EACH FLOOR STOP	GSH209 C32D
1 ROLL GASKETING	S44BL21

1 SGL DOOR DC116 WC C116 RH

1000mm x 2185mm x 45mm

FRAME TYPE: F1

DOOR TYPE: A

HOLLOW METAL DOOR / HOLLOW METAL FRAME

3 EACH CONCEALED BEARING HINGE	TA714 4.5 X 4 C15
1 EACH MORTISE PRIVACY SET	8265 LNL C32D
1 EACH OCCUPANCY INDICATOR	185P C32D C/W EMERGENCY RELEASE
1 EACH KICKPLATE	GSH80A 8in x 1.5in LDW x TAPE x 630
1 EACH FLOOR STOP	GSH209 C32D
1 ROLL GASKETING	S44BL21

1 SGL DOOR DC117

STAFF ROOM C117

LH

1000mm x 2185mm x 45mm

FRAME TYPE: F3

DOOR TYPE: F

WOOD DOOR / HOLLOW METAL FRAME

- | | |
|----------------------------------|------------------------|
| 3 EACH CONCEALED BEARING HINGE | TA714 4.5 X 4 C15 |
| 1 EACH MORTISE CLASSROOM LOCKSET | 8237 LNL C32D |
| 1 EACH MORTISE CYLINDER | BASE BUILDING KEYWAY |
| 1 EACH KEYING | GMK TO BUILDING SYSTEM |
| 1 EACH FLOOR STOP | GSH209 C32D |
| 1 ROLL GASKETING | S44BL21 |
-

1 POCKET DOOR DC117-1

LAUNDRY AND TOY WASH C113

915mm x 2185mm x 45mm

WOOD DOOR / FRAMELESS

- | | |
|---------------------------------|-----------------------------|
| 1 SET CATCH&CLOSE TRACK-HANGERS | CC-2-993-W-CA X 72" 1DR KIT |
| 2 EACH FLUSH PULL | GSH960 C26D |
-

1 SGL DOOR DC118

ELEC C118

LH

915mm x 2185mm x 45mm

FRAME TYPE: F1

DOOR TYPE: A

HOLLOW METAL DOOR / HOLLOW METAL FRAME

TRR 3/4 HR Fire Label

- | | |
|--------------------------------------|-------------------------------|
| 3 EACH CONCEALED BEARING HINGE | TA714 4.5 X 4 C15 |
| 1 EACH CARD READER BY OTHERS | BY SECURITY VENDOR |
| 1 EACH MORTISE STOREROOM LOCKSET | 8204 LNL C32D |
| 1 EACH MORTISE CYLINDER | BASE BUILDING KEYWAY |
| 1 EACH KEYING | GMK TO BUILDING SYSTEM |
| 1 EACH ELECTRIC STRIKE | HES 4500C 630 |
| 1 EACH DOOR CLOSER | 1431 UO EN - SURFACE MOUNTED |
| 1 EACH KICKPLATE | GSH80A 8in X 34.5in TAPE C32D |
| 1 EACH FLOOR STOP | GSH209 C32D |
| 1 ROLL GASKETING | S44BL21 |
| 1 EACH DOOR CONTACT SWITCH BY OTHERS | DOOR CONTACT SWITCH BY OTHERS |
-

Automatic Door Operators

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Automatic door operators.

1.2 Administrative Requirements

- .1 Coordination:
 - .1 Check dimensions at the Place of the Work before fabrication commences, and report to Contract Administrator in writing all discrepancies.
 - .2 Where dimensions are not available before fabrication commences, the dimension required shall be agreed upon between the various sections concerned.
- .2 Conduct a pre-installation meeting in accordance with Section 01 31 19.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Shop drawings to be prepared specifically for this Contract and to indicate location of components, anchorage details, adjacent construction interface, and dimensions as well as all necessary wiring and electrical requirements.
- .4 Samples:
 - .1 Submit samples of each finish material proposed for use in the Work.
- .5 Certificates:
 - .1 Submit certificate of conformance to specified standards following procedures for submittal of Product data.
- .6 Templates:
 - .1 Submit templates to Contractor for use by installers and fabricators as required for proper location and installation of hardware.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Demonstrate, and provide instruction in, the proper operation and maintenance of the Products Provided as part of the work of this section to the Owner.

Automatic Door Operators

- .2 Submit operation data and maintenance data for cleaning and maintenance of hardware for incorporation into the operation and maintenance manual.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Installers / applicators / erectors:
 - .1 Subcontractor:
 - .1 Has adequate plant, equipment, and skilled workers to perform the work expeditiously.
 - .2 Has successfully completed installations similar to that specified during a period of at least the immediate past 5 years.
 - .3 Has 10 years' satisfactory experience.
 - .2 Installer shall be approved in writing by the manufacturer of the operators for installation of their Product.
 - .2 Barrier free door operators shall be certified by the manufacturer to performance design criteria in accordance with CAN/CSA C22.2 No. 247-92(R2014), and ANSI/BHMA A156.19-2013.

1.6 Delivery, Storage, and Handling

- .1 Store finishing hardware in locked, clean dry area.
- .2 Package each item of hardware, including fastenings, separately or in like groups of hardware, and label each package as to item definition and location.
- .3 Submit hardware with an easily removable covering to protect against scratches, abrasions, coating with dissimilar finish materials on adjacent surfaces, and tarnishing.

1.7 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

- .1 Assa Aboy.
- .2 Horton.
- .3 Substitutions: in accordance with Section 01 25 00.

Automatic Door Operators

2.2 Performance/Design Requirements

- .1 Use ULC or ULI listed and labelled hardware in fire separations and exit doors.
- .2 Be responsible for, and abide by, all requirements and regulations of the building code. Conduct tests and inspections required, and pay all charges incidental thereto.

2.3 Automatic Door Operators - General

- .1 Operation:
 - .1 Activation type: Push-button.
 - .2 Door to safely stop and reverse if an object is encountered in the opening or closing cycle.
 - .3 Operating forces:
 - .1 Push plate: 22.2 N.
 - .2 Door, manual opening force: 62 N.
 - .3 Door, Closing force: 26.6 N.
 - .4 Factory-set door hold open voltage.
 - .5 Fail safe: In the event of power failure, door shall operate manually, without damage to operator components.
- .2 Activators; wall-mounted:
 - .1 Push-button:
 - .1 Wall-mounted push-button switch, 2 required per opening.
- .3 Electrical supply: 120 Volt.

2.4 Finishes

- .1 Exposed aluminum components; anodized:
 - .1 Clear anodized, to AAMA 611-20, designation AA-M10C22A41.

2.5 Fabrication

- .1 Fit intersecting members to flush hairline weathertight joints and mechanically fasten together, except where indicated otherwise.
- .2 Conceal fastenings from view, except where indicated otherwise.
- .3 Form cut-outs, recesses, mortising or milling for finishing hardware to templates supplied. Reinforce with aluminum or galvanized steel plates.
- .4 Field apply isolation coating to aluminum in contact with dissimilar metals or cementitious materials.

Automatic Door Operators

PART 3 - EXECUTION

3.1 Examination

- .1 Verify that door openings are properly installed and ready to receive the work of this section.
- .2 Verify that electrical service is available, properly located, and of proper type.
- .3 Check dimensions at the Place of the Work before fabrication commences, and report to Contract Administrator in writing all discrepancies.
- .4 Where dimensions are not available before fabrication commences, the dimension required shall be agreed upon between the various sections concerned.

3.2 Preparation

- .1 Before furnishing any hardware, carefully check Agreement, Drawings, Schedules, and Specifications, verify door swings, door and frame materials and operating conditions, and assure that hardware will fit work to be attached.
- .2 Check shop drawings and frame and door lists affecting hardware type and installation, and verify to correctness thereof, or advise of required revisions. Check that doors, frames and panels requiring additional support are reinforced.
- .3 Point out special requirements to installer. Make final adjustment of hardware, in particular closer arms, valves and locksets, to work properly.

3.3 Installation

- .1 Install in accordance with manufacturer's requirements and in accordance with CAN/CSA C22.2 No. 247-92(R2014).
- .2 Provide operator system complete in all its parts and connected to electrical service Provided as part of the work of Divisions 26, 27, and 28. Secure all wiring such that it is concealed from view.

3.4 Adjusting and Cleaning

- .1 Verify that installed hardware and operators function properly, and instruct installers accordingly of requirements and procedures for adjustments for operation without binding or scraping, and without excessive noise.
- .2 Clean hardware after installation in accordance with Supplier's requirements.

END OF SECTION

Glass and Glazing

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Glass and glazing.

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting in accordance with Section 01 31 19.
 - .1 Independent inspection and testing company shall attend the pre-installation meeting.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Show details of each type of glazing system in conjunction with the framing system indicating type of glass, sizes, shapes, glazing material and quantity. Show details indicating glazing material, glazing thickness, bite on the glass and glass edge clearance.
 - .2 Indicate analysis of glass including maximum deflection and allowable stresses from imposed dead/live loads and thermal loads.
- .4 Samples:
 - .1 Submit 305 mm (12") square samples of each type of glass indicated except for clear monolithic glass products, and 305 mm (12") long samples of each color required, except black, for each type of sealant or gasket exposed to view.
 - .1 Submit 3 control samples for each glass type showing maximum range of visible difference between units for the Project.
 - .2 Submit samples of glass showing each type of shape and finish of glass edge for exposed glass edges.
- .5 Test and evaluation reports:
 - .1 Obtain compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealant as well as other glazing materials including insulating units.
- .6 Manufacturer reports:
 - .1 Submit glass fabricator's product information and structural calculations indicating compliance with glazing standards established by the Glass Association of North America (GANA). Submittal to include thermal stress and structural load analysis of the proposed glass types, configuration and sizes.

Glass and Glazing

- .7 Submit sample glazing warranty.
- .8 Submit letter from insulating glass unit fabricator that insulating glass units supplied will bear the certification mark of IGMAC or IGCC/IGMA.CAN/CGSB 12.8-97

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit maintenance and cleaning instructions for glass and glazing for incorporation into the operating and maintenance manuals.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Manufacturers: Fabrication processes, including low emissivity and reflective coatings, insulating, laminated, and tempering shall be manufactured by a single manufacturer with a minimum of ten (10) years of fabrication experience and meet ANSI / ASQC 9002 1994.
 - .2 Installers / applicators / erectors:
 - .1 Subcontractor:
 - .1 Shall be thoroughly trained and experienced in skills required.
 - .2 Shall be completely familiar with referenced standards and requirements of the work of this section.
 - .3 Shall personally direct installation performed under this section.
 - .2 Foreperson experience: Shall have 10 years' experience, minimum, as glazing mechanic.
 - .3 Glazing mechanic experience: Shall have 3 years' experience, minimum, as glazers.
 - .4 Mirror installations: Installation only by applicator trained and approved by adhesive manufacturer for application of its products.
 - .2 Mock-ups:
 - .1 Provide mock-up of mirror installation, including minimum of 4 full size mirrors. Locate mirror mock-up where approved by Contract Administrator.

1.6 Delivery, Storage, and Handling

- .1 Protect glass from edge damage, dust, and contaminants during handling and storage. For insulating units exposed to substantial altitude changes, comply with insulating glass manufacturers written recommendations for venting and sealing to avoid hermetic seal ruptures.
- .2 Storage and protection: Protect glazing materials according to manufacturer's written requirements and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun or other causes.

Glass and Glazing

1.7 Field Conditions

- .1 Ambient Conditions: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by the glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation or other causes.
- .2 Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 4.4°C.

1.8 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - .1 General extended warranty:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.
 - .2 Special product warranty for tempered glass products:
 - .1 Warrant that tempered glass will not break spontaneously as a result of Nickel Sulfide (NiS) inclusions at a rate exceeding 0.8% (8/1000) for a period of five years from the date of manufacture. Warranty shall be manufacturer's standard form in which tempered-glass manufacturer agrees to replace tempered-glass units.
 - .2 Duration: 5 years from date of manufacture for fully tempered glass.
 - .3 Special product warranty for insulating glass unit products:
 - .1 Provide a written warranty from date of manufacture for sealed insulating glass units. Warranty shall cover the following:
 - .1 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 obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - .2 Duration: 10 years.
 - .4 Special product warranty for mirror glass products:
 - .1 Provide a written warranty from date of manufacture for mirror silvering. Warranty shall cover the following:
 - .1 Deterioration due to normal conditions of use and not to handling, installing, protecting and maintaining practices contrary to the glass manufacturer's published instructions.
 - .2 Replacement of mirror glass units.
 - .3 Duration: 10 years.

Glass and Glazing

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

.1 General:

.1 Publications: Comply with recommendations in the publications below, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this section.

.1 GANA Glazing Manual.

.2 GANA Engineering Standards Manual.

.3 GANA Laminated Glazing Reference Manual.

.4 GANA Sealant Manual.

.2 Regulatory requirements:

.1 Fire rated glass:

.1 Each lite shall bear permanent, non-removable label by accredited and recognized independent testing agency certifying it for use in tested and rated fire protective assemblies.

.3 Glass strength:

.1 Design glass in conformance with the building code and the following requirements:

.1 Minimum thickness of annealed or heat-treated glass products to be selected so the worst case probability of failure does not exceed the following:

.1 8 breaks per 1000 for glass installed vertically less than 15 degrees from the vertical plane and under wind action.

.2 Maximum lateral deflection; insulating glass units:

.1 For insulating glass units supported on four edges, limit centre-of-glass deflection at design wind pressure to not more than 1/175 times the long-side length or 19 mm (3/4") maximum.

.2 Glass at guards, balustrades, and where glass is likely to be subjected to human impact shall comply with safety glass requirements of CAN/CGSB 12.20-M89 and CAN/CGSB 12.1-M90, DIN EN 14179-1:2005, where applicable, and building code.

.3 Provide annealed, heat strengthened, and tempered lights where required by the building code, and where required for the various solar exposures on the building.

.4 Glass thicknesses and glass types specified, indicated, or scheduled in the Agreement, Drawings, Schedules, and Specifications are minimums required. Modify glass thickness as required to satisfy design and building code requirements, and requirements of authorities having jurisdiction, and any such modifications shall be clearly indicated on shop drawings.

.4 Thermal and optical performance: Provide glass products with performance properties specified or published by glass manufacturer where not specified. Performance properties to be manufacturer's published data as determined according to the following procedures:

Glass and Glazing

- .1 Centre of glass U-Value: National Fenestration Rating Council (NFRC) 100 methodology using Flixo Pro (version 8.0 or later) or LBNL WINDOW 7 computer program.
- .2 Centre of glass solar heat gain coefficient: NFRC 200 methodology using LBNL-35298 WINDOW 5.2 computer program.
- .3 Visible light transmittance: NFRC 200 methodology.
- .4 Solar optical properties: NFRC 300 or LBNL Optics.
- .5 Provide glass Products of uniform appearance, reflectivity, hue, shade, visible light transmittance, and colour when viewed from distance of 3 m (10 ft) to 30 m (100 ft) perpendicular to the glass or from 45 degree angle to the glass.
- .6 Protect laminated glass interlayer from damage or discolouration resulting from contact with deleterious and incompatible sealants, substances, and materials. Comply with manufacturer's recommended installation requirements.

2.2 Performance/Design Requirements - Acoustic

- .1 Design glass and glazing units in conjunction with aluminum framed glazing systems and related assemblies to provide the indicated sound transmission class (STC) as indicated on the drawings when tested to ASTM E90-09.

2.3 Glass Manufacturers

- .1 Subject to compliance with the requirements of the Agreement, Drawings, Schedules, and Specifications, provide primary glass by one of the following float glass manufacturers:
 - .1 Cardinal Glass Industries.
 - .2 Guardian Industries, LLC.
 - .3 Pilkington North America.
 - .4 Vitro Architectural Glass.

2.4 Glass Materials

- .1 General:
 - .1 Single source responsibility: Provide materials from a single manufacturer or fabricator for each kind and condition of glass indicated and composed of primary glass obtained from a single source and manufacturing plant for each type and class required.
- .2 Insulating glass units:
 - .1 Warm edge, hermetically sealed, in accordance with CAN/CGSB 12.8-97 or ASTM E2190-10, minimum 12 mm (1/2") cavity, 90% argon/10% air filled, double sealed edges (primary to be polyisobutylene, secondary to be polysulphide, desiccant filled warm edge spacer (splice connectors at corner of each glass unit).
 - .1 Vinyl faced, electrolytic tin plated steel: Fenzi 'Warmedge'.
 - .1 Spacer bar colour: Black.
 - .2 Grey coloured polyisobutylene shall not be acceptable.

Glass and Glazing

- .3 Edge delete low 'E' coating down to bare glass in accordance with manufacturer's written requirements. Deletion shall be continuous around the entire periphery of glass edges to minimum deletion width from edge of glass to at least 50% through the primary sealant bead width.
- .4 Set spacer bar evenly into glass units to maximum variation of +/- 2.0 mm (0.080")/length of spacer bar. Primary sealant shall not extend past spacer bar greater than 1.5 mm (0.060").
- .5 IGMAC or IGCC/IGMA certified, permanently marked either on spacers or on at least one component lite of units with appropriate certification label.
- .1 Low 'E' coating:
 - .1 Location: Second surface.
 - .2 Acceptable Products:
 - .1 Vitro 'Solarban 60'.
 - .2 Substitutions: in accordance with Section 01 25 00.
 - .2 Glass thickness: 6 mm (1/4") minimum, and as required to suit design requirements.
 - .3 Glass colour: clear, unless otherwise indicated.
- .3 Annealed (float) glass:
 - .1 Clear, annealed glass, 6 mm (1/4") thick minimum, in accordance with CAN/CGSB 12.3-M91, Glazing Quality.
 - .1 Acceptable products:
 - .1 Cardinal.
 - .2 Guardian Industries.
 - .3 Pilkington.
 - .4 Vitro Architectural Glass.
- .4 Heat treated (tempered or heat strengthened) float glass:
 - .1 In accordance with CAN/CGSB 12.1-M90.
 - .2 Minimum thickness: 6 mm (1/4").
 - .3 Fabrication process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
 - .4 For uncoated glass, comply with requirements for Condition A in accordance with ASTM C1048-18.
 - .5 For coated vision glass, comply with requirements for Condition C (other coated glass) in accordance with ASTM C1048-18.
 - .6 Heat strengthened glass shall have surface compression of 24-52 MPa (3,500-7,500 psi).
- .5 Mirrors:
 - .1 Annealed glass, to ASTM C1503-18 as follows:

Glass and Glazing

- .2 Grade: Mirror Cut Size.
- .3 Quality: Mirror Select Quality, except allowable distortion shall be $\geq 80^\circ$ vision interference angle in accordance with ASTM C1036-21 Table 5.
- .4 Colour: Clear.
- .5 Thickness: 6.35 mm (1/4").
- .6 Exposed edges shall be chamfered, ground, and polished.
- .7 For indicated mirrors, shop-apply impact-resistant film adhered to entire back surface of mirrors.
 - .1 White polyester scrim-reinforced film, 0.18 mm (7 mils) thick, with pressure-sensitive acrylic adhesive, specifically designed as safety backing for mirrors. Application of film to mirrors shall provide compliance with CPSC 16 CFR 1201 for Category II materials.
 - .2 Provide in widths as required for a single sheet of film to cover full extent of each mirror.
 - .3 Provide with additional adhesives as recommended by film manufacturer.
 - .4 Acceptable Product and manufacturer:
 - .1 C.R. Laurence Company, Inc. 'Category II Shatterproof Safety Tape for Mirrors'.
 - .2 Substitutions: in accordance with Section 01 25 00.

2.5 Fire-Rated Glass

- .1 Fire-resistive rated, impact safety resistant glass, non-wired:
 - .1 In accordance with CAN/ULC-S104-15/CAN/ULC-S106-15, CPSC 16 CFR 1201 (Cat. I and II).
 - .2 Film faced and non-film faced glazing:
 - .1 Fire-protective-rated and impact safety-rated, transparent glazing material and listed for use in doors, sidelites, transoms, and borrowed lites in both interior and exterior applications, not functioning as a barrier.
 - .2 Surface finish:
 - .1 Premium Grade: transparent glass, polished for superior optical clarity.
 - .3 Acceptable Product:
 - .1 Safti First 'SuperLite II-XL'.
 - .2 Saint Gobain 'Keralite Select F'.
 - .3 Schott 'Pyran Platinum F'.
 - .4 Technical Glass Products 'FireLite NT'.
 - .3 Non-film faced glazing:

Glass and Glazing

- .1 Fire-protective-rated and impact safety-rated, transparent glazing material with no exposed film facing, and listed for use in doors, sidelites, transoms, and borrowed lites in both interior and exterior applications, not functioning as a barrier to heat.
- .2 Surface finish:
 - .1 Premium Grade: transparent glass, polished for superior optical clarity.
- .3 Acceptable Product:
 - .1 Safti First 'SuperLite II-XL'.
 - .2 Saint Gobain 'Keralite Select L'.
 - .3 Schott 'Pyran Platinum L'.
 - .4 Technical Glass Products 'FireLite Plus'.

2.6 Glazing Materials (Non-Fire Rated)

- .1 Glazing materials; general: Select glazing sealants, tapes, gaskets and additional glazing materials of proven compatibility with other materials they will contact, including glass products, seals of insulating glass units and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.
- .2 Glazing gaskets: Moulded or extruded gaskets of profile and hardness required to maintain watertight seal, made from the following:
 - .1 Preformed silicone to ASTM C1115-17(2022).
- .3 Setting blocks: Moulded or extruded material with Shore, Type A Durometer hardness of 85, plus or minus 5, made from the following:
 - .1 Preformed silicone to ASTM C1115-17(2022).
- .4 Spacers: Moulded or extruded blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated made from the following:
 - .1 Preformed silicone to ASTM C1115-17(2022).
- .5 Edge blocks: Moulded or extruded material of hardness needed to limit glass lateral movement (side walking) made from one of the following:
 - .1 Preformed silicone to ASTM C1115-17(2022).
- .6 Cleaners, primers and sealers: Type recommended by sealant or gasket manufacturer.
- .7 Polyurethane foam glazing tape:
 - .1 High density, closed-cell, flexible, non-extruding tape, adhesive backed one side only; recommended by manufacturer for exterior applications with nominal pressure in glazing channel.
 - .2 Acceptable Products: As recommended by manufacturer suitable for conditions of application and use.
- .8 Silicone glazing (Weatherseal) sealant:
 - .1 Non-staining, low dirt pick-up, medium-modulus, neutral-curing silicone sealant; complying with ASTM C920-14, Type M or S, Grade NS, Class 50.

Glass and Glazing

- .2 SWRI Validation.
- .3 Colour: to later selection by Contract Administrator from full range.
- .9 Mirror clips:
 - .1 Nickel plated, CR Laurence 'Dallas' clips.
- .10 Mirror adhesive:
 - .1 Acceptable Product:
 - .1 Palmer 'Mirro-Mastic', complete with sealer as required.

2.7 Fire Rated Glazing Accessories

- .1 Glazing tape; fire-rated glass (non-wired):
 - .1 Closed cell polyvinyl chloride (PVC) foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent, designed for compression of 25 percent to effect an air and vapour seal.
 - .2 Silicone sealant: One-part neutral curing silicone, medium modulus sealant, to ASTM C920-14, Type S; Grade NS; Class 25 with additional movement capability of 50 percent in both extension and compression (total 100 percent); Use (Exposure) NT; Uses (Substrates) G, A, and O as applicable.
 - .1 Acceptable Products:
 - .1 DOWSIL '795'.
 - .2 Momentive 'Silglaze-II 2800'.
 - .3 Tremco 'Spectrem 2'.
 - .3 Setting blocks: Neoprene or other resilient blocks of 40 to 50 Shore A durometer hardness, adhesive-backed on one face only, tested for compatibility with specified glazing compound.
 - .4 Cleaners, primers, and sealers: Type recommended by manufacturer of glass and gaskets.

2.8 Fabrication of Glazing Units

- .1 Fabricate glazing units in sizes required to fit openings, 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.
 - .1 Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
- .2 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.
- .3 Grind smooth and chamfer, and polish exposed glass edges and corners, unless otherwise indicated.

Glass and Glazing

PART 3 - EXECUTION

3.1 Examination

- .1 Examine framing, glazing channels, and stops, with glazing installer present, for compliance with the following:
 - .1 Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - .2 Inspect butt and mitre joints in framing. Seal joints found to be open with a compatible sealant prior to glazing.
 - .3 Glazing pockets and surfaces are free of dust, construction debris, and contaminants.
 - .4 Presence and functioning of weep systems.
 - .5 Minimum required face and edge clearances as per FGIA and GANA standards.
 - .6 Effective sealing between joints of glass-framing members.
- .2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Preparation

- .1 Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- .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 Clean contact surfaces with solvent and apply primers to surfaces to receive tapes and sealants in accordance with the manufacturer's requirements. Ensure surfaces are free of moisture and frost.

3.3 Glazing - General

- .1 Comply with combined written requirements of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- .2 Adjust glazing channel dimensions as required by conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- .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.
- .4 Clean glazing rebate surfaces of traces of dirt, dust, or other contaminants.
- .5 Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

Glass and Glazing

- .6 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.
- .7 Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- .8 Provide spacers for glass lites where length plus width is greater than 1270 mm (50").
 - .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 3.2 mm (1/8") minimum bite of spacers on glass and use thickness equal to sealant width.
- .9 Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel.
- .10 Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- .11 Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- .12 Glaze hollow metal doors and frames specified under work of Section 08 11 13 using tape glazing installation.
- .13 Install fire rated glazing in accordance with fire rated glazing Product manufacturer's written requirements and with current fire-resistance listing for each Product. Field cutting or tampering is not permissible.

3.4 Tape Glazing

- .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.
- .2 Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- .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.
- .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.
- .5 Do not remove release paper from tape until right before each glazing unit is installed.
- .6 Centre 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 centres of openings.

3.5 Gasket Glazing (Dry)

- .1 Allow gaskets to relax and cut compression gaskets to lengths recommended by gasket manufacturer to fit openings to suit frame dimensions.
- .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.

Glass and Glazing

- .3 Installation with drive-in wedge gaskets: Centre 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 centres of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- .4 Installation with Pressure-Glazing Stops: Centre 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.
- .5 Install gaskets so they protrude past face of glazing stops.

3.6 Sealant Glazing (Wet)

- .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.
- .2 Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- .3 Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 Installation - Mirrors

- .1 Provide frameless mirrors only. Grind and polish exposed mirror edges.
- .2 Mount mirrors in true planes, free of distortions. Surfaces of butted mirrors shall be flush to ≤ 1 mm (0.04"). Mirror installation shall be flat to within 1.5 mm in 1220 mm (1/16" in 4 ft).
- .3 Locate joints in mirrors at maximum available mirror sizes to Contract Administrator's direction, unless otherwise indicated. Provide butt joints with flat ground and polished edges to provide inconspicuous joint complete with black tape behind joint to hide wall substrate.
- .4 Mirror clip support installation:
 - .1 Secure mirrors in place over pressure sensitive foamed plastic tape with metal clips. Locate clips at not more than 914 mm (36") on centre on top and bottom edges of mirrors.
 - .2 Secure mirrors in place over pressure sensitive foamed plastic tape with bottom metal channels and top clips. Locate clips at not more than 914 mm (36") on centre on top and bottom edges of mirrors.
 - .3 Secure mirrors in place over pressure sensitive foamed plastic tape with top and bottom metal channels and top clips. Locate clips at not more than 914 mm (36") on centre on top and bottom edges of mirrors.
- .5 Mastic adhesive and top and bottom support clip installation:

Glass and Glazing

- .1 Secure mirrors in place over mastic adhesive with metal clips. Locate clips at not more than 914 mm (36") on centre on top and bottom edges of mirrors.
- .2 Make sure mirror and substrate are free of dust, clean, and dry. On nonporous substrates, such as glass, tile, or metal, sealing is not necessary. On porous substrates, such as drywall or wood, use Mirro-Mastic Bond (or a primer or sealer, not paint) on the substrates and allow it to dry. Painted surfaces should be sanded through to the original surface and the substrate cleaned and sealed where the mastic is to be applied.
- .3 Support mirror at the bottom using concealed bottom angles.
- .4 Apply mirror adhesive to the mirror or substrate in a minimum of 1 ping-pong ball size mound for every 0.0929 m² (1 ft²) of mirror. Do not apply mastic too close to the edge to prevent "squeeze out". Place the mounds so space will be left between them when the mirror is installed. Mastic adhesive shall be at room temperature (22°C).
- .5 Press mirror firmly in place making good contact between the mirror, mastic, and substrate. Mastic should spread to a pat approximately 114 mm (4-1/2") in diameter. The mastic needs air circulation to cure properly. Curing time will depend on temperature, humidity, type of substrate, and amount of air that can reach the mastic.

3.8 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00.
 - .1 Performing random testing on:
 - .1 Argon gas concentration within insulating glass units.
 - .2 Surface compression tests on heat strengthened and tempered glass.
- .2 Manufacturer's field review to be in accordance with Section 01 45 00.

3.9 Protection

- .1 Provide safety markings to installed glass by attaching streamers or tape to face of sash. Do not apply tape directly to the glass. Do not mark the glass with paint or any other substance that is hard to remove or could leave permanent stains.
- .2 Take all precautions necessary to protect stored glass and installed glass from lime mortar, water run-off from concrete or copper, weld spatter, acids, roofing tar, solvents, abrasive cleaners, careless handling of construction machinery and equipment, and any other activities that could permanently damage the glass.
- .3 Install protective cover to glass where there is a high risk of damage. Use plywood, heavy kraft paper, or non-staining transparent plastic sheet. Do not let protective materials contact surface of glass.
- .4 Do not rely on use of adhesive plastic films to protect installed glass. When plastic sheeting is used, it must be transparent, suspended away from the surface of the glass, and be provided with adequate ventilation holes to prevent heat build-up.

Glass and Glazing

3.10 Adjusting and Cleaning

- .1 Immediately remove sealant and compound droppings from finished surfaces. Remove labels after work is completed.
- .2 Final cleaning of glass in accordance with Section 01 77 00.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Translucent film; applied to interior glazing; FILMC1.

1.2 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product* data sheets:
 - .1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.
- .3 Samples:
 - .1 Submit 3 - 200 mm x 200 mm (8" x 8") samples of each specified film type, pattern and colour.

1.3 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit maintenance and cleaning instructions for incorporation into operating and maintenance manuals.
 - .2 Instruct *Owner's* representative on proper care and maintenance for work of this section.

1.4 Quality Assurance

- .1 Qualifications:
 - .1 *Subcontractor*. Shall have 5 years' experience, minimum, in application of *Products* specified.

1.5 Delivery, Storage, and Handling

- .1 Package materials and identify on attached labels the manufacturer, contents and material specification number.

1.6 Field Conditions

- .1 Conform to manufacturer's written documented temperatures, relative humidity, and substrate moisture content and temperature for application of materials of this section.

1.7 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - .1 System:
 - .1 Labour, materials, and workmanship for work of this section.

Applied Films

- .2 Duration: 2 years.
- .2 Film manufacturer's product warranty.
 - .1 Duration: 6 years.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Applied film shall function as intended, and exhibit none of the following:
 - .1 Bubbling.
 - .2 Cracking.
 - .3 Crazing.
 - .4 Delamination.
 - .5 Discolouration.
 - .6 Peeling.

2.2 Materials

- .1 FILMC1; Applied films; translucent:
 - .1 *Acceptable Products:*
 - .1 Refer to Material/Equipment/Product Tag Schedule.
 - .2 Substitutions: in accordance with Section 01 25 00.

PART 3 - EXECUTION

3.1 Examination

- .1 Examine glass surfaces to receive film and verify that they are free from defects and imperfections which will affect the final appearance of installed film. Correct such deficiencies before starting film application.

3.2 Preparation

- .1 Prepare surfaces for film application in accordance with film manufacturer's written requirements.
- .2 Window and window framing will be cleaned thoroughly with a neutral cleaning solution. Surface of glass shall be bladed with industrial razor to ensure the removal of any foreign contaminants in accordance with film manufacturer's instructions.
- .3 Towelling or other absorbent material shall be placed on the window sill or sash to absorb moisture accumulation generated by the film application.

3.3 Installation

- .1 Applied film; interior application:
 - .1 Apply film to indicated surface of glazing units in accordance with film manufacturer's written requirements, applied plumb, true and level over clean glazing, without air bubbles, wrinkles, blisters, and other defects.

Applied Films

- .2 After installation, applied film shall be flat with no obvious concentrations of moisture, free of creases, free of tears, with no moisture dimples when viewed under normal conditions.
- .3 Film edges shall be cut neatly and square at a uniform distance of 1.5 mm (1/16") to 0.79 mm (1/32") from frame.

3.4 Adjusting and Cleaning

- .1 Clean film and glass surfaces so they are free of foreign matter using cleaners recommended by film manufacturer.

3.5 Protection

- .1 Comply with manufacturer's written requirements respecting protection.

END OF SECTION

Metal Supports for Gypsum Board

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Metal support systems for interior gypsum board partitions, interior ceilings, shaftwalls and interior assemblies as indicated.

1.2 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the Work of this section, including additional data as may be required to demonstrate compliance with the Agreement, Drawings, Schedules, and Specifications.
- .3 Shop drawings; for engineered shaftwalls:
 - .1 Shop drawings shall be engineered.
 - .2 Submit design for metal support systems at interior locations where noted as engineered.
 - .3 Submit written confirmation and design for shaftwall construction showing adequacy of system in meeting fire ratings and its ability to withstand pressures and deflections that may occur in high velocity duct shafts. Shaftwall design shall be prepared as an engineered shop drawing.
- .4 Test and evaluation reports:
 - .1 Submit certified test results for each required fire resistance rated assembly for work of this section.

1.3 Quality Assurance

- .1 Qualifications:
 - .1 Installers / applicators / erectors:
 - .1 Subcontractor: Shall have 5 years' experience, minimum, in application of Products, systems and assemblies specified.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements - Shaftwall System Description

- .1 Gypsum board shaft systems include special purpose assemblies of gypsum boards and metal components designed for erection entirely from room side of shaft (except for application of finish layer on shaft side, where required to form an enclosure).
- .2 Provide gypsum board shaft systems designed and tested by manufacturer to withstand lateral design loading (air pressure) of 48 kg/m² (10 lb/ft²), applied transiently and cyclically, for maximum heights of partitions required, within deflection limit of 1/240 of partition height and in stairways.

Metal Supports for Gypsum Board

- .3 Provide drywall shaft systems designed and tested by manufacturer to achieve a minimum STC rating of 35 in accordance with ASTM E90-09.

2.2 Performance/Design Requirements - Fire Resistance Rated Assemblies

- .1 Where gypsum board systems with fire resistance ratings are indicated or required, provide materials and installations that are identical with those of applicable assemblies tested by fire testing laboratories acceptable to authorities having jurisdiction.

2.3 Materials - General

- .1 For sheet metal Products: Sheet metal thickness indicated herein pertains to the minimum base steel thickness exclusive of coating.
- .2 Protective coatings for metal supports and framing:
 - .1 Minimum corrosion protection: Z120 (G40) ASTM A653/A653M-13.
 - .2 Heavy duty corrosion protection where scheduled or indicated: Z275 (G90) ASTM A653/A653M-13.
- .3 Sheet metal screws shall have a minimum coating thickness of 0.008 mm (0.0003") of zinc. Other coatings providing equal or better corrosion protection may be used, subject to acceptance of Contract Administrator.
- .4 Screws:
 - .1 Steel screws shall be equal to or exceed minimum diameter indicated on shop drawings.
 - .2 Penetration beyond joined materials shall be not less than 3 exposed threads.
 - .3 Thread types and drilling capability shall conform to manufacturer's recommendations.

2.4 Partition Support Materials

- .1 Interior non-loadbearing channel stud framing: to ASTM C645-18; roll formed from 0.455 mm (0.0179") minimum thickness unless otherwise indicated or as recommended by gypsum board manufacturer, galvanized steel sheet. Provide service holes starting at 450 mm (18") from bottom, then 914 mm (36") on centre to top of studs.
 - .1 Steel studs; at backer plate locations: 0.836 mm (0.0329") minimum thickness.
 - .2 Steel studs at abuse resistant gypsum board locations: 0.836 mm (0.0329") minimum thickness.
 - .3 Steel studs at tile backer board locations: 0.836 mm (0.0329") minimum locations.
- .2 Interior floor and ceiling tracks (runners): to ASTM C645-18; in widths to suit stud sizes.
 - .1 Metal thickness: to match studs.
 - .2 For openings wider than 914 mm (36"), provide 0.836 mm (0.0329") minimum thickness for header.
 - .3 Curve tracks to radius detailed:
 - .1 Basis of design:
 - .1 Bailey Metal 'Radius Track - Ready-Track'.

Metal Supports for Gypsum Board

- .2 Substitutions: in accordance with Section 01 25 00.
- .3 Interior floor and ceiling track (runner) fasteners:
 - .1 To concrete and masonry: Use stub nails or power-driven fasteners.
 - .1 Power actuated fastening systems are not permitted.
 - .2 To suspended acoustic ceiling tile grid: Manufactured to fit applicable ceiling grid profile; CGC 'Partition Clip'.
- .4 Bracing channels: Minimum 19 mm x 10 mm x 1.087 mm (3/4" x 3/8" x 0.0428") cold rolled galvanized steel.

2.5 Ceiling Support Materials and Systems

- .1 General: Size ceiling support components to comply with ASTM C754-20 unless otherwise indicated.
- .2 Main runners: Steel channels, hot or cold rolled; Z180 (G60) galvanized.
- .3 Hanger wire: in accordance with ASTM A641/A641M-19, soft, Class 1 galvanized, minimum 4.064 mm (0.160", 8 AWG).
- .4 Hanger rods and flats: Mild steel with zinc coating, galvanized for exterior applications.
 - .1 General: Size devices for 5 times load imposed by completed system as determined in accordance with ASTM E488/E488M-22.
 - .2 Screws, clips, bolts, concrete inserts or other devices for ceiling hangers whose suitability for use intended has been proven through standard construction practices or by certified test data.
 - .3 Hangers: Comply with ASTM C754-20 for maximum ceiling area and loads to be supported.
 - .4 Interior concrete ceiling anchors:
 - .1 Acceptable Products:
 - .1 ITW Ramset/Red Head 'Dynabolt Sleeve Anchor TW-1614' or 'Redi-Drive Tie Drive' or 'Redi-Drive' with angle clip.
 - .2 ITW Ramset/Red Head 'Trubolt' or 'Dynabolt' anchors complete with galvanized angle clip.
 - .3 Hilti 'Kwik-Bolt 3' and 'HHDC A 1/4 Ceiling Hangers'.
 - .5 Fasteners exposed to weather, condensation, and corrosion: Zinc-plated or stainless steel fasteners in applicable product lines specified in preceding paragraphs.
- .5 Tie wire: 1.19 mm (0.047", 18 AWG) minimum zinc coated, soft-annealed wire, to ASTM A641/A641M-19.
- .6 Furring anchorages: 1.62 mm (0.0637", 16 AWG) galvanized wire ties, manufacturer's standard wire type clips, bolts, nails or screws as recommended by furring manufacturer and complying with ASTM C754-20.
- .7 Runner (carry) channels: 1.367 mm (0.0538") thick cold rolled steel, primer painted or zinc coated for interior locations, to ASTM C754-20, with minimum 228 MPa yield strength:

Metal Supports for Gypsum Board

- .1 38 mm x 12.7 mm (1-1/2" x 1/2") where supported at centres of 914 mm (36") maximum.
- .2 38 mm x 19 mm (1-1/2" x 3/4") where supported at centres of 1220 mm (48") maximum.

2.6 Furring

- .1 Furring channels: 0.455 mm (0.0179") minimum typical thickness, , cold rolled steel, wiped coated, nominal size of 22 mm (7/8") depth x 35 mm (1-3/8") face, hat type with knurled face.
- .2 Resilient furring channels:
 - .1 Acceptable Product:
 - .1 Bailey Metal 'Resilient Channel'.
 - .2 Substitutions: in accordance with Section 01 25 00.
 - .3 Z-furring members: Galvanized steel z-shaped furring members; ASTM A653/A653M-13, G60, 0.836 mm (0.0329") minimum thickness of base metal, of depth indicated, designed for mechanical attachment of insulation boards or blankets.
 - .4 Fasteners for furring members: Type and size recommended by furring manufacturer for substrate and application indicated, load rating and spacing to support materials carried by assembly with factor of safety of 3x per fastener manufacturer data sheets.

2.7 Shaftwall

- .1 Shaftwall studs and accessories: 0.455 mm (0.0179"), rolled galvanized steel sheet fabricated specially for gypsum coreboard and facing boards.
- .2 Provide manufacturer's standard shapes for shaftwall construction; of profile, size and base metal thickness designed to comply with AISI "Specification for Design of Cold Formed Steel Structural Members" for structural performance characteristics indicated. Fabricate from steel sheet complying with ASTM A653/A653M-13, Grade A or B, for structural performance of base metal, as well as with ASTM A653/A653M-13, G60, for hot dip galvanized products, and ASTM A463/A463M-22 for aluminized Products.

2.8 Accessories

- .1 Backer plates:
 - .1 Metal backer plates: Steel, galvanized; minimum 150 mm (6") wide x 0.836 mm (0.0329") minimum x length and width to suit size of items to be attached; fastened to studs for attachment of surface mounted fittings and accessories.
 - .2 Plywood backer plates: Softwood plywood; 19 mm (3/4") minimum x length and width to suit size of items to be attached; fastened to studs for attachment of surface mounted fittings and accessories.
 - .3 Elimination of backer plates or direct attachment of accessories or equipment to studs will not be permitted.

Metal Supports for Gypsum Board

PART 3 - EXECUTION

3.1 Installation General

- .1 Comply with ASTM C754-20 and manufacturer's requirements, except as modified herein. Do not bridge building expansion joints with support system. Frame both sides of joints with furring and other supports as indicated.
- .2 Provide and install studs, framing, shimming, and furring to provide proper support for gypsum board to achieve the following installation tolerances:
 - .1 Do not exceed 3 mm (1/8") in 3 m (10') variation from plumb, level, and plane.
 - .2 Do not exceed 10 mm (3/8") from drawings locations.
 - .3 Do not exceed 1.5 mm (1/16") variation between planes of abutting edges or ends.
 - .4 Install each framing member so fastening surfaces vary not more than 3.2 mm (1/8") from the plane formed by faces of adjacent framing.
 - .5 In double stud walls, do not bridge across studs on opposite sides of wall with gypsum board or metal cross bracing.
- .3 Give complete cooperation and direction to trades erecting framing and furring over which this work is applied. Coordinate finished joint location with framing.
- .4 Coordinate installation and cooperate with mechanical and electrical work to accommodate mechanical electrical items and any other work required to be incorporated into or coordinated with the partitions, ceiling and soffit systems.
 - .1 Where the presence of suspended ductwork or other mechanical or electrical services or devices above ceiling framing conflicts with ceiling framing suspension points from structure above, provide bridging framing below conflicting work as required to support ceiling framing on specified intervals.
 - .2 Do not suspend ceiling framing from mechanical or electrical suspension systems unless agreement is obtained in writing from engineer for Subcontractor installing such framing that additional imposed loads are acceptable; obtain Contract Administrator's acceptance before proceeding.
- .5 Provide clearances between work of this section and structural elements to prevent transference of structural loads.
- .6 Do not bridge building expansion joints with steel framing or furring members. Independently frame both sides of joints with framing of furring members or as indicated.
- .7 Size framing systems according to manufacturer's engineered load tables, to meet allowable deflection without permanent deformation.
 - .1 Maximum allowable deflection: L/240.
 - .2 Maximum allowable deflection for tiled partitions: L/360.

3.2 Blocking

- .1 Attach to framing adequate backer plates to support the load of, and to withstand the withdrawal and shear forces imposed by, items installed upon the work of this section.

Metal Supports for Gypsum Board

3.3 Furring - General

- .1 Furring indicated in Agreement, Drawings, Schedules, and Specifications is schematic. Do not regard as exact or complete. Provide all necessary framing and furring to support gypsum board in accordance with manufacturers' specifications.
- .2 Shim furring as required to achieve required installation tolerances.
- .3 Leave finished work rigid, secure, square, level, plumb, curved to detailed radius and erected to maintain finish gypsum board line dimensions and contours. Make allowance for thermal movement.
- .4 Thermally separate metal studs from exterior concrete or masonry.

3.4 Suspended and Furred Ceilings

- .1 Arrange hangers for suspended gypsum board ceilings to provide support independent of walls, columns, pipes, ducts; erect plumb, and securely anchored to structural frame, or embed in concrete slabs.
- .2 Keep lateral braces at hangers back 450 mm (18") minimum unless otherwise noted.
- .3 Space hangers at 914 mm (36") on centre maximum along runner channels, and not more than 150 mm (6") from ends.
- .4 Space runner channels at 1220 mm (48") on centre, maximum, and not more than 150 mm (6") from boundary walls, interruptions of continuity, and changes in direction. Run channels transversely to structural framing members.
- .5 Where splices are necessary, lap members at least 200 mm (8") and wire each end with 2 loops. Avoid clustering or lining up of splices.
- .6 Attach to rod hangers by bending hanger sharply under bottom flange of runner, and securely wiring in place with saddle tie.
- .7 Erect cross furring channels transversely across runner channels at 400 mm (16") on centre maximum, 305 mm (12") on centre at fire rated assemblies, at not more than 150 mm (6") from boundary wall openings, interruptions in ceiling continuity, and changes in direction. Provide 22 mm (7/8") furring at 400 mm (16") on centre for curved ceilings.
- .8 Secure furring channels to each support with purpose-made slips or wire tie. Splice joints by lapping channels and tying together.
- .9 Install proprietary ceiling systems in accordance with manufacturer's written directions.
- .10 Level cross furring channels to maximum tolerance of 3 mm in 3 m (1/8" in 10 ft).
- .11 Install ceiling framing assemblies at interface with suspended acoustical ceilings specified in Section 09 51 23, to project minimum of 100 mm (4") above acoustic tile suspension assemblies.

3.5 Wall Furring

- .1 Install steel furring for braced walls, free standing walls, walls that are furred out as indicated.
- .2 Frame openings and around built-in equipment, cabinets, access panels, on 4 sides, with channels. Extend furring into reveals. Check clearances with equipment suppliers.

Metal Supports for Gypsum Board

- .3 Provide bulkheads and boxed-in duct shafts, for beams, columns, pipes and around exposed services where indicated. Install 19 mm (3/4") channels at corners and at 305 mm (12") on centre.

3.6 Resilient Furring

- .1 Ceilings:
 - .1 Fasten the resilient furring perpendicular to the ceiling framing every 305 mm (12").
 - .2 Fasten the first furring member 150 mm (6") from the wall.
 - .3 Fasten the second furring member 305 mm (12") from the same wall.
 - .4 Fasten the last furring member 150 mm (6") from the opposite wall.
- .2 Partitions:
 - .1 Install resilient furring with outer leg oriented upward.
 - .2 Fasten the resilient furring maximum 610 mm (24") on centre.
 - .3 Fasten the first furring member 50 mm (2") from the floor. Install 150 mm (6") continuous strip of 12.7 mm (1/2") gypsum board along base of partitions where resilient furring installed.
 - .4 Fasten the second furring member 610 mm (24") from the floor.
 - .5 Fasten the last furring member 150 mm (6") from the ceiling.
- .3 Secure to each support with 25 mm (1") gypsum wallboard screw.
- .4 Provide resilient furring channel transverse to framing members, or as indicated.

3.7 Metal Stud Partition Framing

- .1 Provide partition tracks (runners) at floor and underside of structural assembly and as follows:
 - .1 Align accurately and lay out according to partition layout.
 - .2 Secure runners to concrete, access flooring and to concrete slabs, as applicable, with screwed or shot fasteners located 50 mm (2") from each end and spaced at maximum 610 mm (24") on centre.
 - .3 At partition corners, extend one runner to end of corner and butt other runner to it, allowing necessary clearance for gypsum board thickness. Runners should not be mitred.
- .2 Unless otherwise indicated, place interior studs vertically at centres as follows:
 - .1 Provide studs at 400 mm (16") on centre, and as specially spaced in accordance with details indicated.
 - .2 Provide studs not more than 50 mm (2") from abutting walls, openings and each side of corners.
 - .3 Provide freedom for 19 mm (3/4") deflection under beams, structural slabs and the like to avoid transmission of structural loads to studs, or install 50 mm (2") leg ceiling tracks.
- .3 Install studs in tracks at floor and ceiling.

Metal Supports for Gypsum Board

- .4 Where horizontal runs of service lines are scheduled to be installed, arrange with applicable trades and install studs simultaneously with services.
- .5 At openings in stud walls, erect track at head and sills to accommodate intermediate studs. At each end of track, cut out flanges, turn up web, and fasten to studs. Install intermediate studs above and below openings in same manner and spacing as wall studs. Install double studs at each jamb, and double tracks at head of door openings.
- .6 At partitions requiring fire rating, erect in accordance with requirements of listing.
- .7 Size studs, connections, and runners to carry loads according to stud manufacturer's load tables, at 24 kg/m² (5 lb/ft²) live load to meet maximum allowable deflection limits. Where depth of stud is indicated, size metal thickness to meet allowable deflection limits.
- .8 Provide three studs at corner and intermediate intersections of partitions.
- .9 Coordinate work with others installing horizontal runs of service lines so that work is done simultaneously. Where standard holes are too small for installed services, notch studs, and splice notched flanges with splice pieces 305 mm (12") longer than notches, each fastened with 2 screws.
- .10 Coordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.
- .11 Coordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other sections.
- .12 Unless otherwise indicated, partitions, together with gypsum board facings, shall extend above ceilings to underside of structure above.
- .13 Chase walls:
 - .1 Provide chase walls consisting of two parallel steel stud partitions.
 - .2 Provide cross bracing consisting of metal furring, located at quarter points on each pair of studs. Attach cross bracing to studs with metal screws.
- .14 Lateral support bracing channels:
 - .1 Stiffen partitions over 3 m (10') in vertical span, at mid-height to maximum vertical spacing of 2440 mm (8') on centre, with at least one 19 mm (3/4") horizontal bracing channel, extending full length of partition, overlapping at least two stud spaces at ends of bracing channels.
 - .2 Stiffen partitions at not more than 150 mm (6") from the top and bottom of openings and across two full stud spaces at each side of openings with horizontal bracing channel.

3.8 Control Joints

- .1 Control joints: in accordance with Section 09 29 00.

3.9 Concrete Anchors

- .1 Provide anchors and anchorage points in reinforced concrete floor slab underside in accordance with gypsum board manufacturer's suspension requirements. Drill holes with carbide-tipped drill bits conforming to ANSI B212.15-1994 (R2000).

Metal Supports for Gypsum Board

- .2 Provide anchors; minimum installation depth, and method of expansion as recommended by the anchor manufacturer.

3.10 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00.

END OF SECTION

Gypsum Board

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Gypsum board; paper-faced.
 - .2 Gypsum board; interior mould and moisture resistant; paper-faced.
 - .3 Gypsum board; fire-rated, paper-faced.
 - .4 Gypsum board; abuse resistant.
 - .5 Gypsum board; shaftwall liner; paper faced.
 - .6 Gypsum board; tile backer board; glass scrim.
 - .7 Gypsum board; flexible.
 - .8 Gypsum board accessories and miscellaneous related materials.

1.2 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Fire-rated assembly listings and STC assembly ratings:
 - .1 Submit fire-rated assembly listings for each required fire resistance rated assembly for work of this section.
 - .2 Submit STC assembly ratings for each required STC rated assembly for work of this section.

1.3 Quality Assurance

- .1 Qualifications:
 - .1 Subcontractor: Shall have 10 years' experience, minimum, in successful installation of work of type and quality indicated and specified.

1.4 Field Conditions

- .1 Comply with requirements of referenced gypsum board application standards and recommendations of gypsum board manufacturer, for environmental conditions before, during and after application of gypsum boards.
- .2 Install paper-faced gypsum panels after installation areas are enclosed and conditioned.
- .3 Panels that are wet, moisture damaged, or mould damaged shall not be installed.
 - .1 Indications that panels are wet or moisture damaged include, but are not limited to, discolouration, sagging, or irregular shape.
 - .2 Indications that panels are mould damaged include, but are not limited to, fuzzy or splotchy surface contamination and discolouration.

Gypsum Board

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Single source responsibility: Obtain gypsum and cement board products from a single manufacturer.
- .2 Fire resistance rating:
 - .1 Construct fire resistance rated assemblies in accordance with listing and CAN/ULC S101-14.
- .3 Paper-faced gypsum board: in accordance with ASTM C1396/C1396M-17.
- .4 Glass scrim gypsum board: in accordance with ASTM C1658/C1658M-13.
- .5 Fire rated in accordance with listed assemblies where indicated: Type X or Type C.

2.2 Gypsum Board Panels

- .1 Gypsum board; paper faced:
 - .1 Acceptable Products:
 - .1 CertainTeed 'Regular Gypsum Board'.
 - .2 CGC 'Sheetrock Brand Gypsum Panel'.
 - .3 Georgia-Pacific 'ToughRock Gypsum Board'.
 - .4 National Gypsum 'Gold Bond Gypsum Board'.
 - .2 Gypsum board; interior mould and moisture resistant, wall applications; paper-faced:
 - .1 Resistant to mould growth with highest level of performance (score of 10) when tested to ASTM D3273-21.
 - .2 Acceptable Products:
 - .1 CertainTeed 'M2Tech Moisture and Mould Resistant Gypsum Board.
 - .2 CGC 'SHEETROCK Mold Tough Panel'.
 - .3 Georgia-Pacific 'ToughRock Mold Guard'.
 - .3 Gypsum board; fire-rated, paper faced:
 - .1 Acceptable Products:
 - .1 CertainTeed 'Type X and Type C'.
 - .2 CGC 'SHEETROCK Brand Firecode X and Firecode C'.
 - .3 Georgia-Pacific 'ToughRock Fireguard X Gypsum Board and ToughRock Fireguard C Gypsum Board'.
 - .4 National Gypsum 'Gold Bond Brand Fire-Shield Gypsum Board and Gold Bond Fire Shield C Gypsum Board'.
 - .5 PABCO Gypsum 'QuietRock ES'.
 - .4 Gypsum board; abuse resistant:
 - .1 Mould and moisture resistant: in accordance with ASTM D3273-21, with a panel score of 10.

Gypsum Board

- .2 Abuse resistance performance:
 - .1 Surface abrasion surface damage: in accordance with ASTM D4977/D4977M-20, Level 3.
 - .2 Surface indentation surface damage: in accordance with ASTM D5420-21, Level 1.
 - .3 Soft-body impact penetration: in accordance with ASTM E695-22, Level 2.
 - .4 Hard Body Impact resistance: in accordance with ASTM C1629/C1629M-19, App.1, Level 1.
- .3 Paper faced:
 - .1 Acceptable Products:
 - .1 CertainTeed 'Air-Renew Extreme Abuse Resistant' Gypsum Board.
 - .2 CertainTeed 'Extreme Abuse' Gypsum Board.
 - .3 CGC 'Sheetrock Brand Panels Mold Tough AR Firecode X'.
 - .4 National Gypsum 'Hi-Abuse XP Gypsum Board'.
- .5 Gypsum board; shaftwall liner, paper faced:
 - .1 Acceptable Products:
 - .1 CertainTeed 'M2TECH Shaftliner'.
 - .2 National Gypsum '1" Gold Bond Fire-Shield Shaftliner XP'.
 - .3 Substitutions: in accordance with Section 01 25 00.
- .6 Gypsum board; tile backer, glass scrim:
 - .1 In accordance with ASTM C1178/C1178M-13.
 - .2 Acceptable Products:
 - .1 CertainTeed 'GlasRoc Diamondback Tile Backer'.
 - .2 CGC 'Durock Brand Glass-Mat Tile Backerboard'.
 - .3 Georgia-Pacific 'Dens-Shield Tile Backer'.
- .7 Gypsum board; flexible for special curved applications, paper faced:
 - .1 Gypsum core panel with enhanced core to allow for flexibility.
 - .2 Thickness: 6.4 mm (1/4").
 - .3 For multiple layer application to achieve 12.7 mm (1/2") thick minimum overall thickness, flexible style for tight bending radii.
 - .4 Acceptable Products:
 - .1 CertainTeed '1/4" Flex Gypsum Board'.
 - .2 CGC 'SHEETROCK 1/4" Flexible Gypsum Panels'.
 - .3 Georgia-Pacific 'ToughRock Flexroc Gypsum Board'.
 - .4 National Gypsum 'Gold Bond High Flex Gypsum Board'.

Gypsum Board

2.3 Attachment Materials

- .1 Screws; for gypsum board: bugle head, fine thread, self-tapping, Type W or S or S-12 point to suit framing type and metal gauge, with corrosion resistant finish in accordance with ASTM C1002-07/ASTM C954-11.
 - .1 Screw sizing:
 - .1 #6 x 25 mm (1") for single thickness board fastening.
 - .2 #6 x 32 mm (1-1/4") for single thickness 15.9 mm (5/8") board fastening.
 - .3 #7 x 41 mm (1 5/8") for double thickness board fastening.
 - .2 Tie wire: 1.6 mm (0.063") diameter galvanized soft annealed steel wire.
 - .3 Laminating adhesive; for gypsum panels only: in accordance with gypsum board manufacturer's written installation requirements, to suit application.
 - .1 Use adhesives that have a VOC content of 50 g/L (1.8 oz/gal) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 Accessories

- .1 Accessories: in accordance with ASTM C1047-19 unless otherwise indicated, maximum length pieces per location. Flanges shall be free from dirt, grease, or other material that adversely affects the bond of joint treatment or decoration.
- .2 Trims:
 - .1 Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
 - .1 Shapes:
 - .1 Corner bead.
 - .1 Mechanically fastened corner beads at impact resistant gypsum walls.
 - .2 "L" or "LC" beads.
 - .3 Reveal trims.
 - .4 Control joints, certified by manufacturer for use at fire resistance rated assemblies as required.
 - .3 Aluminum trims: extruded accessories of profiles and dimensions as indicated.
 - .1 Alloy and temper with not less than the strength and durability properties of ASTM B221 (ASTM B221M), Alloy 6063-T5.
 - .2 Shapes:
 - .1 Z reveal.
 - .2 Reveals and moldings at round columns.
 - .3 Acceptable manufacturers:
 - .1 Fry Reglet.
 - .2 Gordon Interior Specialties.
 - .4 Aluminum gypsum board trim:

Gypsum Board

- .1 Extruded alloy 6063-T5 to ANSI H35.1/H35.1M-2017 consisting of fin, tapered, grooved, and prepunched for screw attachment and bonding agent.
 - .1 Acceptable manufacturers:
 - .1 Fry Reglet.
 - .2 Gordon, Inc.
 - .3 Soffforms.
- .5 Corner guard; CG1:
 - .1 Radius: 76 mm.
 - .2 Colour: in accordance with Material/Equipment/Product Tag Schedule.
 - .3 Acceptable Products:
 - .1 In accordance with Material/Equipment/Product Tag Schedule.

2.5 Related Support Assemblies and Backer Plates

- .1 Dimensional wood blocking at interior assemblies: in accordance with Section 06 10 53.
- .2 Metal support systems and backer plates at interior assemblies: in accordance with Section 09 22 00.

2.6 Joint Treatment Materials

- .1 General: Comply with ASTM C475/C475M-17(2022).
- .2 Joint tape: in accordance with manufacturer's written requirements.
- .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: Use setting-type compound as recommended by panel board manufacturer.
 - .2 Embedding and first coat: Use setting-type or taping compound as recommended by panel board and trim accessory manufacturers.
 - .3 Fill and finish coats: Use sanding type setting-type or taping compound as recommended by panel board manufacturer.
- .4 Joint compound for tile backing panels: in accordance with manufacturer's written requirements.

2.7 Acoustic Wall Assembly Materials

- .1 Acoustic sealant; concealed locations: to meet material requirements as listed in Part 9 of ASTM C919-22, including ASTM C834-10 or ASTM C920-14:
 - .1 Acceptable Products:
 - .1 Hilti Canada Corp 'CS-S SA Light'.
 - .2 Owens Corning 'QuietZone Acoustic Sealant'.
 - .3 Pecora 'BA-98'.
 - .4 Pecora 'AC-20'.

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- .5 Tremco 'Tremflex 834'.
- .6 Substitutions: in accordance with Section 01 25 00.
- .2 Acoustic sealant; exposed locations, acrylic:
 - .1 Acrylic/latex acoustic sealant, Type S, Grade NS, Class 12.5 to ASTM C920-14, maximum VOC content 60 g/L, non-hardening or ASTM C834-10, Type OP, Grade -18° C.
 - .2 For exposed sealants use paintable sealant products, do use non-skinning type products where they are exposed to view or where sealant products may deteriorate (stain or bleed into) into painted surfaces.
 - .3 Acceptable Products:
 - .1 Hilti Canada Corp 'CS-S SA Light'.
 - .2 Master Builders Solutions Canada 'MasterSeal NP 520'.
 - .3 Owens Corning 'QuietZone Acoustic Sealant'.
 - .4 Pecora 'AC20'.
 - .5 Tremco 'Tremflex 834'.
- .3 Smoke and acoustic sealant; concealed and exposed locations, non-fire-rated acoustic assemblies:
 - .1 Acrylic smoke and acoustic sealant, in accordance with ASTM C834-10 maximum VOC content 60 g/L, paintable, Flame Spread Value of maximum 25 to CAN/ULC-S102-10.
 - .2 Sealant shall not deteriorate (stain or bleed into) painted surfaces.
 - .3 Acceptable Products:
 - .1 Hilti Canada Corp 'CS-S SA Light'.
 - .2 Tremco 'Tremstop Smoke & Sound Sealant'.
 - .3 Substitutions: in accordance with Section 01 25 00.
- .4 Acoustic sealant for plenum locations: Smoke-seal sealant with flame-spread not more than 25 and smoke developed classification not more than 50 to CAN/ULC-S102-10, in accordance with Section 07 84 00.
- .5 Acoustic compound: premixed perlite plaster.
- .6 Acoustic (sound attenuation) insulation:
 - .1 Mineral-fibre sound attenuation batts: in accordance with CAN/ULC S702-14, Type 1, fire resistant and non-combustible to CAN/ULC-S114-05, high density for sag-free, tight fitting installation.
 - .1 Density: minimum 40 kg/m³ (2.5 lbs/ft³).
 - .2 Acceptable Products:
 - .1 Johns Manville 'MinWool Sound Attenuation Fire Batts'.
 - .2 Owens-Corning 'Thermafiber SAFB'.
 - .3 Rockwool 'AFB'.

Gypsum Board

2.8 Access Doors

- .1 Access doors: in accordance with Section 08 31 13.

PART 3 - EXECUTION

3.1 Installation

- .1 General:
 - .1 Comply with ASTM C840-18b, GA 216-21, GA 600-21, and manufacturer's written requirements, except as otherwise indicated.
 - .2 Do not bridge building expansion joints with support system.
 - .3 Frame both sides of joints with furring and other supports as indicated.
- .2 Install exposed gypsum board with face side out. Do not install imperfect, damaged or damp boards. Butt boards together for a light contact at edges and ends with not more than 1.6 mm (1/16") open space between boards. Do not force into place.
- .3 Cover both faces of stud partition framing with gypsum board in concealed spaces (above ceiling, and the like) unless otherwise indicated, except in chase walls which are properly braced internally.
- .4 Attach gypsum board to supplementary framing and blocking provided for additional support at openings and cut-outs.
- .5 Apply components of fire-rated assemblies in conformance with indicated designs.
- .6 Do not apply gypsum board in close proximity to hot pipes or heating ducts.
- .7 Install materials with the minimum number of joints. Tightly butt joints, without force, and neatly align them.
- .8 Frame openings on every side. Provide clearances with services.
- .9 Work shall include bulkheads over doors, frames, screens, and changes in ceiling levels, pipe space and as indicated.
- .10 Provide clearances between work of this section and structural elements to prevent transference of structural loads in accordance with Section 09 22 00.
- .11 Tolerances:
 - .1 Do not exceed 3 mm (1/8") in 3 m (10') variation from plumb, level, and plane in exposed surfaces, except at end joint between gypsum board panels.
 - .2 Do not exceed 10 mm (3/8") from indicated location.
 - .3 Do not exceed 1.5 mm (1/16") variation between planes of abutting edges or ends.
 - .4 Surface flatness shall not exceed 1.5 mm (1/16") within 305 mm (12") straight edge. For non-tapered-edge end joints between boards, measure flatness tolerance with end of straight end at centreline of joint.

3.2 Accessories

- .1 At external corners install corner trim secured to framing at 230 mm (9-1/16") on centre on both flanges with screw fasteners or clinch tool.

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- .2 Secure casing trim at board edges where exposed to view, where board butts against other materials with no trim to conceal junction, at perimeter of ceiling surfaces at tops of partitions where they stop against continuous ceiling surfaces, and where indicated.
- .3 Erect accessories straight, plumb or level, rigid and at proper plane.
- .4 Use full length pieces.
- .5 Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners, free from rough edges. Secure in accordance with manufacturer's specifications unless otherwise required.
- .6 Installation tolerances:
 - .1 Alignment with board panels shall not exceed tolerances specified above.
 - .2 End joints shall be flush aligned to maximum offset of 0.5 mm (0.020").

3.3 Board Application - General

- .1 Before installation of board commences, ensure that internal services have been installed, tested, and approved; conduits, pipes, cables, and outlets are plugged, capped, or covered; and that fastenings and supports installed by others are in place.
- .2 Extend board into door, window, and other openings, reveals, behind fitments, and other applied items and on metal stud partitions to structure above unless indicated otherwise.
- .3 Apply board with long dimension perpendicular to supports, unless otherwise indicated.
- .4 Locate joints on opposite sides of partitions on different studs, and at least 305 mm (12") from opening jambs.
- .5 Install board to minimize joints, and align end joints to be the least objectionable (where they are unavoidable), according to the indicated lighting design. Locate joints in ceilings where least prominently discerned, and never line them up with opening edges.
- .6 Form smooth joints at ends and at field cut edges of board panels.
- .7 Fasten board to metal support members by metal gypsum board screws, 9.5 mm (0.374") minimum to, and 12.7 mm (1/2") maximum from, centre of joints.
 - .1 Space screws:
 - .1 At fire rated board as per fire-rated assembly.
 - .2 At typical board walls at 400 mm (16") on centre at edges and field unless otherwise required.
 - .3 At typical board ceilings at 305 mm (12") on centre at edges and field unless otherwise required.
- .8 Offset gypsum board joints 150 mm (6") minimum from corners of openings.
- .9 Locate gypsum panel product joints so that no joint will align with the edge of an opening unless control joints are to be installed at these locations.
- .10 Replace damaged or weathered sheathing boards.

3.4 Curved Partition Installation

- .1 Framing erection:

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- .1 Cut top and bottom runner through leg and web at 51 mm (2") intervals for arc length. Allow 300 mm (12") uncut straight runner at each end of arc. Bend runners to uniform curve of specified radius. Clinch a 25 mm (1") x 25 gauge steel strip to inside of cut leg using metal lock fastener. Attach steel runners at floor and ceiling to structural elements with suitable fasteners located 51 mm (2") from each end and spaced 600 mm (24") on centre. To suspended ceilings, use toggle bolts or hollow wall anchors spaced 400 mm (16") on centre.
- .2 Position studs vertically, with open side facing in same direction and engaging floor and ceiling runners. Begin and end each arc with a stud and space intermediate studs equally along outside of arc. Secure studs to runners with 10 mm (3/8") pan head framing screws. On tangents, place studs 150 mm (6") on centre leaving last stud freestanding. Install balance of stud system in normal manner according to specifications.
- .2 Gypsum panel preparation:
 - .1 Select length and cut panel so one unbroken panel covers curved surface and 300 mm (12") tangents at each end. Outside panel must be longer than inside panel to compensate for additional radius contributed by studs.
 - .2 When wet panels are required, evenly spray water per manufacturer's written requirements on the surface to be in tension when panels are hung. Panels, while wet, should be bent to desired radius. Panels should be allowed to set in this shape prior to installation.
- .3 Gypsum panel erection:
 - .1 Apply gypsum panels horizontally with the wrapped edges perpendicular to studs. On the convex side of the partition, begin installation at one end of the curved surface and fasten panel to studs as it is wrapped around the curve. On the concave side, start fastening panel to the stud at the centre of the curve and work outward to the panel ends. Fasten single-layer panels with 25 mm (1") Type S screws spaced 300 mm (12") on centre.
 - .2 For double-layer application, apply base layer horizontally and fasten to stud with 25 mm (1") Type S screws spaced 400 mm (16") on centre. Centre face layer panels over joints in the base layer and secure to studs with 41 mm (1-5/8") Type S screws spaced 300 mm (12") on centre. Allow panels to dry completely before applying joint treatment.

3.5 Curved Surfaces

- .1 Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 305 mm (12") long straight sections at ends of curves and tangent to them.
- .2 For double-layer construction, fasten base layer to studs with screws 400 mm (16") on centre. Centre gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 305 mm (12") on centre.

3.6 Interior Mould and Moisture Resistant Gypsum Board Application

- .1 Apply water resistant sealant to edges, ends, cut-outs which expose gypsum core and to fastener heads. Do not apply joint treatment on areas to receive tile finish.

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3.7 Abuse Resistant Board Application

- .1 Install abuse resistance gypsum board in accordance with gypsum board manufacturer's written requirements.
- .2 Where both abuse resistant gypsum panels and plain gypsum board are used together on the same surface plane adjacent to one another, a smooth transition between the two types of boards is required. Finish the work in a manner such that the transition provides an inconspicuous joint when viewed by a person at normal viewing angles while standing in front of the boards from a distance of not less than 1000 mm (39").

3.8 Interior Tile Backer Board Application

- .1 Install in accordance with manufacturer's written requirements.
- .2 Section 09 31 00 to install tile setting material over tape installed by this section. Install mesh tape centred over tile backer board joints.

3.9 Acoustic Wall Assemblies

- .1 Acoustical sealant and plaster:
 - .1 Apply acoustical sealant to seal gaps in accordance with ASTM C919-22 and in accordance with the STC rated assembly.
 - .2 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 C919-22 and with manufacturer's written requirements for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
 - .3 Clean substrate, remove debris and deleterious substances.
 - .4 Apply sealant to close voids; no leaks around track and gypsum board.
- .2 Sound attenuation insulation:
 - .1 Install sound attenuation insulation to fill cavity unless otherwise indicated.
 - .2 Trim insulation to provide close-fit contact to framing assemblies and fill the partition cavity or acoustic insulation assemblies to thicknesses specified or indicated.
 - .3 Maintain air space between backs of sound attenuation insulation and back of opposite partition face layer, as applicable.
 - .4 Cut insulation to provide close-fit contact around electrical boxes, pipes, and other obstructions and penetrations through and within acoustic assemblies.
 - .5 Extend acoustic partition assemblies to underside of structure. Incorporate approved provision to prevent transmittance of structural deflection to partition assembly.
 - .6 Staple sound attenuation insulation where required by manufacturer's installation requirements.
 - .7 Where studs are not faced with gypsum board on both sides, mechanically fasten wire mesh to non-faced side of stud to retain insulation.

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- .8 Mechanically attach sound attenuation insulation in wall assemblies where cavity of wall assembly is greater than 150 mm (6").
- .9 Secure insulation in such a manner that it will not sag or settle away from required locations.
- .3 Sound flanking paths:
 - .1 Where sound rated partition walls intersect non rated gypsum board partition walls, extend sound rated construction to completely close sound flanking paths through non rated construction.
 - .2 Seal joints between face layers at vertical interior angles of intersecting partitions.

3.10 Finishing

- .1 Provide levels of gypsum board finish for locations as follows, in accordance with GA 214-21.
 - .1 Level 1: Ceiling plenum areas and concealed areas, except provide higher level of finish as required to comply with fire resistance ratings and acoustical ratings.
 - .2 Level 2: Gypsum board substrate at applied hard surfaces, except remove tool marks and ridges.
 - .3 Level 3: Skimming of existing drywall at new commercial grade vinyl wallcovering.
 - .4 Level 4: Exposed gypsum board surfaces, except where another finish level is indicated.
 - .5 Level 5: Exposed gypsum board surfaces where indicated.
- .2 Interior gypsum board:
 - .1 Prefill:
 - .1 Use setting-type joint compound. Mix joint compound according to manufacturer's written requirements.
 - .2 Fill joints between boards flush to top of eased or beveled edge.
 - .3 Fill joints of gypsum board above suspended ceilings in fire rated partitions.
 - .4 Wipe off excess compound and allow compound to harden.
 - .5 Prefill joint gaps not greater than 3.2 mm (1/8") with either ready-mix or setting type joint compound; prefill joint gaps greater than 3.2 mm (1/8") with setting-type joint compound.
 - .2 Taping (Level 1):
 - .1 Butter taping compound into inside corners and joints.
 - .2 Centre tape over joints and press down into fresh compound.
 - .3 Remove excess compound.
 - .4 Tape joints of gypsum board above suspended ceilings.
 - .3 First coat (Level 2):
 - .1 Use taping or all-purpose drying-type compound.

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- .2 Immediately after bedding tape, apply skim coat of compound and allow to dry completely in accordance with manufacturer's written requirements.
- .3 Apply first coat of compound over flanges of trim and accessories, and over exposed fastener heads and finish level with board surface.
- .4 Cover fastener heads and accessories with 1 coat of joint compound.
- .4 Second coat (Level 3): After first coat treatment is dried, apply second coat of compound over tape and trim, feathering compound 50 mm (2") beyond edge of first coat.
 - .1 Cover fastener heads and accessories with total of 2 separate coats of joint compound.
- .5 Third coat (Level 4):
 - .1 After second coat has dried, sand surface lightly and apply thin finish coat to joints, fasteners and trim, feathering compound 50 mm (2") beyond edge of second coat.
 - .2 Allow third coat to dry. Apply additional compound, and touch-up and sand, to provide surface free of visual defects, tool marks, and ridges, and ready for application of finish.
 - .3 Finished joints will be accepted with a camber not greater than 1 mm (1/32") and shall be seamless, plumb, true and flush and with square, neat corners.
 - .4 Cover fastener heads and accessories with total of 3 separate coats of joint compound.
 - .5 Where new partitions align with existing gypsum board, apply required amount of skim coats to make transition inconspicuous from a distance of 914 mm (36").
 - .6 Completed installation at interface between new and existing construction shall provide an inconspicuous joint.
- .6 Skim coat (Level 5):
 - .1 After the fourth coat has dried, apply skim coat over exposed surfaces of gypsum board in accordance with manufacturer's written requirements.
 - .2 After skim coat has dried, touch-up and sand to provide surface free of visual defects, tool marks, and ridges, and ready for application of finish.
- .3 Interior mold and moisture resistant gypsum board: Treat fastener heads and joints with setting-type joint compound.
 - .1 For joints to be covered with tile, apply tape and joint compound bedding coat and skim coat only; do not apply finish coats.
 - .2 Do not crown joints or leave excess compound on panels.
 - .3 Remove tool marks and ridges.
 - .4 For fastener heads to be covered with tile, apply one coat of joint compound.
- .4 Interior tile backer board: Prepare and finish joints in accordance with manufacturer's written requirements.

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- .5 Joint compound:
 - .1 Apply finish coat of compound feathering 75 to 100 mm (3" to 4") beyond tape edges.
 - .2 Feather coats onto adjoining surfaces so that camber is maximum 0.79 mm (1/32").
- .6 Trim:
 - .1 Use same fasteners to anchor trim accessory flanges as required to fasten gypsum board to supports, unless otherwise recommended by trim manufacturer.
 - .2 Install metal corner beads at external corners.
 - .3 Install metal casing bead trim whenever edge of gypsum base would otherwise be exposed or semi exposed, and where gypsum base terminates against dissimilar material.
 - .4 Erect beads plumb or level, with minimum joints.
- .7 Control joints:
 - .1 Provide control joints set in board facing. Support control joints with studs or furring channels on both sides of joint.
 - .2 Provide control joints in required locations
 - .1 Review control joint locations with Contract Administrator prior to installation.
 - .3 Install control joints where a partition, wall, or ceiling traverses a construction joint (expansion, seismic or building control element) in the building structure.
 - .4 Install control joints where a wall or partition runs in an uninterrupted straight plane exceeding 9100 mm (30 linear feet).
 - .5 Install control joints in interior ceilings:
 - .1 With perimeter relief:
 - .1 Linear dimensions between control joints shall not exceed 15000 mm (50 ft) and total area between control joints shall not exceed 230 m² (2500 ft²).
 - .2 Without perimeter relief:
 - .1 Linear dimensions between control joints shall not exceed 9100 mm (30 ft) and total area between control joints shall not exceed 84 m² (900 ft²).
 - .6 Install control joints where ceiling framing members change direction.
 - .7 Where a control joint occurs in an acoustical or fire-rated system, provide blocking behind the control joint by using a backing material such as 16 mm (5/8") Type X gypsum panel products, mineral fibre, or other tested equivalent. Construct through-wall control joints at fire-rated assemblies in accordance with assembly listing requirements.
 - .8 Line up control joints with joints in other construction or with centre lines of mullions, columns, piers, or similar building elements, where accepted by Contract Administrator.
 - .9 Install control joints straight and true.

Gypsum Board

- .10 Ceiling height door frames may be used as control joints. Less than ceiling height frames shall have control joints extending to the ceiling from both corners. If control joints are not used, additional reinforcement is required at corners to distribute concentrated stresses.
- .11 Locate board joints so that no joint will align with the edge of an opening unless control joints are to be installed at these locations.

3.11 Fire Separations

- .1 Install fire-rated assemblies in accordance with assembly listing requirements in order to obtain fire ratings indicated and as required by authorities having jurisdiction.
- .2 Vertical bulkheads in ceiling spaces over fire rated partitions, doors and the like shall have same fire rating as the partition over which they occur. Such bulkheads shall be of gypsum board construction unless otherwise indicated.
- .3 Use fire rated gypsum wallboard as specified.
- .4 Where lighting fixtures, diffusers, and the like are recessed into fire rated ceilings or bulkheads, provide enclosure to maintain required fire rating. Form removable panel to give access to fixture outlet box.
- .5 Where fire hose cabinets or other fixtures or equipment are recessed in fire rated walls or partitions, provide gypsum board enclosure or backing to maintain required fire rating, unless otherwise detailed.

3.12 Access Doors

- .1 Install access doors to mechanical and electrical fixtures specified in respective sections of Divisions 21, 22, and 23 and Divisions 26, 27, and 28.
- .2 Install access panels in locations to be determined by coordination with trades installing mechanical, electrical and other building services and consultation with Contract Administrator.
- .3 Rigidly secure frames to furring or framing systems.

3.13 Adjusting and Cleaning

- .1 Clean up and remove surplus materials and rubbish resulting from the work of this section upon completion.
- .2 Clean off beads, casings, joint compound droppings and the like, leave the work of this section ready for painting trades.

END OF SECTION

Tiling

PART 1 - GENERAL

- .1 Section includes:
 - .1 Interior hard surface tiling.
 - .2 Mortar bed for tiling.
 - .3 Thin-set mortar for tiling.
 - .4 Levelling underlayment.
 - .5 Sheet crack suppression membrane.
 - .6 Trim accessories.

1.2 References

- .1 Definitions:
 - .1 Large format tile: Tiles with dimension measured along any edge 380 mm (15") and greater.

1.3 Administrative Requirements

- .1 Conduct a pre-installation meeting in accordance with Section 01 31 19.
- .2 Sequencing and scheduling:
 - .1 Coordinate installation of tile work with related work.
 - .2 Proceed with tile work only after curbs, vents, drains, piping, and other projections through substrate have been installed and when substrate construction and framing of openings have been completed.

1.4 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
 - .2 Submit manufacturer's installation requirements for Products proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Indicate location and sizes of expansion and control joints.
- .4 Samples:
 - .1 Submit 3 -full size samples of each type of tile specified.
 - .2 Submit 3 -full size samples of each unglazed tile, fully grouted (4 tiles) with selected grout colours to determine whether staining will be a problem.
 - .3 Submit 3 - 305 mm (12") long samples trim accessory.
 - .4 Submit 3 - 305 mm (12") long samples of control joint sealant.

Tiling

- .5 Test and evaluation reports:
 - .1 Submit moisture, alkalinity, and mortar bond test results.

1.5 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance requirements for inclusion in the operation and maintenance manuals.
- .3 Maintenance materials:
 - .1 Provide minimum 2% of each type and colour of tile required for the Work for maintenance use.
 - .2 Maintenance material to be of same production run as installed material.

1.6 Quality Assurance

- .1 Qualifications:
 - .1 Subcontractor:
 - .1 Has adequate plant, equipment, and skilled workers to perform the work expeditiously.
 - .2 Has successfully completed installations similar to that specified during a period of at least the immediate past 5 years.
 - .3 Shall be a member company in good standing of the Terrazzo, Tile and Marble Association of Canada and have been a member for at least the past 5 years.
- .2 Mock-ups:
 - .1 Grouted mock-up: 1220 mm x 1220 mm (48" x 48") sample panels of each tile type and colour, texture, size, and pattern of tile and grout.
 - .2 Install tile to suite mock-up for acceptance by Contract Administrator. Accepted mock-up shall form basis of standard of workmanship for remainder of work.
 - .3 Install each product and colour mock-up for acceptance by Contract Administrator. Accepted mock-up shall form basis of standard of workmanship for remainder of work.
 - .4 Mock-up shall consist of floor/wall/base corner intersection, with 300 mm (12") of finish product on each face and expansion and control joints.

1.7 Field Conditions

- .1 Ambient conditions:
 - .1 Execute work of this section while ambient temperature and humidity within safe working temperatures in accordance with manufacturer's installation requirements for a period of 72 hours before, during and following installation. Avoid concentrated or irregular heating during curing period.

Tiling

1.8 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - .1 System:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Terrazzo, Tile and Marble Association of Canada ("TTMAC") Specification Guide 09 30 00 Tile Installation Manual TTMAC 2019-2021 Specification Guide 09 30 00, Tile Installation Manual.
- .1 Slip resistance: Floors shall have a wet Dynamic Coefficient of Friction (DCOF) of 0.42 or greater in accordance with ANSI A326.3.
- .2 Tiling systems shall exhibit none of the following once installed:
 - .1 Waterproofing under tile assemblies that fails to remain watertight.
 - .2 Staining or discolouration of tile due to mortar or grout.
 - .3 Delaminating of tile.
 - .4 Cracked or chipped tiles.
 - .5 Cracked grout.

2.2 General

- .1 Tile products shall be from same production run, dye lot, calibre, and batch number. If shading variation is evident, notify Contract Administrator prior to installation.

2.3 Tile Products

- .1 Porcelain:
 - .1 TLC-1; Backsplash:
 - .1 Acceptable Product: Refer to Material/Equipment/Product Tag Schedule.
 - .1 Size: 70 mm x 280 mm (2-3/4" x11").
 - .2 Colour: Refer to Material/Equipment/Product Tag Schedule.
 - .2 TLC-2; Backsplash:
 - .1 Acceptable Product: Refer to Material/Equipment/Product Tag Schedule.
 - .1 Size: 70 mm x 280 mm (2-3/4" x11").
 - .2 Colour: Refer to Material/Equipment/Product Tag Schedule.
- .2 TLC3; Floor tile:
 - .1 Acceptable Product: Refer to Material/Equipment/Product Tag Schedule.

Tiling

- .1 Size: 300 mm x 300 mm (12" x 12").
- .2 Colour: Refer to Material/Equipment/Product Tag Schedule.

2.4 Mortar Materials

- .1 Unless otherwise specified, select from the following thin-set mortar:
 - .1 Latex modified Portland cement thin bed mortar gauged:
 - .1 ANSI A118.4 (ANSI A108/A118/A136.1-20) and ANSI A118.11 (ANSI A108/A118/A136.1-20).
 - .2 White colour for translucent tile applications.
 - .3 Acceptable Products:
 - .1 Ardex 'X77 Microtec Fiber Reinforced Mortar' with Ardex 'E90 Mortar Admix'.
 - .2 Custom Building Products 'ProLite'.
 - .3 Flextile '51' mixed with Flextile '44'.
 - .4 Mapei 'KERALASTIC' mixed with 'KERABOND'.
 - .5 Profix '6500' liquid latex mixed with '8500' thin set mortar.
 - .6 Promo Adhesives Inc. 'Pro Bond Plus' with 'Pro Bond Plus Additive'.
 - .7 TEC 'Superflex Ultra-Premium Thin Set'.
 - .2 Enriched, modified, Portland cement thin bed mortar, single component, with integral polymer:
 - .1 ANSI A118.4 (ANSI A108/A118/A136.1-20) and ANSI A118.11 (ANSI A108/A118/A136.1-20).
 - .2 White colour for translucent tile applications.
 - .3 Acceptable Products:
 - .1 Ardex 'X 5 Flexible Tile & Stone Mortar'.
 - .2 Custom Building Products 'Versabond LFT'.
 - .3 Flextile '52'.
 - .4 Laticrete '254 Platinum Multipurpose Thin-Set Mortar'.
 - .5 Mapei 'Ultraflex 3' or 'Ultraflex RS'.
 - .6 Profix 'Megaflex' thin set mortar.
 - .7 Promo Adhesives Inc. 'Pro HPX'.
 - .8 TEC 'Ultimate Large Tile Mortar'.
- .2 Special mortar and setting materials:
 - .1 Mortar for large format tiles meeting definition under paragraph 1.2.1.1:
 - .1 Enriched, modified, fast-set Portland cement medium bed mortar high-hydration, low residual moisture behind the tile formula.

Tiling

- .2 ANSI A118.4 (ANSI A108/A118/A136.1-20) and ANSI A118.11 (ANSI A108/A118/A136.1-20).
- .3 Substrate primer: in accordance with manufacturer's installation requirements.
- .4 White colour for translucent tile applications and light coloured stones.
- .5 Acceptable Products:
 - .1 Ardex 'S 28 Microtec Rapid Hardening and Rapid Drying Semi-Pourable Natural Stone Floor Tile'.
 - .2 Custom Building Products: 'MegaLite'.
 - .3 Flextile '58XT'.
 - .4 Mapei 'Granirapid'.
 - .5 Laticrete '4-XLT Rapid'.
 - .6 Profix 'Flex GT-30'.
 - .7 Profix 'Optiflex' Full-Contact Mortar.
 - .8 Promo Adhesives Inc. 'Pro Quick SF' with 'Pro Quick Plus Additive'.
 - .9 TEC 'Fast Set Ultimate Large Tile Mortar'.
 - .10 TEC 'Fast Set 3N1 Performance Mortar'.
- .2 Latex-Portland cement mortar for thick beds, levelling beds and scratch coats:
 - .1 ANSI A118.4 (ANSI A108/A118/A136.1-20) and ANSI A118.11 (ANSI A108/A118/A136.1-20).
 - .2 Acceptable Products:
 - .1 Ardex 'A 38 Rapid Hardening and Drying Cement for Floor Screeds in Internal or External Locations'.
 - .2 Custom Building Products 'SpeedSlope'.
 - .3 Custom Building Products 'Thick Bed Bedding Mortar'.
 - .4 Flextile '4:1 Dry Pack Mortar mixed with Flextile '44'.
 - .5 Laticrete '226 Thick Bed Mortar' gauged with Laticrete '3701 Mortar Admix'.
 - .6 Mapei 'Ultraflex LFT'.
 - .7 Profix 'GT 30' medium bed mortar.
 - .8 Promo Adhesives Inc. 'Pro P-151 SF'.
 - .9 TEC 'Floor Mud'.
- .3 Mortar beds, levelling coats:
 - .1 Materials:
 - .1 Water: clean and free of chemicals detrimental to mortar and grout mixes.
 - .2 Sand: to ASTM C144-18, passing 16 mesh.
 - .3 Cement: to CSA A3002-13, Type U.

Tiling

- .4 Latex: Formulated for use with Portland cement mortars.
 - .5 Cleavage membrane: 0.10 mm (4 mil) thick polyethylene film to CAN/CGSB 51.34-M86.
 - .6 Reinforcing mesh: 51 mm x 51 mm (2" x 2") mesh size, fabricated from 1.6 mm (0.06") thick galvanized steel wire; welded fabric design.
- .2 Mixes:
- .1 Scratch coat (by volume): 1 part Portland cement, 4 parts sand, and water or latex where required by TTMAC detail. Premixed mortar may be used per manufacturer's requirements. Adjust liquid volume may be adjusted depending on water content of sand to obtain consistency and workability.
 - .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): 1 part Portland cement, 4 parts sand, and water or latex where required by TTMAC detail. Premixed mortar may be used per manufacturer's requirements. Adjust liquid volume may be adjusted depending on water content of sand to obtain consistency and workability.
 - .4 Levelling coat (by volume): 1 part Portland cement, 4 parts sand, and water or latex where required by TTMAC detail. Premixed mortar may be used per manufacturer's requirements. Adjust liquid volume may be adjusted depending on water content of sand to obtain consistency and workability.
 - .5 Mortar bed for floors (by performance): 1 part Portland cement, 4 parts sand, and water or latex where required by TTMAC detail. Premixed mortar may be used per manufacturer's requirements. Adjust liquid volume may be adjusted depending on water content of sand to obtain consistency and workability that will allow compaction during tamping of the mortar bed, and achieve minimum compressive strength of 15 MPa after 28 days.
- .4 Levelling underlayment:
- .1 Cement-based, quick-setting, self-levelling, self-drying underlayment for installations from featheredge to minimum 32 mm (1") thick in single application.
 - .2 Primer: Type as recommended by levelling underlayment manufacturer to suit substrate.
 - .3 Acceptable Products:
 - .1 Ardex 'Liquid BackerBoard Self-Levelling Underlayment'.
 - .2 Ardex 'TL 1000'.
 - .3 Custom Building Products 'TechLevel 100'.
 - .4 Flextile '5900 Flex-Flo Plus Self-Levelling Underlayment'.
 - .5 Laticrete 'Supercap SC500'.
 - .6 Mapei 'Ultraplan 1 Plus'.
 - .7 Promo Adhesives Inc. 'Pro Plan'.
 - .8 TEC 'Contractor Grade Self Levelling'.

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.9 TEC 'Levelset 200'.

2.5 Grout Materials

- .1 High performance polymer-modified grout:
 - .1 Weather, frost and shock resistant.
 - .2 ANSI A118.7 (ANSI A108/A118/A136.1-20).
 - .3 Acceptable Products:
 - .1 Custom Building Products: 'Prism Ultimate Performance Grout'.
 - .2 Laticrete 'PermaColor Grout'.
 - .3 Mapei 'Ultracolor Plus FA'.
 - .4 Promo Adhesives Inc. 'Pro Topgrout'.
 - .5 TEC 'Power Grout'.
- .2 Grout colours to later selection by Contract Administrator from manufacturer's full range.
- .3 Grout sealer: as recommended by grout manufacturer.

2.6 Sheet Crack Suppression Membrane

- .1 Review floor assembly design (live load deflection) with Contract Administrator and crack suppression membrane manufacturer's representative. Confirm crack suppression membrane manufacturer's recommended product to Contract Administrator in writing, on crack suppression membrane manufacturer's company letterhead prior to commencing the installation.
- .2 Walls: waterproofing membrane:
 - .1 Polyethylene membrane with polypropylene fleece laminated on both sides. Membrane meets or exceeds ANSI A118.10 (ANSI A108/A118/A136.1-20).
 - .2 Acceptable Products:
 - .1 Schluter 'Kerdi'.
- .3 Floors; crack suppression membrane:
 - .1 High density corrugated polyethylene matting with dovetail-shaped ribs with polypropylene-fibre support webbing laminated to the underside to provide a mechanical bond to the substrate mortar. Membrane meets or exceeds ANSI A118.10 (ANSI A108/A118/A136.1-20) and ANSI A118.12 (ANSI A108/A118/A136.1-20).
 - .2 Acceptable Products:
 - .1 Schluter 'Ditra'.
 - .2 Schluter 'Ditra XL'.
- .4 Accessories:

Tiling

- .1 Mortar for setting tile and installing membranes and membrane waterproofing accessories: Compatible product as recommended by sheet crack suppression membrane manufacturer.
- .2 Membrane waterproofing accessories:
 - .1 Use Schluter 'KERDI-BAND' to seal waterproofing membrane seams and joints where manufacturer preformed corners cannot be used.
 - .2 Use 'KERDI-FLEX' to seal expansion joints or flexible edge joints.
 - .3 Use 'KERDI-KERS-B' and 'KERDI-KERS' for inside and outside corners.
 - .4 Use 'KERDI-SEAL-PS/-MV' for sealing pipe protrusions.
 - .5 Use 'KERDI'FIX' to seal pipe protrusions where 'KERDI-SEAL-PS/-MV' cannot be used.

2.7 Accessories and Related Materials

- .1 Trim accessories:
 - .1 Finishing and edge protection:
 - .1 Acceptable Products:
 - .1 Schluter Systems 'SCHIENE'.
 - .2 Joint sealants: mildew resistant sealant in accordance with Section 07 92 00.
 - .3 Expansion and control joint sealant:
 - .1 One-component, neutral cure, exterior grade silicone sealant.
 - .2 Tensile strength (ASTM C794-18): 1.5 MPa (225 psi).
 - .3 Hardness (ASTM D751-06(2011); Shore A): Minimum 25 (colored sealant)/15 (clear sealant).
 - .4 Weather Resistance (QUV Weather-ometer): No change after 10,000 hours.
 - .5 Acceptable Products:
 - .1 Flextile 'Ultra Performance Caulk'.
 - .2 Laticrete 'Latasil Tile and Stone Sealant'.
 - .3 Mapei 'Mapesil T'.
 - .4 Control joint sealant:
 - .1 One-component, neutral cure, exterior grade silicone sealant.
 - .2 Tensile strength (ASTM C794-18): Minimum 1.5 MPa (225 psi).
 - .3 Hardness (ASTM D751-06(2011); Shore A): Minimum 15.
 - .4 Weather resistance (QUV Weather-ometer): No change after 10,000 hours.
 - .5 Acceptable Products:
 - .1 Ardex 'SX'.
 - .2 Flextile 'Tile & Grout Caulk'.

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- .3 Laticrete 'Latasil Tile and Stone Sealant'.
- .4 Mapei 'Mapesil T'.
- .5 Profix 'Poly 400 Flexible Caulking'.
- .6 TEC 'Accucolour 100% Silicone Sealant'.

PART 3 - EXECUTION

3.1 Examination

- .1 Ensure compatibility of Products supplied under this section, and which bear contact with substrate.
- .2 Before work of this section commences, examine the areas to be covered and report any flaw or adverse conditions in writing to the Contractor and the Contract Administrator. Do not proceed with work until surfaces and conditions comply with the requirements indicated in the manufacturer's requirements and in ANSI A108.5 (ANSI A108/A118/A136.1-20) specification.
- .3 Miscalibrated tiles, tiles with chipped corners, tiles with holes, will not be accepted for installation.
- .4 Inspect tiles for colour variation. Tiles presenting noticeable variations shall be carefully selected, set aside and used in areas where they fit in the pattern homogeneously. Provide for appropriate lighting equipment in addition to existing lighting in the immediate area where the installation is being performed so that any shade differences which are normally very slight can be identified easily.

3.2 Preparation

- .1 Completely remove contaminants and deleterious substances and debris which may prevent, reduce, and affect adhesion or performance or may act as bond breaker.
- .2 Wire brush steel substrates to remove deleterious substances and rust, to promote full adhesion to steel.
- .3 Roughen surfaces with previously painted glossy finishes by sandpaper or other abrasive medium, and completely remove finishes which are not compatible with products specified under this section.
- .4 Prime gypsum, wood or porous concrete with primer, brush or roller applied at full strength in accordance with mortar manufacturer's recommendations.
- .5 Floor surfaces:
 - .1 At door opening locations where finished flooring is adjacent to weather-stripping or automatic door bottoms provide trowel-applied levelling compound to provide full contact between finished flooring and weather-stripping or automatic door bottoms. Taper trowel-applied levelling compound to transition with adjacent flooring substrate to be provide smooth and seamless transition at maximum slope of 3:1000 (height to distance) ratio.
- .6 Alkalinity, moisture, and adhesion testing:
 - .1 Perform moisture and alkalinity tests and mortar bond test.

Tiling

- .2 Where concrete substrate exhibits higher than permitted moisture and alkalinity levels, Provide water vapour reduction system and repeat moisture and alkalinity tests and mortar bond tests.
- .3 Proceed with installation only after substrates pass testing. Document tests performed and submit in writing to Contract Administrator.

3.3 Mixing

- .1 Mix mortars, additives and grouts in accordance with manufacturer's written requirements.

3.4 Levelling Underlayment Installation

- .1 Install levelling underlayment to tile flooring assemblies utilizing large format tile, except for large format tile installations over mortar bed sloped to drain.
- .2 Mix and apply primer to prepared subfloor. Allow to dry prior to installation of levelling material.
- .3 Mix and apply levelling material in accordance with manufacturer's written requirements to produce a smooth, flat surface.
 - .1 Apply levelling underlayment to provide substrate surface flatness tolerances to achieve $F_F 60$ in accordance with ASTM E1155-14 or 3 mm (1/8") with a 3000 mm (10'-0") straightedge.
- .4 Allow to set prior to installation of tile.

3.5 Sheet Crack Suppression Membrane Installation

- .1 Levelling and sloping of substrates shall be completed prior to installation of crack suppression membranes.
- .2 Remove dust, dirt, oil, grease, paint, laitance, efflorescence, curing compounds, sealers, water repellents and other deleterious materials that prevent bond. Metal plumbing pipe penetrations and fixtures must be clean of oil, grease, rust and other potential bond breakers.
- .3 Install membranes to locations as indicated or scheduled to provide watertight performance.
- .4 Install membranes to comply with ANSI A108.13 (ANSI A108/A118/A136.1-20) and manufacturer's written requirements to produce waterproof membrane of uniform thickness and bonded securely to substrate.
- .5 Install prefabricated corners at outside and inside corner conditions.
- .6 Install prefabricated pipe collars at penetrations.
- .7 Provide strips of membrane where required to span expansion joints or terminate membrane into movement joint type tile setting accessories, in accordance with manufacturer's requirements.
- .8 Seal membranes at penetrations and terminations in accordance with manufacturer's installation requirements.
- .9 Floors; crack suppression membrane:

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- .1 At the joints, fill the cut-back cavities with mortar centred over membrane seams and apply additional mortar with notched trowel. Centre membrane bands over seam and embed to achieve 100% contact with mortar and substrate removing air pockets.
- .2 At wall junctions apply a 250 mm (10") band strips in same manners as membrane seams.
- .3 Membrane bands shall overlap crack suppression membrane seams, floor/wall transitions minimum 50 mm (2").
- .10 Drains shall be of the clamping ring type, with weepers.
- .11 Embed reinforcing fabric/mesh into waterproofing/crack isolation membrane to achieve full contact and to remove air pockets.
- .12 Seal waterproofing/crack isolation at penetrations and terminations.
- .13 Apply waterproofing/crack isolation membrane coats at manufacturer's recommended application rates.

3.6 Installation - General

- .1 Install Products in accordance with manufacturer's specifications and as indicated herein, in accordance with TTMAC Specification Guide 09 30 00 Tile Installation Manual TTMAC 2019-2021, and in accordance with ANSI A108.5 (ANSI A108/A118/A136.1-20) except where specified otherwise.

3.7 Thin-Set Method

- .1 Make joints even, straight, plumb and of uniform width.
- .2 Provide mortar beds and levelling coats in accordance with TTMAC details.
- .3 Provide uniform positive slope to floor drains, to minimum allowable slope of 20 mm/m (1/4 inch/ft).
- .4 Provide edge protection at tile edges and corners, unless otherwise indicated, using maximum length pieces.
- .5 Provide edge protection and transition strips at tile transitions, unless otherwise indicated, using maximum length pieces.
- .6 Review locations of tile accessories with Contract Administrator prior to setting tile and comply with directions of Contract Administrator.
- .7 Lap tile and seal with sealant at inside corners and bath/shower fixtures. Caulk around pipes and openings made in tile with sealant.
- .8 Apply sealant at interface with frames at openings. Apply sealant in accordance with Section 07 92 00 and manufacturer's requirements.
 - .1 Sealant colour to later selection by Contract Administrator.

Tiling

- .9 Install flooring to entire area indicated or scheduled. Unless otherwise indicated, include coverplates occurring within finished floor areas. Maintain overall uniform continuity of colour and pattern with pieces of flooring installed on cover plates. Tightly butt edges to perimeter of floor around cover plates and to cover plates. Do not install flooring to floor drains occurring within finished floor areas.

3.8 Tile Setting

- .1 Lay out tile work as indicated on drawings, and where lay-out is not indicated, lay-out tiles so tiles less than 1/2 the least dimension do not occur and with minimum amount of cutting.
- .2 Using a damp towel, wipe off the back side of tile to remove any dust or other residue that may be left over from the manufacturing process.
- .3 Place as much tile as possible in one operation before setting bed reaches initial set. Clean back and remove bed when it has set before tile is laid.
- .4 Prime materials and by methods specified by manufacturer of bond coat.
- .5 Except where tiles have setting tabs, and except for expansion, control and isolation joints, maintain joint widths as selected by Contract Administrator.
- .6 Back up tile coves, curbs and other shaped pieces solid with mortar. Rigidly set, reinforce or otherwise make firm and secure such pieces.
- .7 Beat tiles in thoroughly and sufficiently to cause mortar ribs or notches to come together into a continuous void free bed and allow the mortar to flow up partially into the joint space to maximum of 1/3 the thickness of the tile. Sound floor tiles by tapping and reset tiles with voids in setting bed.
- .8 Tile shall contact setting materials for minimum of 95% coverage unless otherwise indicated.
- .9 Obtain 100% mortar coverage with applicable requirements for back buttering of tile in referenced TTMAC and ANSI A108/A118/A136.1-20 series of tile installation standards for the following:
 - .1 Tile in wet areas:
 - .1 Laundries.
 - .2 Tile installed with chemical resistant mortars and grouts.
 - .3 Tile having any dimension 300 mm (12") or larger in any direction.
 - .4 Tile with raised or textured backs.
 - .5 Tile installation rated for Heavy or Extra Heavy Duty.
 - .6 Porcelain tiles with more than 20% of the tile backs covered with firing release dust back buttered so that 100% of the back is covered with mortar rated for C627, Extra Heavy Duty rating.
- .10 Remove any excess setting material from the joint area so that 2/3 of the depth of the tile is available for grouting.
- .11 Remove smudges or smears of setting material from the tile surface with a damp sponge or cloth immediately after final adjustment and beat-in while the mortar is fresh.

Tiling

- .12 Do necessary cutting and drilling of fixtures, fittings, and built-in or penetrating units without marring the tile. Replace cracked or damaged tile.
- .13 Form external angles with round edge tile extending over edge of square edge adjacent tile. Internal angles shall be formed square, carrying 1 flat tile past edge of other.
- .14 Extend tile into recesses at windows, doors, or other openings.
- .15 Extend tiles 100 mm (4") behind mirrors, and fully behind cabinets, cupboards and other fixed objects at walls.
- .16 Cut tiles to conform to irregularities in wall lines and vertical planes along outer edges. Smooth cut edges with carborundum block or by other means to provide clean straight edge.
- .17 Install tiles to provide even distribution of shading, colour, and characteristics.

3.9 Control and Expansion Joints

- .1 Install control joints and expansion joints in tile work in accordance with TTMAC Detail 301MJ-2019-2021 in floors and walls and at perimeters of floors, around columns and where tile abuts other hard materials and as indicated or in accordance with the following table:

Environment	Minimum	Maximum	Minimum Joint Width
Interior/Shades	4800 mm	6100 mm	6 mm
Interior/Sunlight	2400 mm	3700 mm	6 mm
Exterior/Normal	2400 mm	3700 mm	10 mm
Exterior/Excessive	2400 mm	3000 mm	13 mm

- .1 Review locations with Contract Administrator prior to setting tile and comply with instruction given by Contract Administrator.
- .2 Carry substrate control and movements joints through to tile work.
- .3 Incorporate expansion joints over building expansion joints.
- .4 Cut tiles on both sides along the edges of control or expansion joints.
- .5 Sealant control joints: Raking out joints to full depth of tile and cleaning joints for application of sealant in accordance with Section 07 92 00.
- .6 Manufactured control joint trim: in accordance with "Accessories and Related Materials" paragraph.

3.10 Trim Accessories Installation.

- .1 Install trims in accordance with manufacturer's written requirements.
- .2 Install in continuous lengths.
- .3 Scribe and fit to obstructions.
- .4 Mitre corners.
- .5 Tile shall be installed flush with top surface of trim accessory with tolerance of 1 mm (1/32") lower than the top surface of trim accessory. The trim accessory shall not be higher than the tiled surface. A joint of 3 mm (1/8") shall be left between the tile and the profile to be filled with grout.

Tiling

3.11 Grouting

- .1 Install grout to comply with ANSI A118.4 (ANSI A108/A118/A136.1-20) unless otherwise specified and in accordance with manufacturer's written requirements.
 - .2 Allow tile installation to cure a minimum of 24 hours prior to grouting.
 - .3 Grout joints shall be free of dirt, debris, water or tile spacers and face of tiles are clean.
 - .4 Apply a coat of grout release and achieve 100% surface covered of tile following grout release manufacturer's written requirements.
 - .5 Pack joints full and free of voids/pits.
 - .6 Allow grout joints to become firm. Inspect joint for pinholes/voids and repair them with freshly mixed grout. Within 24 hours, check for remaining haze and remove it with warm soapy water and a nylon scrubbing pad, using a circular motion, to lightly scrub surfaces and dissolve haze/film.
- .1 Grout joint width to be 3 mm (1/8") unless otherwise indicated; except at mosaic type tiles on paper or mesh backed sheets.
 - .2 Use caution when using sanded grouts to prevent scratching of tile or other material surfaces.
 - .3 Do not cover, bridge or fill any expansion joints in tile with grout.

3.12 Tile Installation Tolerances

- .1 Maximum allowable lippage:
 - .1 Tile up to 152 mm x 152 mm (6" x 6") in size: 1 mm (0.040").
 - .2 Tile greater than 152 mm x 152 mm (6" x 6") in size: 2 mm (0.080").
- .2 Finish planes shall be straight and plumb to within 6 mm in 3 m (1/4" in 10 feet).

3.13 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00.
 - .1 Field tests and inspections:
 - .1 For concrete floor substrates subject to moisture sensitive materials, conduct the following tests in accordance with the following:
 - .1 Test for moisture vapour transmission in accordance with ASTM F710-22 and ASTM F1869-22 or ASTM F2170-19a in accordance with manufacturer's written installation requirements. Results must not exceed the written recommendations of the product manufacturer.
 - .2 Test for surface pH. Levels of pH shall not exceed the written recommendations of the product manufacturer. Test in accordance with ASTM F710-22.
 - .3 For each test type: Conduct 3 tests for flooring applications up to 93 m² (1000 square feet) in area, and 1 additional test for each additional 93 m² (1000 square feet) of flooring area.
 - .2 Adhesion bond test:

Tiling

- .1 Proceed with bond test after substrates have been prepared and alkalinity and moisture test have been completed.
 - .2 Adhesion bond test shall be completed in accordance with tile flooring and mortar setting manufacturer's written requirements.
 - .3 Using the specified mortar, set test tiles using mortar manufacturer's recommended trowel.
 - .4 After pre-determined duration, attempt to remove the test tiles by pulling up from the corners.
 - .5 Using the specified mortar, set test tiles using mortar specified and to comply with specifications.
 - .6 After tiles have set and after duration of time as specified by *Consultant*, commence pull off test to determine bonding strength of mortar between tile and substrate. Testing specimen sizes and number of tests including locations of tests shall be as directed by *Consultant*.
- .2 Manufacturer shall provide field review in accordance with Section 01 45 00.

3.14 Adjusting and Cleaning

- .1 Clean installed tile surfaces after grouting has cured.
- .2 Re-point joints after cleaning to eliminate imperfections. Avoid scratching tile surfaces.

3.15 Protection

- .1 Protect work of this section against damage by work of other sections for a minimum of 72 hours after application of grouting by prohibiting passage of traffic over tile. Do not immerse in water and protect tilework from freezing for at least 28 days after installation.
- .2 Protect floors from impact and vibration for a minimum of 48 hours after installation.
- .3 Install floor protection in areas where other work, repairs and installation of equipment, and foot traffic will occur.
- .4 Where latex or polymer additives are used in mortar materials, materials shall be cured a minimum of 14 days before exposure to moisture and before water immersion and longer as included in mortar manufacturer's written requirements.

END OF SECTION

Acoustical Panel Ceiling Systems

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Acoustical panel ceiling systems; APN1.

1.2 Administrative Requirements

- .1 Coordination:
 - .1 Coordination of work: coordinate layout and installation of acoustic ceiling units and suspension systems components with other work supported by or penetrating through ceilings, including light fixtures, HVAC equipment, partition system and fire suppression system components.
- .2 Conduct a pre-installation meeting in accordance with Section 01 31 19.
 - .1 Independent inspection and testing company shall attend the pre-installation meeting.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Submit shop drawings, indicating panel layout and system components, for each panel system.
 - .2 Include plans, sections and large scale details, and indicate components and methods of assembly, materials and their characteristics, fastenings, finishes, and other fabrication information required for the work of this section. Indicate assembly joint lines.
 - .3 Submit coordination drawings indicating locations of concealed grounds, cutouts, plates, and other required fabrications.
 - .4 Show relation to adjoining construction, details of outside and inside corners and door openings.
- .4 Samples:
 - .1 Submit 2 - 300 mm (12") x 300 mm (12") samples of each component of panel system to Contract Administrator for review.
 - .2 Samples shall fully represent materials to be supplied in colour, texture, finish and construction.
- .5 Acoustic data:
 - .1 Submit acoustic data verifying that Products meet specified acoustic design requirements.

Acoustical Panel Ceiling Systems

- .2 Acoustic data submitted shall be from a certified acoustic testing agency.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.
- .3 Maintenance materials:
 - .1 Deliver for maintenance use, 2% of each type and colour of panels used in the Work.
 - .2 Pack panels in suitable containers, clearly dated and identified as to type and location of installation in the Work, and store where directed by Owner.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Installers:
 - .1 Shall have 5 years' experience, minimum, in application of Products, systems and assemblies specified and with approval and training of Product manufacturers.
- .2 Mock-ups:
 - .1 Submit 3000 mm x 3000 mm (118" x 118") mock-up of each acoustical finish system, for review and acceptance by Contract Administrator.
 - .2 Install at the Place of the Work a pre-selected job mock-up of full size panel system.
 - .3 Obtain Contract Administrator's acceptance of surface, finish and workmanship as a standard by which remainder of the Project will be judged. Apply material in accordance with manufacturer's written application requirements. Mock-up must be approved and accepted prior to start of system application. Maintain mock-up during construction for workmanship comparison. Do not alter, move or destroy mock-up until the work is completed and approved by Contract Administrator.

1.6 Delivery, Storage, and Handling

- .1 Ship panels in rigid crates to avoid damage. Bent or deformed material shall be rejected.
- .2 Deliver acoustical panel ceilings to the Place of the Work in original, unopened packages and store in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- .3 Before installing acoustical panel ceilings, permit them to reach room temperature and stabilized moisture content. Acclimatization period shall be 24 hours, minimum, longer as recommended by panel manufacturer.
- .4 Handle acoustical panel ceilings carefully to avoid chipping edges or damaging units in any way.

Acoustical Panel Ceiling Systems

1.7 Field Conditions

- .1 Commence installation after building is enclosed with windows and exterior doors in place and glazed, and roof watertight.

PART 2 - PRODUCTS

2.1 General

- .1 Single source responsibility: Obtain each type of acoustical ceiling unit and suspension system from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the work of this section shall be from same production run.

2.2 Materials

- .1 APN1; Acoustical panel ceiling system:
 - .1 Classification: Type XII, Form 1, Pattern G in accordance with ASTM E1264-22.
 - .2 Size: 610 mm x 1830 mm (24" x 72").
 - .3 Thickness: 28.6 mm (1-1/8").
 - .4 NRC: 0.85.
 - .5 Material: Fibreglass.
 - .6 Surface texture: Coated fibreglass mat.
 - .7 Edge: Swing down.
 - .8 Colour: Techstyle White.
 - .9 Flame spread:
 - .1 Maximum values in accordance with CAN/ULC-S102-10:
 - .1 Flame Spread Value (FSV): 25.
 - .2 Smoke Developed Value (SDV): 50.
 - .10 Suspension system:
 - .1 Standard suspension system:
 - .1 Acceptable Products:
 - .1 Certaineed '15/16" EZ Stab Classic System'
 - .1 Trim: WT1 Wall Trim.
 - .11 Accessories: type as recommend by manufacturer.
 - .12 Acceptable Products:
 - .1 Refer to Material/Equipment/Product Tag Schedule.
 - .2 Substitutions in accordance with Section 01 25 00.

Acoustical Panel Ceiling Systems

PART 3 - EXECUTION

3.1 Installation

- .1 Do not start installation until exterior glazing has been completed and exterior openings are closed in. Ensure wet work is completed and dried out to a degree acceptable to panel manufacturer before installation is commenced. Maintain uniform temperatures of at least 16°C for 72 hours prior to commencement of the work of this section and maintain temperature until completion of the work of this section.
- .2 Do not commence installation until all work above suspended ceiling has been completed, inspected and accepted.
- .3 Panel arrangements as indicated. Coordinate layout with Contract Administrator prior to commencing installation. Lay out system to a balanced grid design, with edge units not less than 50% of acoustical unit size.
- .4 Install finished work rigid, secure, square, level and plumb, framed and erected to maintain dimensions and contours indicated. Make allowance for thermal and structural movement.
- .5 Install ceiling panels and metal suspension system in accordance with ASTM C636/C636M-19, and manufacturer's directions. Where manufacturer's directions are at variance with Agreement, Drawings, Schedules, and Specifications, notify Contract Administrator before proceeding with installation.
- .6 Panels:
 - .1 Install acoustical panels to clean, dry and firm substrates in accordance with manufacturer's written requirements.
 - .2 Panels shall have no visible fastenings. Faces of panels and bulkheads must be flush.
- .7 Installation tolerance: Maximum variation from flat and level surface is 1:360.

3.2 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00.
 - .1 Inspection and testing company may perform random load tests for ceiling anchor installation.

3.3 Adjusting and Cleaning

- .1 Carefully examine suspended acoustical ceilings on completion and replace uneven or defective or damaged materials, eliminate all waves, remedy damaged exposed finished surfaces and remove soiled or stained areas.
- .2 Clean dirty and discoloured surfaces of acoustical units and suspension system according to manufacturer's recommendations.

END OF SECTION

Acoustical Tile Ceiling Systems

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Acoustical tile ceiling systems; ACT1.

1.2 Administrative Requirements

- .1 Coordination:
 - .1 Cooperate with mechanical and electrical Subcontractors.
 - .2 Coordinate layout and installation of acoustic ceiling units and suspension systems components with other work supported by or penetrating through ceilings, including light fixtures, HVAC equipment, partition system, fire suppression system components and other work required to be incorporated in or coordinated with the ceiling system.
- .2 Conduct a pre-installation meeting in accordance with Section 01 31 19.
 - .1 Independent inspection and testing company shall attend the pre-installation meeting.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Submit manufacturer's standard details.
 - .2 Indicate lay-out, insert and hanger spacing and fastening details, splicing method for main and cross runners, location of access splines, and acoustical unit support at ceiling fixture.
 - .3 Submit reflected ceiling plans for special grid patterns as indicated.
- .4 Samples:
 - .1 Submit sample of each component of ceiling system. Samples shall fully represent materials to be supplied in colour, texture, finish and construction.
 - .2 Submit samples, load test data and design tables for each type of insert to be used in the Work for hanger supports.
- .5 Certificates:
 - .1 Submit certificate of compliance stating that the suspension system provided, including materials and installation, comply with the requirements of the Agreement, Drawings, Schedules, and Specifications.

Acoustical Tile Ceiling Systems

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Maintenance data:
 - .1 Submit maintenance and cleaning instructions for acoustical ceiling systems for incorporation into the maintenance manuals.
- .3 Maintenance materials:
 - .1 Deliver for maintenance use, 2% of each type and colour of suspension components and acoustical tiles used in the Work.
 - .2 Pack panels in suitable containers, clearly dated and identified as to type and location of installation in the Work, and store where directed by Owner.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Installers / applicators / erectors:
 - .1 Installers: Shall have 5 years' experience, minimum, in application of Products, systems and assemblies specified.
- .2 Mock-ups:
 - .1 Construct in locations acceptable to Contract Administrator a typical sample ceiling installation 10 m² (108 ft²) in area. Modify sample as directed and as required to obtain approval. Upon acceptance retain sample as standard of quality for acoustical ceiling.
 - .2 Do not begin fabrication and erection of remainder of ceiling system until sample installation has been reviewed and accepted. Accepted sample may become a part of the final Work, subject of approval of Contract Administrator.

1.6 Delivery, Storage, and Handling

- .1 Ship exposed members and mouldings in rigid crates to avoid damage. Bent or deformed material shall be rejected. Baked enamelled members shall be suitably wrapped and protected against damage.
- .2 Deliver acoustical ceiling units to the Place of the Work in original, unopened packages and store in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- .3 Before installing acoustical ceiling units, permit them to reach room temperature and stabilized moisture content.
- .4 Handle acoustical ceiling units carefully to avoid chipping edges or damaging units.

1.7 Field Conditions

- .1 Commence installation after building is enclosed with windows and exterior doors in place and glazed, and roof watertight.

Acoustical Tile Ceiling Systems

- .2 Interior temperature of building to range from 15°C to 30°C and relative humidity of not more than 70% before and during installation. Maintain uniform temperatures for 72 hours prior to commencement of the work of this section and maintain temperature until completion of the work of this section.

1.8 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranties:
 - .1 System:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.
 - .2 Manufacturer's Product warranty for the following:
 - .1 Acoustical tiles:
 - .1 Duration: 30 years.
 - .2 Suspension systems:
 - .1 Duration: 10 years.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Design suspension systems for a maximum mid-span deflection not exceeding L/360 in accordance with ASTM C635/C635M-22 deflection test.
- .2 Design suspension system to support safely, and without distortion, the superimposed loads of:
 - .1 Air supply diffusers and return grilles.
 - .2 Lighting fixtures.

2.2 General

- .1 Single source responsibility: Obtain each type of acoustical ceiling unit and suspension system from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the work of this section shall be from same production run.

2.3 Acoustical Tiles

- .1 ACT1; Lay-in acoustical tiles:
 - .1 Classification: as indicated in accordance with ASTM E1264-22.
 - .2 Size: 610 mm x 1220 mm x 16 mm (24" x 48" x 5/8").
 - .3 NRC: as indicated.
 - .4 Material: Mineral fibre.
 - .5 Surface texture: Fine.

Acoustical Tile Ceiling Systems

- .6 Edge: Square.
- .7 Colour: White.
- .8 Flame spread:
 - .1 Maximum values in accordance with CAN/ULC-S102-10:
 - .1 Flame Spread Value (FSV): 25.
 - .2 Smoke Developed Value (SDV): 50.
- .9 Acceptable Products:
 - .1 Refer to Material/Equipment/Product Tag Schedule.
 - .2 Substitutions: in accordance with Section 01 25 00.

2.4 Metal Suspension Systems

- .1 Hanger anchorage devices: Screws, clips, bolts, concrete inserts or other devices applicable to the indicated method of structural anchorage for ceiling hangers and whose suitability for use intended has been proven through standard construction practices or by certified test data. Size devices for 3 x calculated load supported except size direct pull-out concrete inserts for 5 x calculated loads.
- .2 Concrete hanger anchors; post installed: Steel eye bolts and nuts to suit ceiling hangers with capability to sustain, without failure, a load equal to 4 times that imposed by ceiling construction, as determined by testing per ASTM E488/E488M-22, conducted by a qualified independent testing laboratory.
 - .1 Dynabolt Sleeve Anchor 'TW-1614' or Readi-Tie-Drive 'TD4-112' tie wire anchor by ITW Ramset/Red Head.
 - .2 Kwik-Bolt III 'HHDCA 1/4' tie wire anchor by Hilti Corporation.
 - .3 Fasteners exposed to weather, condensation, and corrosion: Zinc-plated or stainless steel fasteners in applicable product lines specified in preceding paragraphs.
- .3 Hangers and tie wire: Galvanized wire, recommended by manufacturer of suspension system, minimum 2.66 mm (0.1") (12 gauge).
- .4 Suspension system accessories:
 - .1 Splices, clips, and perimeter moulding, of manufacturer's standard type to suit the applicable conditions unless special conditions and access area are shown or specified.
 - .2 Angle wall mouldings; hemmed with prefinished exposed flanges:
 - .1 For 24 mm (15/16") grid applications; angle moulding with exposed bottom flange of 22 mm (7/8").
 - .1 Armstrong '7803'.
 - .2 CertainTeed 'WA15-15'.
 - .3 CGC 'M7'.
 - .2 For 14 mm (9/16") grid applications; angle moulding with exposed bottom flange of 24 mm (15/16").

Acoustical Tile Ceiling Systems

- .1 Armstrong '7804'.
- .2 CertainTeed 'Wall Angle WA15-9'.
- .3 CGC 'M9'.
- .3 Stepped wall mouldings; hemmed with prefinished exposed flanges:
 - .1 For 24 mm (15/16") grid applications; shadow moulding with exposed bottom flange of 22 mm (7/8") and reveal of 19 mm (3/4").
 - .1 Armstrong '7871'.
 - .2 CertainTeed 'SM1020'.
 - .3 CGC 'MS154'.
 - .2 For 14 mm (9/16") grid applications; shadow moulding with exposed bottom flange of 14 mm (9/16") and reveal of 10 mm (3/8").
 - .1 Armstrong '7873'.
 - .2 CertainTeed 'SM1000'.
 - .3 CGC 'MS174'.
- .5 Standard suspension system, non fire-rated:
 - .1 Intermediate duty in accordance with ASTM C635/C635M-22, 24 mm (15/16") interlocking tee system, designed to support acoustical panels in patterns indicated with deflection of main tees less than L/360, consisting of main tees and cross tees. The system shall provide lock joint intersections of cross and main tees.
 - .2 Acceptable *Products*:
 - .1 Armstrong 'Prelude XL 15/16" Exposed Tee Systems'.
 - .2 CertainTeed '15/16" Classic Stab System'.
 - .3 CGC 'DX'.

2.5 Miscellaneous Materials

- .1 Acoustical sealant: Non-drying, non-hardening, non-skinning, non-staining, non-bleeding, gunnable sealant complying with requirements specified in Section 07 92 00.

2.6 Metal Finish

- .1 Metal exposed in finished work shall have a pre-coated baked enamel finish in non-yellowing colour. Submit paint formulation of grid system to lighting fixture, speaker grille, sprinkler and diffuser manufacturers to ensure consistency of colour, sheen and texture of all exposed metal components in the ceiling assemblies.
 - .1 Colour: Flat white.

Acoustical Tile Ceiling Systems

PART 3 - EXECUTION

3.1 Installation - General

- .1 Install ceiling panels and metal suspension system in accordance with manufacturer's directions. Where manufacturer's directions are at variance with Agreement, Drawings, Schedules, and Specifications, notify Contract Administrator before proceeding with installation.
- .2 Do not commence installation until all work above suspended ceiling has been completed, inspected and accepted.

3.2 Installation - Suspension System

- .1 Install suspension system rigid, secure, square, level and plumb, framed and erected to maintain dimensions and contours indicated, and in accordance with ASTM C636/C636M-19, CISCA installation standards and any other applicable national or local code requirements. Make allowance for thermal and structural movement.
- .2 Attach hangers to structure with inserts and hanger supports. Do not use powder activated fasteners.
- .3 Support hangers for suspended ceiling grid independent of walls, columns, pipes and ducts.
- .4 Space hangers for ceilings at maximum 1220 mm (48") on centre in both directions. Provide additional hangers as required to comply with manufacturer's written installation requirements.
- .5 Locate hangers at not more than 150 mm (6") from ends of main tee members.
- .6 Install exposed tee members to pattern indicated. Securely attach hangers to main tee members.
- .7 Exposed tees shall be as long as possible to minimize joints. Make joints square, tight, flush and reinforce with splines. Distribute joints to prevent clustering in one area.
- .8 Space tee bars to suit ceiling panels and as detailed, and to accommodate lighting fixtures, diffusers and return grilles.
- .9 Cooperate in the installation of ceiling systems, making adjustments where required to ensure that the lighting fixtures, supply diffusers, exhaust grilles and other built-in items properly fit into ceiling module and finish flush with rest of ceiling.
- .10 Restrict creep inside module panels so that in all cases strips are centred on module lines.
- .11 Install edge moulding as detailed where ceiling abuts vertical surfaces. Lap corners, use maximum lengths to minimize joints. Make joints square, tight and flush.
 - .1 Screw attach mouldings to substrates at intervals not more than 400 mm (16") on centre and not more than 210 mm (8") from ends, levelling with suspension system. Lap corners accurately and connect securely.

3.3 Installation - Tiles

- .1 Take precautions during installation to ensure tile edges are not chipped or otherwise damaged.

Acoustical Tile Ceiling Systems

- .2 Minimize field cutting. Rectify cut tile edges of tile to match factory cut edge profile and colour.
- .3 Install acoustical tiles to form horizontal and level ceiling with all parts flush and joints butted tightly to hairline appearance.
- .4 Distribute variations in colour and texture of panels to obtain a uniform appearance.

3.4 Installation - Tolerances

- .1 Allowable tolerances: in accordance with ASTM C636/C636M-19.
- .2 Install suspension systems level to tolerance of 1:1200.
- .3 Install edge mouldings level to tolerance of 3 mm in 3660 mm (1/8" in 12'-0").

3.5 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00 and as follows:
 - .1 Field tests and inspections:
 - .1 Independent inspection and testing company shall perform random load tests for ceiling anchor installation.

3.6 Adjusting and Cleaning

- .1 Replace uneven, defective or damaged materials and finishes, eliminate waves, remove soiled or stained areas.
- .2 Clean dirty and discoloured surfaces of acoustical units and suspension system according to manufacturer's recommendations.

END OF SECTION

Resilient Base and Accessories

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Resilient base; BTC1, BTC2.
 - .2 Resilient floor transition trims.

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting in accordance with Section 01 31 19.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Samples:
 - .1 Samples for verification: Submit 3 samples of the following:
 - .1 305 mm (12") long samples of each colour and type of base material. Include sample of outside corner of base.
 - .2 100 mm (4") long samples of each colour and type of floor transition trims.
- .4 Test and evaluation reports:
 - .1 Submit moisture, alkalinity, and adhesive bond test results.
- .5 Manufacturer's instructions:
 - .1 Submit manufacturer's installation instructions for Products proposed for use in the work of this section.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.
- .1 Maintenance materials:
 - .1 Provide minimum 2% of each colour, pattern and type of resilient base required for this project.
 - .2 Maintenance materials to be same production run as installed materials.
 - .3 Suitably package for protection and storage, each identified with name of manufacturer and material.
 - .4 Tag and store where directed by Owner.

Resilient Base and Accessories

1.5 Quality Assurance

.1 Qualifications:

.1 Installers:

- .1 Shall have 5 years' experience, minimum, in application of Products, systems and assemblies specified.

1.6 Field Conditions

.1 Ambient conditions:

- .1 Install materials of this section only when surfaces and air temperatures have been maintained between 21°C and 29.4°C for 7 days preceding installation, and will be so maintained during installation and for 48 hours thereafter. Maintain a minimum temperature of 13°C after above period.
- .2 Verify that adequate ventilation is provided during installation and curing of materials of this section.
- .3 Applications exposed to intense or direct sunlight, protect Products during the conditioning, installation, and adhesive curing periods, by covering the light source.
- .4 Allow coiled material to lay flat for at least 24 hours at 18°C prior to installation, and maintain this temperature during installation.

1.7 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.

PART 2 - PRODUCTS

2.1 General

- .1 Single source responsibility: Obtain each type of resilient Product from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the work of this section shall be from same production run.

2.2 Resilient Base; BTC1, BTC2

.1 Rubber base types:

- .1 Manufactured from thermoplastic rubber formulation meeting ASTM F1861-21, Type TP, Group 1 (Solid).
- .2 Acceptable manufacturers:
 - .1 Mannington.
 - .2 Roppe.
 - .3 Tarkett.

Resilient Base and Accessories

- .4 Substitutions: in accordance with Section 01 25 00.
- .3 Rubber base; wall base:
 - .1 Acceptable Products:
 - .1 Refer to Material/Equipment/Product Tag Schedule.
 - .1 Profile: Coved.
 - .2 Height: 100 mm (4") high.
 - .3 Colours: to later selection by Contract Administrator.
 - .2 Substitutions: in accordance with Section 01 25 00.

2.3 Resilient Floor Transition Trims

- .1 Resilient strip:
 - .1 Colour to later selection by Contract Administrator from manufacturer's full range.
 - .2 Acceptable Products:
 - .1 Tarkett 'SLT-XX-B'.
 - .2 Substitutions: in accordance with Section 01 25 00.
- .2 Metal transition trim:
 - .1 Acceptable Products:
 - .1 Schluter-RENO-U.
 - .2 Substitutions: in accordance with Section 01 25 00.

2.4 Accessories

- .1 Block wall filler: Filler type as recommended by resilient base manufacturer to suit substrate and compatible with materials.
- .2 Concrete patching and levelling compound:
 - .1 Trowel applied Portland cement based, moisture, mildew, and alkali-resistant.
 - .2 Minimum compressive strength after 28 days shall be minimum 3,500 psi when tested in accordance with ASTM C109/C109M-16a.
 - .3 Gypsum based compounds are not acceptable.
 - .4 Acceptable manufacturers:
 - .1 Ardex.
 - .2 Mapei.
 - .3 Substitutions: in accordance with Section 01 25 00.
 - .5 Acceptable Product: type as recommended by resilient product manufacturer for substrate conditions.
- .3 Primers and adhesives: Types as recommended by resilient product manufacturer compatible with materials and to suit substrate types.
- .4 Sealant:

Resilient Base and Accessories

- .1 Medium-modulus, neutral-curing silicone sealant; complying with ASTM C920-14, Type S, Grade NS.
- .2 Colour: Clear.
- .3 Acceptable Manufacturers:
 - .1 Dowsil.
 - .2 Momentive.
 - .3 Tremco.

PART 3 - EXECUTION

3.1 Examination

- .1 Verify that field conditions have been provided as requested and specified.
- .2 Substrates shall be firm, structurally sound, sufficiently porous, and dry.
- .3 Examine substrate to ensure clean lines, correct level and freedom from cracks, ridges, dusting, scaling and carbonation.
- .4 Examine substrates in advance of application of products to ensure that substrates are protected against entry of water and moisture.
- .5 Report conditions contrary to requirements preventing proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.
- .6 Failure to call attention to defects or imperfections will be construed as acceptance and approval of the substrate. Installation indicates acceptance of substrates with regard to conditions existing at the time of installation.
- .7 Defective work resulting from application to unsatisfactory surfaces will be considered the responsibility of those performing the work of this section.

3.2 Preparation

- .1 Substrates shall be free of deleterious material that may inhibit bond strength or act as a bond breaker. Remove such contaminants and deleterious material using mechanical methods recommended by manufacturer. Do not use chemical abatement methods.
- .2 Fill gaps, voids, and cracks, and remove ridges, or other defects which will ghost or telegraph through finished product installation.
- .3 Expansion joints, isolation joints, and other movement joints in substrates shall not be filled with patching or levelling compound.
- .4 Sweep and vacuum clean substrates minimum 24 hours prior to alkalinity, moisture, and adhesion testing. Do not use sweeping compounds.
- .5 Notify Contract Administrator of any substrate or levelling compound defects or installation conditions that may result in unsatisfactory performance.
- .6 Alkalinity, moisture, and adhesion bond testing:
 - .1 Perform moisture and alkalinity tests and adhesive bond test.
 - .2 Proceed with installation only after substrates pass testing. Document tests performed and submit in writing to Contract Administrator.

Resilient Base and Accessories

- .7 Do not install products until they are same temperature as space where they are to be installed.
- .8 Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation. Do not use sweeping compounds.
- .9 Where flooring adjoins thicker floor materials, apply levelling screed, feather out to make up difference in level between materials.
- .10 Spray paints, permanent markers and other indelible ink markers shall not be used to write on the back of the resilient material or used to mark the substrate as they could bleed through and permanently stain the resilient material. If such contaminants are present on the substrate they shall be mechanically removed prior to the installation of the resilient material.

3.3 Installation of Resilient Base

- .1 Spread adhesive to ribbed surface (back) of wall base with a 3 mm (1/8") square-notched trowel; allow slight set-up, then bring base into contact with substrate. Ensure full adhesion of base to substrate. Adhesive should cover 80% of back surface. Leave a 6 mm (1/4") uncovered space at the top of the wall base to prevent the adhesive from oozing onto the wall above the base when installed.
- .2 Position wall base on wall surface and roll with hand roller. Always roll back to starting point to prevent stretching the wall base.
- .3 Set base to ensure installation over finished flooring material is free of gaps.
- .4 Install base in longest lengths possible, minimum 2440 mm (8'). Adhere toe of base to substrate, and ensure edge of toe is straight.
- .5 Scribe and fit to door frames and other obstructions.
- .6 Joints shall be tightly fitted, straight and vertical, and not less than 610 mm (24") from corners.
- .7 Provide joints in base over substrate control joints.
- .8 Field-made inside corners:
 - .1 Install wall base to terminate into the corner with a mitre cut.
 - .2 Position another piece of wall base on opposing wall, without adhesive, approximately 25 mm (1") from the installed piece.
 - .3 Utilizing the dividers, place the hooked end at the top of the installed piece and the pointer end on the top of the uninstalled piece. Carefully, move the dividers downward in a straight vertical motion, allowing the hooked end of the dividers to follow the profile of the installed piece. At the same time, place adequate pressure on the pointer end to transfer and/or scribe the profile onto the surface of the uninstalled piece.
 - .4 Use a utility knife to cut the pattern on the uninstalled wall base, apply adhesive, and position the trimmed section into place.
- .9 Field-made outside corners:
 - .1 Install wall base to terminate into the corner with a mitre cut.

Resilient Base and Accessories

- .2 Stop application of adhesive to wall base approximately 450 mm (18") from the outside corner of the wall.
- .3 Position the wall base at the corner and pencil line the back of the wall base where the bend is desired.
- .4 Lay the wall base on the floor with the back up. Utilizing a top-set or pull-type gouge tool, make a shallow notch along the pencil line.
- .5 Notch depth should not exceed one-quarter the total thickness of the wall base.
- .6 Reposition the wall base corner on the wall. The corner of the wall should fit snugly into the notched recess on the back of the wall base.
- .7 Apply adhesive and roll firmly into place.

3.4 Installation Transition Trim

- .1 Coordinate transitions with work of other sections and install transition trim to transitions between different flooring types.
- .2 Locate thresholds directly beneath the door (in a closed position).
- .3 Set to ensure installation is free of gaps.
- .4 Install in longest lengths possible.
- .5 Scribe and fit to obstructions.
- .6 Fit joints tightly, straight and vertical as applicable. Transition trim joints shall be not less than 610 mm (24") from corners.
- .7 Mitre corners.

3.5 Installation Tolerances

- .1 Resilient base: Install straight and level to variation of 3 mm (1/8") over 3 m (10'-0").
- .2 Transition trim: Install straight to variation of 3 mm (1/8") over 3 m (10'-0").

3.6 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00.
 - .1 Field tests and inspections:
 - .1 Moisture and alkalinity:
 - .1 Test for moisture and alkalinity in accordance with product manufacturer's written requirements.
 - .2 Adhesion bond test:
 - .1 Proceed with bond test after substrates have been prepared and alkalinity and moisture test have been completed.
 - .2 Adhesions tests shall be completed in accordance with product manufacturer's written requirements.

Resilient Base and Accessories

3.7 Adjusting and Cleaning

- .1 Remove adhesive from surfaces as work progresses in manner described by manufacturer.
- .2 Thoroughly clean surfaces in accordance with manufacturer's written requirements.

END OF SECTION

Linoleum Flooring

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Linoleum sheet flooring; RSFC1, RSFC2, RSFC3.

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting in accordance with Section 01 31 19.
 - .1 Independent inspection and testing company shall attend the pre-installation meeting.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Show sheet flooring roll and width layout as related to Contract Administrator's floor pattern including borders and accents including where flooring materials meet other floor materials.
 - .2 Show locations of seams, floor drains, floor plates, and where flooring meets other flooring.
- .4 Samples:
 - .1 Samples for verification:
 - .1 Flooring: In manufacturer's standard size, but not less than 150 mm (6") x 230 mm (6" x 9") sections of each different colour and pattern of floor covering required.
 - .2 Heat-welding bead: Manufacturer's standard-size samples, but not less than 230 mm (9") long, of each colour required.
 - .3 Transition trim: Manufacturer's standard size samples, but not less than 100 mm (4") long, of each colour required.
 - .4 Seam samples: For each floor covering product, colour, pattern, and seam required, installer shall Provide a 150 mm x 230 mm (6" x 9") sample directly applied to a rigid backing material with the seam running lengthwise and in the center of the sample.
- .5 Test and evaluation reports:
 - .1 Submit moisture, alkalinity, and adhesive bond test results.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 00.

Linoleum Flooring

- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.
- .3 Maintenance materials:
 - .1 Submit 2% of each colour in full running length, pattern and type flooring material required for this project for maintenance use.
 - .2 Maintenance materials to be same production run as installed materials.
 - .3 Suitably package for protection and storage, each identified with name of manufacturer and flooring material.
 - .4 Tag and store where directed by Owner.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Installers:
 - .1 Shall have 5 years' experience, minimum, in application of Products, systems and assemblies specified.
- .2 Mock-ups:
 - .1 Prior to commencing flooring installation for this section, prepare full room mock-up (room size at least 10 m² (100 ft²) in area) for acceptance by the Contract Administrator.
 - .2 Mock-up shall include flooring showing edge treatment and relationships to adjoining surfaces.
 - .3 Location of installation shall be determined by Contract Administrator.
 - .4 Do not proceed with flooring specified in this section until mock-up has been accepted by Contractor and Contract Administrator.

1.6 Delivery, Storage, and Handling

- .1 Package flooring materials and identify contents of each package.
- .2 Store materials for a minimum of 24 hours immediately before installation to comply with temperatures specified under Field Conditions.
- .3 Store flooring rolls on end.

1.7 Field Conditions

- .1 Ambient conditions:
 - .1 Install materials of this section only when surfaces and air temperatures have been maintained between 18.4°C and 29.4°C for 48 hours preceding installation, and will be so maintained during installation and for 48 hours thereafter. Maintain a minimum temperature of 13°C after above period. Relative humidity shall be 50 +/- 10%.
 - .2 Ensure that adequate ventilation is provided during installation and curing of materials of this section.

Linoleum Flooring

- .3 In areas that are exposed to intense or direct sunlight, Products shall be protected during the conditioning, installation, and adhesive curing periods, by covering the light source.
- .4 Allow products to acclimatize in installation area for a minimum 24 hour prior to installation.

1.8 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Slip resistance: Floors shall have a wet Dynamic Coefficient of Friction (DCOF) of 0.42 or greater in accordance with ANSI A326.3.
- .2 Linoleum sheet flooring shall not:
 - .1 Become stained or discoloured due to slab markings.
 - .2 Delaminate from substrates.
 - .3 Have welded seams which separate.

2.2 General

- .1 Single source responsibility: Obtain each Product from a single source with resources to provide products of consistent quality in appearance and physical properties, same production run. Products installed as part of the work of this section shall be from same production run.

2.3 Linoleum

- .1 Linoleum sheet flooring:
 - .1 In accordance with ASTM F2034-18, Type 1, colours and pattern detail shall be dispersed throughout the thickness of the wear layer.
 - .2 Thickness: 2.5 mm (1/10").
 - .3 Colours and acceptable Products: Refer to Material/Equipment/Product Tag Schedule.
- .2 Seam construction:
 - .1 Hot welded joints, provide welding rod matched to floor pattern/colour selected.
 - .2 Colours: To later selected by Contract Administrator from full colour range.
- .3 Primers and adhesives:

Linoleum Flooring

- .1 Types designed for wet areas as recommended by resilient flooring manufacturer compatible with materials and to suit substrate types and to comply with warranty requirements.
- .4 Patching and levelling compound:
 - .1 Trowel applied Portland cement based, moisture, mildew, and alkali-resistant.
 - .2 Minimum compressive strength after 28 days shall be minimum 3,500 psi when tested in accordance with ASTM C109/C109M-21.
 - .3 Gypsum based compounds are not acceptable.
 - .4 Acceptable manufacturers:
 - .1 Ardex.
 - .2 Mapei.
 - .3 Substitutions: in accordance with Section 01 25 00.
 - .5 Acceptable Product: type as recommended by flooring manufacturer for substrate conditions.
- .5 Cleaning solution:
 - .1 Acceptable Products: type as recommended by flooring manufacturer.
- .6 Metal transition trim: in accordance with Section 09 65 13.
- .7 Sealant: Mildew resistant sealant in accordance with Section 07 92 00.

PART 3 - EXECUTION

3.1 Examination

- .1 Verify that field conditions have been provided as requested and specified.
- .2 Verify that substrates have been provided as specified without holes, protrusions, cracks greater than 1.6 mm (0.06") wide, unfilled control joints, depressions greater than 3 mm (1/8") deep, or other major defects.
- .3 Substrates shall be firm, structurally sound, sufficiently porous, and dry.
- .4 Examine substrate to ensure clean lines, correct level and freedom from cracks, ridges, dusting, scaling and carbonation.
- .5 Examine floors in advance of application of flooring to ensure that floors are protected against entry of water and moisture.
- .6 Report conditions contrary to requirements preventing proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.
- .7 Failure to call attention to defects or imperfections will be construed as acceptance and approval of the substrate. Installation indicates acceptance of substrates with regard to conditions existing at the time of installation.
- .8 Defective work resulting from application to unsatisfactory surfaces will be considered the responsibility of those performing the work of this section.

Linoleum Flooring

3.2 Preparation

- .1 Comply with recommendations of ASTM F710-22.
- .2 Substrates shall be free of wax, oil, silicone, soap, grease, dust, solvents, sealers, curing compounds, hardeners, alkaline salts, excessive carbonation or laitance, mould, mildew, paints, varnish, asphalt, residual adhesives, adhesive removers, or other contaminants or deleterious material that may inhibit bond strength or act as a bond breaker. Remove such contaminants and deleterious material using mechanical methods recommended by manufacturer. Do not use chemical abatement methods.
- .3 Concrete substrates that are loose, sandy, scaly, or have a white powdery surface are not acceptable. Substrates shall be mechanically prepared.
- .4 Flooring substrates shall be smooth and level within a tolerance of 3 mm (1/8") in a 3 m (10'-0") radius.
- .5 Fill surface cracks, holes, score marks, depressions, and grooves, and repair surface spalls with Portland cement patching or levelling compound.
- .6 Expansion joints, isolation joints, and other movement joints in substrates shall not be filled with patching or levelling compound.
- .7 Remove bumps, high spots, peaks and ridges to produce a uniform and smooth substrate.
- .8 Prepare substrates so that installation of flooring shall not show telegraphing of substrate.
- .9 Remove chalking and dusting and loose material from concrete surfaces with wire brushed or by scraping.
- .10 Sweep and vacuum clean substrates minimum 24 hours prior to alkalinity, moisture, and adhesion testing. Do not use sweeping compounds.
- .11 Notify Contract Administrator of any substrate or levelling compound defects or installation conditions that may result in unsatisfactory performance.
- .12 Prepared concrete substrate shall have a finish equivalent to a magnesium trowel finish. Shiny, slick, non-porous, or overly porous substrates are not acceptable and shall require additional preparation prior to installation of flooring products. Prepared concrete substrates shall have a Concrete Surface Profile #3 to #5 in accordance with International Concrete Repair Institute (ICRI).
 - .1 Substrate to be approved in writing by flooring manufacturer prior to application of flooring.
 - .2 Submit written report to Contract Administrator following procedures for manufacturer's field review in accordance with Section 01 45 00.
- .13 Alkalinity, moisture, and adhesion bond testing:
 - .1 Test substrates in accordance with paragraph 3.7 Field Quality Control after mechanically preparing subfloor or applying patching and levelling compounds.
 - .2 Proceed with installation only after substrates pass testing. Document tests performed and submit in writing to Contract Administrator.
- .14 Do not install floor coverings until they are same temperature as space where they are to be installed.

Linoleum Flooring

- .1 Move floor coverings and installation materials to acclimatize in spaces where they will be installed at least 48 hours in advance of installation.
- .15 Where flooring adjoins thicker floor materials, apply levelling screed, feather out to make up difference in level between materials to achieve flush floor finish between adjacent flooring materials unless otherwise indicated.
- .16 Spray paints, permanent markers and other indelible ink markers shall not be used to write on the back of the flooring material or used to mark the substrate as they could bleed through and permanently stain the flooring material. If such contaminants are present on the substrate they shall be mechanically removed prior to the installation of the flooring material.

3.3 Sheet Flooring Installation

- .1 Before commencing installation, verify product type, size, thickness, and colour. Do not install flooring with visual imperfections, colour variations or apparent defects.
- .2 Install rolls and cuts in sequence by roll number and cuts from each individual roll in consecutive order. Do not reverse sheets for seaming.
- .3 Unroll material in the same direction and follow the flooring manufacture's numbered sequence/layout diagram.
 - .1 Lay flooring with joints parallel to building lines to produce symmetrical pattern and minimum joints.
 - .2 Place seams in inconspicuous and low-traffic areas, at least 150 mm (6") away from parallel joints in floor covering substrates.
 - .3 Avoid cross seams.
 - .4 Lay sheet flooring centered in corridors, with equal sized sheet to either side of center sheet.
 - .5 Mitre intersections at corridors typically. "T" type corridors shall be butt type installation.
 - .6 Layout seaming uniformly, using full length flooring typically, minimum flooring size of not less than roll width. Limit quantity of less than full length floor pieces at corridors to maximum of 1.
 - .7 Layout flooring to match reviewed shop drawings floor pattern including borders and accents.
 - .8 Match edges of floor coverings for colour shading at seams.
- .4 Allow material to relax overnight, minimum 12 hours in installation areas.
- .5 Cutting and fitting sheets:
 - .1 Cut pieces to length allowing approximately 75 mm (3") to 150 mm (6") excess for trimming.
 - .2 Remove 12.7 mm (1/2") off the factory seam edge using an edge trimmer or straight edge and knife.
 - .3 Seams shall be a minimum of 150 mm (6") away from levelling underlayment and concrete joints, saw cuts and other type of joints.

Linoleum Flooring

- .4 Cut sheet and fit neatly around fixed objects without gaps.
- .5 Position remaining sheets so that the top sheet overlaps the previous sheet by 12.7 mm (1/2") to 19 mm (3/4").
- .6 Install one sheet at a time in wet adhesive.
- .7 Roll the flooring immediately in both directions using a clean, 45 kg (100 lb) three-section roller.
- .8 After the material has been laid and rolled in wet adhesive, underscribe the seam using the short scribes with a scribed pin right away.
- .9 Cut the material along the scribe line using a hooked blade knife and holding it at an angle so to slightly undercut the material.
- .10 Roll the seam with a hand roller.
- .11 Cross seams:
 - .1 Straight edge and undercut at an angle the end of the first sheet.
 - .2 Spread adhesive and lay in wet adhesive.
 - .3 Roll the flooring immediately in both directions using 45 kg (100 lb) three-section roller.
 - .4 Overlap the second sheet at butt seam approximately 25 mm (1").
 - .5 Adhere second sheet except for last 450 mm (18") of butt seam; wait 20 – 30 minutes.
 - .6 Spread the adhesive for the last 450 mm (18"), lay in material, underscribe the seam to a neat, fit cut, and roll flooring immediately in both directions using 45 kg (100 lb) three-section roller.
- .6 Apply adhesive uniformly and install flooring in accordance with flooring manufacturer's requirements. Do not spread more adhesive than can be covered by flooring before initial set takes place.
- .7 Obtain 100% adhesive coverage to flooring backing.
- .8 Install flooring to entire area indicated or scheduled, including coverplates occurring within finished floor areas. Maintain overall continuity of colour and pattern with pieces of flooring installed on cover plates. Tightly butt edges to perimeter of floor around cover plates and to cover plates. Cut flooring to floor drains occurring within finished floor areas.
- .9 Terminate flooring at centerline of door in openings where there is an adjacent floor finish or colour is dissimilar unless otherwise indicated or scheduled.
- .10 Centreline of transition should coincide with centreline of door.
- .11 Heat-welded seams:
 - .1 Weld seams in accordance with ASTM F1516-13(2018).
 - .2 Wait minimum of 24 hours after flooring installation before grooving and heat welding seams.
 - .3 Prepare, weld, and trim seams to produce flat surfaces flush with adjoining floor covering surfaces.

Linoleum Flooring

- .4 Rout joints to approximately 2/3 of the thickness of the material and use welding bead to permanently fuse sections into a seamless floor covering. Groove shall be between 3 mm (0.118") and 3.5 mm (0.138") wide.
- .5 Using a weld plate and skiving knife to make first cut and allow weld rod to fully cure to room temperature.
- .6 Using a skiving knife only, finish the trimming of the remainder of the weld. The finish should be smooth and on the same level as the flooring.
- .7 Trimming of welded joint while warm is not permitted unless final trimming is performed after weld has cooled to flooring temperature. Excess weld shall be removed using a heated standard putty knife.
- .8 Roll the seam area with 45 kg (100 lb) three-section roller.
- .9 Maximum variation of welds from plane or from straight: 6 mm (1/4") in 3 m (10 ft) length using a 3 m (10 ft) straight edge.
- .12 Flooring installation shall not show telegraphing of substrate. Flooring installation shall be homogenous free of substrate lines, pockets, bumps and unevenness.

3.4 Prefabricated Flash Cove Base Installation

- .1 Butt joints to be square cut; inside and outside corners to be mitre cut on site using appropriate power mitre saw. Joints to be seam welded according to manufacturer's requirements.
- .2 Seal ends of cove, where the cove meets a doorframe, walls, and other surfaces with colour matched sealant.
- .3 Scribe and fit to door frames and other obstructions.
- .4 Joints shall be tightly fitted, straight and vertical, and not less than 610 mm (24") from corners.
- .5 Provide joints in base over substrate control joints.

3.5 Installation - Transition Strips

- .1 Protect exposed edges of flooring, where finished and unfinished areas adjoining, by means of a transition trim butting to and flush with the finished surface of the flooring covering material and securely adhered to the substrate material.
- .2 Coordinate transitions with work of other sections.
- .3 Allow coiled vinyl material to lay flat for at least 24 hours at 21°C prior to installation.
- .4 Set to ensure installation is free of gaps.
- .5 Install in longest lengths possible.
- .6 Install straight to maximum allowable variation of 3 mm (1/8") over 3 m (10'-0").
- .7 Scribe and fit to obstructions.
- .8 Fit joints tightly, straight and vertical as applicable and not less than 610 mm (24") from corners.
- .9 Mitre corners.

Linoleum Flooring

3.6 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00.
 - .1 Field tests and inspections:
 - .1 Moisture and alkalinity:
 - .1 Test for moisture vapour transmission in accordance with ASTM F710-22 and ASTM F1869-22 or ASTM F2170-19a in accordance with manufacturer's written flooring installation requirements. Results must not exceed 170 µg/m² (3 lb per 1,000 ft²) in 24 hours when tested to ASTM F1869-22, or exceed 75% when tested to ASTM F2170-19a.
 - .2 Test for surface pH. Levels of pH shall not exceed the written recommendations of the flooring manufacturer and adhesive manufacturer. Test in accordance with ASTM F710-22.
 - .3 For each test type: Conduct 3 tests for flooring applications up to 93 m² (1000 ft²) in area, and 1 additional test for each additional 93 m² (1000 ft²) of flooring area.
 - .4 Testing shall be conducted by independent inspection and testing company and in accordance with Section 01 45 00.
 - .2 Adhesion bond test:
 - .1 Proceed with bond test after substrates have been prepared and alkalinity and moisture test have been completed.
 - .2 Select six substrate test areas, each 915 mm (3'-0") x 915 mm (3'-0") in size. Test areas shall be spaced a minimum 1220 mm (48") apart.
 - .3 Cut 915 mm (3'-0") x 915 mm (3'-0") panels from specified material.
 - .4 Using the specified adhesive, glue down each panel using adhesive manufacturer's recommended trowel.
 - .5 After 72 hours, attempt to remove the panels of flooring by pulling up from the corners.
 - .6 Testing shall be conducted by independent inspection and testing company and in accordance with Section 01 45 00.
 - .2 In addition to the requirements of Section 01 45 00, the independent inspection and testing company shall:
 - .1 In the presence of Contract Administrator and manufacturer's representative, review installation procedures, preparation of substrate, bond test requirements, inspection of welds, protection methods for finished floor, and ensure that installation of flooring meets specified requirements.
 - .2 Provide a certificate in writing indicating that preparation and installation of flooring including welding of joints is in compliance with the requirements of the Agreement, Drawings, Schedules, and Specifications.
 - .3 Repair areas as directed by independent inspection and testing company or Contract Administrator, as a result of any inspection and testing work.
- .2 Manufacturer's field review to be in accordance with Section 01 45 00.

Linoleum Flooring

3.7 Adjusting and Cleaning

- .1 Remove excess adhesive from surfaces of the sheet flooring and base as work progresses.
- .2 Only use materials and products recommended by flooring manufacturer to remove excess adhesive.

3.8 Protection

- .1 Prohibit foot traffic on installed flooring for a period of 24 hours after installation. No heavy traffic, rolling loads, or furniture placement are permitted for a minimum of 72 hours after installation.
- .2 Protect new floors from time of final set of adhesive until final inspection.
- .3 Install floor protection in areas where other work, repairs and installation of equipment, and foot traffic will occur.

3.9 Maintenance

- .1 Perform initial maintenance according to the manufacturer's written requirements.
- .2 Allow flooring to dry prior to applying protection.

END OF SECTION

Fluid-Applied Floor Coatings

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Fluid-applied flooring; EPX.

1.2 Administrative Requirements

- .1 Coordination:
 - .1 Advise other trades of fixtures and fittings not to be installed until floor coating materials are cured, such as: radiators, painting, decorating, floor-supported equipment or cabinetwork, caulking, plumbing, fixtures, and the like.
- .2 Conduct a pre-installation meeting in accordance with Section 01 31 19.
 - .1 Independent inspection and testing company shall attend the pre-installation meeting.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Submit shop drawings showing proposed divider strips and start / stop installation lines. Coordinate locations with slab control joints. Lay out divider strips symmetrically in rooms.
- .4 Samples:
 - .1 Submit 305 mm x 305 mm (12" x 12") samples of each specified material, in each specified colour to show successive applications of each coat for Contract Administrator's approval.
 - .2 Submit 305 mm x 305 mm (12" x 12") sample of completed system on rigid backing, demonstrating texture and broadcast aggregate, colour, and sheen, for Contract Administrator's approval.
- .5 Manufacturers' instructions:
 - .1 Submit substrate preparation guidelines, installation instructions, and general recommendations.
- .6 Submit for approval a list of the floor coating materials intended for use in the Work for each substrate condition before installation commences.
- .7 Include sample of warranty customized for this Project.
- .8 Submit list of recent projects completed by installation crew(s) proposed for work of this section available for viewing by Contract Administrator and independent inspection and testing company.

Fluid-Applied Floor Coatings

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Manufacturers:
 - .1 Company specializing in manufacturing the Products specified in this section, with 10 years' experience, minimum.
 - .2 Installers / applicators / erectors:
 - .1 Applicators: Shall have 5 years' experience, minimum, in application of Products and systems specified and with approval and training of Product manufacturers.
 - .2 Subcontractor must be approved by the flooring system manufacturer. Submit Subcontractor's certification letter prepared by the flooring system manufacturer.
 - .3 Execute work of this section only under full time supervision of qualified Subcontractor's site supervisor.
- .2 Mock-ups:
 - .1 Provide mock-up panel 1 m² (10.8 ft²) minimum area, of coating system at the Place of the Work as part of final installation for approval by Contract Administrator, location to be determined by Contract Administrator. Mock-up will serve as a benchmark for installation of the system for the Work.
 - .2 Construct mock-up at the Place of the Work of cove base at door frames.

1.6 Field Conditions

- .1 Ambient conditions:
 - .1 Unless required otherwise by manufacturer's installation requirements maintain ambient temperature of not less than 13°C and below 32°C, and a floor temperature of not less than 16°C from 24 hours before installation to at least 72 hours after installation. Maintain relative humidity of not higher than 80% during same period.
 - .2 Ensure that adequate ventilation is provided during installation and curing of materials of this section.

1.7 Delivery, Storage, and Handling

- .1 Deliver materials to the Place of the Work in sealed undamaged containers clearly labelled with name and batch number.

Fluid-Applied Floor Coatings

1.8 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Material compatibility: Provide materials that are compatible with one another under conditions of service and application required, as demonstrated by manufacturer based on testing and field experience.
- .2 Slip resistance: Floors shall have a wet Dynamic Coefficient of Friction (DCOF) of 0.42 or greater in accordance with ANSI A326.3.
- .3 Floors coatings shall not show spalling, cracking, or delamination.

2.2 General

- .1 Installation of systems specified in this section to be by a single Subcontractor.
- .2 Materials shall be sourced from one manufacturer unless otherwise specified.

2.3 Fluid-Applied Epoxy Flooring; EPX

- .1 Epoxy coating: Two component, high solids, self-priming, gloss coating.
 - .1 Thickness: to later selection by *Consultant*.
 - .2 Finish: Gloss.
 - .3 Texture: Smooth.
 - .4 Colour: as selected by Contract Administrator from manufacturer's standard colours.
 - .5 Acceptable Products:
 - .1 Refer to Material/Equipment/Product Tag Schedule.
 - .2 Substitutions: in accordance with Section 01 25 00.

PART 3- EXECUTION

3.1 Examination

- .1 Verify that specified field conditions are ensured before commencing the work of this section.
- .2 Examine surfaces to receive floor and wall coatings. Surfaces shall be smooth, sound, dry, and free from conditions that will adversely affect execution, permanence, or quality of work.

Fluid-Applied Floor Coatings

- .3 Verify that surfaces to receive coatings can be put into acceptable condition by means of preparation specified in this section.
- .4 Floor surfaces to receive coating shall be equivalent to a light steel trowel finish for new or patched concrete surface.
- .5 Examine floor surfaces to be coated for slope to drain irregularities which could create non-sloping or ponding conditions on the epoxy coating surface.
- .6 Verify that floor drains are installed flush with top of floor slabs.
- .7 Defective work resulting from application to unsatisfactory surfaces will be considered the responsibility of those performing the work of this section.
- .8 Commencement of installation implies acceptance of surfaces as suitable to receive coating system.

3.2 Preparation

- .1 After acceptance of surfaces, prepare them as required to receive the work of this section. Remove projections and other conditions that may affect the installation of the flooring system.
- .2 Concrete slabs shall have sound surface free of dust, chemicals, grease, oil, laitance and curing agents.
- .3 Remove curing compounds, surface hardeners, existing flooring adhesives, and epoxy flooring coatings in accordance with manufacturer's written recommendations.
- .4 Fill open control joints, and other cracks and voids with sealant material compatible with floor coating materials.
- .5 Remove projections and other conditions which may affect installation of the coating.
- .6 Repair surface spalls and imperfections with patching compound approved by manufacturer.
- .7 Test surfaces for moisture content to verify that they are suitable for application, and fully cured. Check moisture content of concrete using a Delmhorst moisture meter. Moisture content shall be within the limits set by the coating manufacturer prior to commencing work.
- .8 Prepare concrete surfaces by mechanical method of steel shotblast, sandblast, or other method approved by coating manufacturer in accordance with International Concrete Repair Institute (ICRI) recommendations to achieve a CSP 3 profile. Thoroughly vacuum clean floors upon completion of blast operation. Substrate to be approved in writing by manufacturer prior to application of coating.
 - .1 Submit written report to Contract Administrator following procedures for manufacturer's field review in accordance with Section 01 45 00.
- .9 Cover or mask surfaces adjacent to those receiving coating to protect work of others and property from damage and soil.

3.3 Installation

- .1 General:

Fluid-Applied Floor Coatings

- .1 Apply coatings with care to ensure that no laps, voids, or other marks or irregularities are visible, and with an appearance of uniform colour, sheen and texture, all within limitations of materials and areas concerned.
 - .2 Match colours and textures of approved samples.
 - .3 Make clean true junctions with no visible overlap between adjoining applications of coatings.
 - .4 Install flooring to entire area indicated or scheduled, including coverplates occurring within finished floor areas. Maintain overall continuity of colour and pattern with pieces of flooring installed on cover plates. Tightly butt edges to perimeter of floor around cover plates and to cover plates. Do not install flooring to floor drains occurring within finished floor areas.
 - .5 Place cloths and other disposable coating materials, that are a fire hazard, in closed metal containers and remove from building every night.
 - .6 Verify that spark-proof electrical equipment is used in area where inflammable materials are being applied.
 - .7 Erect barriers to prevent the entry and presence of personnel not performing work of this section during application of coatings, and for 48 hours following completion of application.
 - .8 Apply coating system in compliance with coating manufacturer's directions to produce a pinhole free surface that also provides a positive slope to drains in flooring system.
 - .9 Apply coatings in continuous manner, starting and stopping in straight lines centre at doorways or other building lines; haphazard installation continuation lines will not be permitted.
- .2 Application; flooring system:
- .1 Terminate flooring in straight lines at centreline of door in openings where adjacent floor finish or colour is dissimilar.
 - .2 Trowelled or broadcast installation shall not show telegraphing of substrate or trowel or toolmarks.
 - .3 Trowelled or broadcast installation shall be homogenous free of substrate lines, pockets, bumps and unevenness greater than 1.5 mm (1/16") in 300 mm (12"), not including texture.
 - .4 Prime coat: mix components and apply primer over prepared substrate at manufacturer's recommended spreading rate, with timing of application coordinated with subsequent application of topping mix to ensure optimum adhesion between flooring materials and substrate.
 - .5 Body coat: mix components and trowel apply body coats over tacky primer at spreading rates as recommended by manufacturer. Broadcast aggregate into wet body coat. Build up flooring system as required to provide positive slope to drains.
 - .6 Clean surface prior to application of finish coat for approval by Contract Administrator.
 - .7 Finish coats: Squeegee apply finish coats over tacky primer at spreading rates as recommended by manufacturer.

Fluid-Applied Floor Coatings

- .8 Provide zinc termination strips, of appropriate thickness, at cove base and where flooring system meets different flooring types.
- .9 Install beads at top of bases, and apply coating to wall with cove formed at junction with floor.
- .10 Apply cove base to a height of 100 mm (4") on vertical surfaces unless shown otherwise. Apply a continuous and even radius at floor transition. Apply base screed at termination of base. Fill gaps between base screed and wall with underlayment material.
- .3 Use saw cut and chip method at termination locations unless otherwise indicated.
- .4 Joints: Where substrate is interrupted by expansion or control joints, provide joint in coating system to comply with details indicated, or if not indicated, as recommended by coating system manufacturer. Fill joints with specified compounds.
- .5 Match approved samples in sheen, colour and texture.

3.4 Field Quality Control

- .1 Conduct quality control in accordance with Section 01 45 00 and as follows:
 - .1 Field tests and inspections:
 - .1 Moisture and alkalinity:
 - .1 Test for moisture vapour transmission in accordance with ASTM F1869-22 in accordance with manufacturer's written installation requirements. Maximum percentage of moisture acceptable is 1.8 kg/93 m² (4 lb/1000 ft²) in a 24 hour period, unless otherwise specified by manufacturer's printed literature.
 - .2 Test for surface pH. Levels of pH shall not exceed the written recommendations of the flooring manufacturer and adhesive manufacturer. Test in accordance with ASTM F710-22.
 - .3 For each test type: Perform 3 tests for flooring applications less than 186 m² (2000 square feet) in area, and 1 test per additional 93 m² (1000 square feet).
 - .2 Coating thickness:
 - .1 Verify to Tooke thickness gauge, and in the presence of Contract Administrator and manufacturer's representative, that thicknesses of completed coatings meet specified requirements.
 - .2 Perform cut through/coring tests where selected by Contract Administrator 1 per 93 m² (1000 ft²) in finished areas to determine thicknesses and finishes of epoxy coatings.
 - .3 Contractor shall repair areas as a result of inspection and testing work.
 - .3 Manufacturer's field review to be in accordance with Section 01 45 00.

Fluid-Applied Floor Coatings

3.5 Adjusting and Cleaning

- .1 Touch up and refinish minor defective work. Refinish entire coated surface areas where finish is damaged or otherwise unacceptable.
- .2 Remove promptly as work progresses spilled or spattered coating materials from surfaces of work performed under other sections. Clean surfaces on completion of work. Do not mar surfaces while removing.
- .3 Leave storage and mixing areas in same condition as equivalent spaces in project. Clean flooring just prior to final acceptance using materials and procedures recommended by flooring manufacturer.
- .4 Final cleaning is specified in section 01 77 00.

END OF SECTION

Acoustic Wall Panels

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Acoustic wall panels; AWP1.

1.2 Administrative Requirements

- .1 Coordination:
 - .1 Coordination of work: coordinate layout and installation of acoustic wall panels and support systems components with other work supported by or penetrating through acoustic wall panel systems.
- .2 Conduct a pre-installation meeting in accordance with Section 01 31 19.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 *Product data*:
 - .1 Submit *Product data* sheets for work of this section, complete with required anchors.
- .3 Shop drawings:
 - .1 Submit shop drawings, indicating panel layout and system components, for each panel system.
 - .2 Include plans, elevations, sections and large scale details, and indicate components and methods of assembly, materials and their characteristics, fastenings, finishes, and other fabrication information required for the work of this section. Indicate assembly joint lines.
 - .3 Submit coordination drawings indicating locations of concealed grounds, cutouts, plates, and other required fabrications.
 - .4 Show relation to adjoining construction, details of outside and inside corners and door openings.
- .4 Samples:
 - .1 Submit 2 - 300 mm x 300 mm (12" x 12") samples of each component of panel system to *Consultant* for review.
 - .2 Samples shall fully represent materials to be supplied in colour, texture, finish and construction.
- .5 Acoustic data:
 - .1 Submit acoustic data verifying that *Products* meet specified acoustic design requirements.

Acoustic Wall Panels

- .2 Acoustic data shall include detailed descriptions of both mounting method and test method used to calculate acoustical performance, complete with references to codes and standards used in such calculations.
- .3 Acoustic data submitted shall be from a certified acoustic testing agency.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.
- .3 Maintenance materials:
 - .1 Maintenance materials: At completion, hand over to the *Owner* an additional 2 panels of each type of panel installed in the *Work*.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Installers:
 - .1 Shall have 5 years' experience, minimum, in application of *Products*, systems and assemblies specified and with approval and training of *Product* manufacturers.
- .2 Mock-ups:
 - .1 Submit 300 mm x 300 mm (12" x 12") mock-up of each acoustical wall panel system, for review and acceptance by *Consultant*.
 - .2 Install at the *Place of the Work* a pre-selected mock-up of full size panel system.
 - .3 Obtain *Consultant's* acceptance of surface, finish and workmanship as a standard by which remainder of the *Project* will be judged. Apply material in accordance with manufacturer's written application requirements. Mock-up must be approved and accepted prior to start of system application. Maintain mock-up during construction for workmanship comparison. Do not alter, move or destroy mock-up until the work is completed and approved by *Consultant*.

1.6 Delivery, Storage, and Handling

- .1 Ship panels in rigid crates to avoid damage. Bent or deformed material shall be rejected.
- .2 Deliver panels and system components to the *Place of the Work* in original, unopened packages and store in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- .3 Before installing panels, permit them to reach room temperature and stabilized moisture content. Acclimatization period shall be 24 hours, minimum, longer as recommended by panel manufacturer.
- .4 Handle panels carefully to avoid chipping edges or damaging units in any way.

Acoustic Wall Panels

1.7 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.

PART 2 - PRODUCTS

2.1 General

- .1 Single source responsibility: Obtain system components for each panel system type from a single source with resources to provide *Products* of consistent quality in appearance and physical properties without delaying progress of the *Work*.

2.2 Acoustic Panels; AWP1

- .1 Materials:
 - .1 Composition: 100% polyester fibre.
 - .2 Acoustical performance: NRC 0.8 minimum.
 - .3 Shapes: as indicated.
 - .4 Mounting method: Z-clips.
 - .1 Acceptable *Products*:
 - .1 Monarch '6.35 mm (1/4") Aluminum Z-Clips'.
 - .2 Substitutions: in accordance with Section 01 25 00.
 - .5 Flammability
 - .1 Fabric must conform to Class A flamespread rating of 25 or under in accordance with CAN/ULC-S102-10.
 - .2 Fabrics that do not meet the CAN/ULC-S102-10 test requirements will be flame treated to meet NFPA 701-2010 Small or Large Scale Vertical Burn tests unless inherently flame retardant.
 - .6 Acceptable *Products*:
 - .1 Refer to Material/Equipment/Product Tag Schedule.
 - .2 Substitutions: in accordance with Section 01 25 00.

PART 3 - EXECUTION

3.1 Examination

- .1 Gypsum board assemblies shall be taped and sanded by Section 09 29 00 and painted in accordance with Section 09 91 00 and shall not permit any air leakage through wall.
- .2 Concrete masonry unit walls shall have flush joints and painted in accordance with Section 09 91 00 and shall not permit any air leakage through wall.

Acoustic Wall Panels

- .3 Do not proceed with installation until unsatisfactory conditions have been corrected. Beginning of installation indicates acceptance of existing substrate conditions.
- .4 Do not start installation until exterior glazing has been completed and exterior openings are closed in. Ensure wet work is completed and dried out to a degree acceptable to panel manufacturer before installation is commenced. Maintain uniform temperatures of at least 16°C for 72 hours prior to commencement of the work of this section and maintain temperature until completion of the work of this section.
- .5 Do not commence installation until work of other sections behind panels has been completed, inspected and accepted by *Consultant*.

3.2 Installation - Panels

- .1 Install acoustical panels to clean, dry and firm substrates in accordance with manufacturer's written requirements.
- .2 Install system in accordance with manufacturer's written installation requirements.
- .3 Panel arrangements as indicated. Maintain dimensions and contours as indicated. Coordinate layout with *Consultant* prior to commencing installation.
- .4 Make allowance for thermal movement.
- .5 Panels shall have no visible fastenings.
- .6 Install fabric systems with matching grain patterns and textures, level, plumb and true free from wrinkles, sags, blisters, waves, and ripples. Installed fabric shall not puddle or dent when touched or leaned upon. Installed fabric shall be self-healing when pushed, punched, or hit and shall revert back to original finished condition.
- .7 Seaming of fabric by sewing is not permitted.

3.3 Installation Tolerances

- .1 Install panels plumb, level, tight, rigid, and secured.
- .2 Comply with the following maximum tolerances:
 - .1 Plumb and level: 3 mm (1/8").
 - .2 Variation from indicated position: plus/minus 3 mm (1/8").
 - .3 Maximum variation of reveal widths: plus/minus 1.5 mm (1/16").
 - .4 Maximum variation of surfaces intended to be flush: plus/minus 1.5 mm (1/16").

3.4 Adjusting and Cleaning

- .1 Examine work of this section on completion and replace uneven or defective materials, eliminate all waves, remedy damaged exposed finished surfaces and remove soiled or stained areas.

END OF SECTION

Painting

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Painting of interior paintable surfaces.
- .2 Paintable and non-paintable surfaces:
 - .1 Paint and finish paintable surfaces included in the Work, except where excluded by the Agreement, Drawings, Schedules, and Specifications.
 - .2 The following surfaces are considered non-paintable, except as otherwise indicated or scheduled:
 - .1 Material and equipment furnished prime and finish painted.
 - .2 Internal surfaces of steel tanks and stacks.
 - .3 Sprayed fire-resistive materials.
 - .4 Exterior concrete.
 - .5 Stainless steel, weathering steel, copper, bronze, chromium plate, nickel, anodized or lacquered or mill finished aluminum, Monel metal.
 - .6 Insulation, glass, plastic, brick, stone.
 - .7 Metallic and mastic insulation finishes.
 - .8 Abrasive material finishes on floors, stair treads, stair nosing and landings.
 - .9 Insulated electric cables.
 - .10 Machined parts of machinery and equipment.
 - .11 Concealed surfaces.
 - .12 Manufactured finish materials.

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting in accordance with Section 01 31 19.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets and list of Products proposed for use in the work of this section as identified in 'Approved Product List' section of the MPI Architectural Painting Specification Manual. Correlate Products to Schedule furnished by Contract Administrator.
- .3 Samples:
 - .1 Samples for initial paint colour and finish selection:

Painting

- .1 Submit manufacturer's colour charts showing full range of colours available, including light and deep dark tones, for each type of finish material indicated for colour selection by Contract Administrator.
- .2 Contract Administrator shall have complete freedom in choice of colours in compiling colour schedule and will not necessarily select colours from standard colour charts of manufacturer of Products specified.
- .3 Submit 3 drawdowns of each selected colour for review by Contract Administrator and resubmit to Contract Administrator as required to obtain approval. Drawdown to be of specified colour, sheen, and paint formula for applicable surface.
- .2 Samples for verification:
 - .1 Submit 3 samples on 200 mm x 305 mm (8"x 12") material of same type as that on which coating is to be applied, for Contract Administrator's approval, at least 30 days before materials are required.
 - .2 Identify each sample as to Project, finish, formula, colour name, number, gloss name and number, date and name of Contractor and painting Subcontractor.
 - .3 Resubmit as required until colours and gloss value are approved.
- .4 MPI Manual:
 - .1 Submit 1 copy of MPI Manual – latest edition, and maintain at site office for reference.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.
- .3 Maintenance materials:
 - .1 Provide 2 sealed containers, each of 4 litres (1 gallon) capacity of each paint product in each colour used in the Work for Owner's maintenance use. Containers shall be new, clearly labelled with manufacturer's name, type of paint, colour and colour number. Store at Place of the Work where directed by Owner.

1.5 Quality Assurance

- .1 Qualifications
 - .1 Manufacturers:
 - .1 Paint manufacturers and Products used shall be as listed under the Approved Product List section of the MPI Painting Manual.
 - .2 Installers / applicators / erectors:
 - .1 Applicators: Shall have minimum 5 years proven satisfactory painting experience of projects of similar size and class subject to Contract Administrator's approval.

Painting

- .2 Only qualified journeymen who have a “Tradesman Qualification Certificate of Proficiency” shall be engaged in painting work. Apprentices shall work under the direct supervision of a qualified journeyman in accordance with trade regulations.
- .2 Mock-ups:
 - .1 Provide mock-ups of each paint system for indicated surfaces of each colour and finish selected to verify preliminary paint selections made under Sample submittals.
 - .2 Mock-ups shall be located to areas as directed by Contract Administrator under lighting conditions matching final area lighting, for acceptance by Contract Administrator.
 - .3 Mock-ups shall demonstrate aesthetic effects of paint colour and sheen and shall set quality standards for material and execution of the Work. Final approval of colour and finish selections shall be based on mock-ups. If colour selections are not approved, apply additional mock-ups of additional colours selected by Contract Administrator at no added cost to the Owner.
 - .4 Do not proceed with work, including ordering of paint Products, until mock-ups of each paint colour and finish and paint system for indicated surfaces have been reviewed and accepted by Contract Administrator.
 - .5 Provide the following in-situ mock-ups:
 - .1 Concrete and gypsum board: 9.3 m² (100 ft²) of vertical surfaces and 9.3 m² (100 ft²) of horizontal surfaces.
 - .2 Hollow metal doors and frames: 1 door and frame for each finish specified.
 - .3 Site painted structural steel, Contract Administrator shall designate steel items and to be included as part of mock-up.
 - .6 Upon completion and approval, mock-ups shall serve as a standard for the balance of the work of this section. Subsequent work carried out and not in the Contract Administrator’s opinion equal to standard shall be repainted without charge.

1.6 Delivery, Storage, and Handling

- .1 Deliver painting materials in sealed, original labelled containers bearing manufacturer’s name, brand name, type of paint or coating and colour designation, standard compliance, materials content as well as mixing and/or reducing and application requirements.
- .2 Store paint Products and materials in original labelled containers in secure (lockable), dry, heated and well ventilated single designated area meeting minimum requirements of both paint manufacturer and authorities having jurisdiction, and at a minimum ambient temperature of 7°C.
- .3 Protect floor and wall surfaces of storage area. Protect floors with sheets or clean plywood or metal pans where mixing is being carried out.

1.7 Field Conditions

- .1 Ambient conditions:
 - .1 Comply with environmental requirements of MPI Manual.

Painting

- .2 Perform no painting work when ambient air and substrate temperatures are below 10°C for both interior and exterior work, unless suitable weatherproof covering and sufficient heating and ventilation facilities are in place in accordance with MPI Manual.
- .3 Perform no painting work when relative humidity is above 85% or when dew point is less than 3°C (5°F) variance between air/surface temperature.

1.8 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranties:
 - .1 System:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.

PART 2 - PRODUCTS

2.1 Performance/Design Requirements

- .1 Except where more stringent requirements are specified, the following reference standard shall govern the work of this section:
 - .1 Master Painters Institute (MPI) Architectural Painting Specification Manual (MPI Manual), including Identifiers, Evaluation, Systems, Preparation and Approved Product List, latest edition, and referenced herein as the MPI Manual, as issued by the local MPI Accredited Quality Assurance Association having jurisdiction.
 - .2 Materials, preparation and workmanship shall conform to requirements of latest edition of Architectural Painting Specification Manual by the Master Painters Institute (MPI) (hereafter referred to as the MPI Painting Manual) as issued by the local MPI Accredited Quality Assurance Association having jurisdiction.
 - .3 Painting systems:
 - .1 Shall remain free from failure due to causes including: material failure; surface preparation less than that specified; and paint film thickness less than that specified, or when not specified, less than that coverage recommended by manufacturer.
 - .2 Presence of any of following shall constitute failure: visible corrosion; film peeling, blistering, checking, scaling, embrittling or general film disintegration; and poor adhesion as determined by tape "peel-off" test procedures.

2.2 Materials

- .1 Products listed in MPI Manual shall be used in the Work, unless specified otherwise.
- .2 Paint and materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, and the like) shall be in accordance with the MPI Manual "Approved Product" listing and shall be from a single manufacturer for each system used.

Painting

- .3 Other paint materials, such as linseed oil, shellac, and the like, shall be highest quality Products of an approved manufacturer listed in the MPI Manual and shall be compatible with other coating materials as required.
- .4 Paint materials shall have good flowing and brushing properties and shall dry or cure free of blemishes or sags.
- .5 Where required, paints and coatings shall meet flame spread and smoke developed ratings designated by building code requirements and/or authorities having jurisdiction.
- .6 Paints and coatings materials used within the weatherproofing system shall not exceed the VOC content limits of the following criteria.
 - .1 Interior paints and coatings: to following Green Seal GS-11 VOC limits:
 - .1 Flat coating type: 50 gm/L.
 - .2 Non-flat coating type: 150 gm/L.
 - .2 Anti-corrosive and anti-rust paints applied to interior ferrous metal substrates: Green Seal Standard GC-03, Anti-Corrosive Paints, maximum 250 gm/L.
 - .3 Clear wood finishes, floor coatings, stains, and shellacs applied to interior elements: South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings.

2.3 Equipment

- .1 Painting and coating equipment in accordance with written requirements of MPI Manual.

2.4 Mixing and Tinting

- .1 Unless otherwise specified, paints shall be ready-mixed. Re-mix prior to application to ensure colour and gloss uniformity.
- .2 Paste, powder or catalysed paint mixes shall be mixed in accordance with manufacturer's written requirements.
- .3 Perform colour tinting operations prior to delivery of paint to Place of the Work.
- .4 Where thinner is used, addition shall not exceed paint manufacturer's recommendations.

2.5 Colours and Gloss Levels

- .1 Paint colours and gloss levels shall be as selected by the Contract Administrator. Locations as indicated or scheduled.
- .2 Colour and gloss schedule: in accordance with Material/Equipment/Product Tag Schedule.
- .3 Paint gloss shall be defined as the sheen rating of applied paint, in accordance with the following MPI values:

Gloss Level	Description	Units @ 60 degrees	Units @ 85 degrees
G1	Matte or Flat finish	0 to 5	10 maximum
G2	Velvet finish	0 to 10	10 to 35
G3	Eggshell finish	10 to 25	10 to 35

Painting

G4	Satin finish	20 to 35	35 minimum
G5	Semi-gloss finish	35 to 70	
G6	Gloss finish	70 to 85	
G7	High-Gloss finish	> 85	

PART 3 - EXECUTION

3.1 Examination

- .1 Prior to commencement of work of this section, thoroughly examine surfaces scheduled to be painted.
- .2 Check moisture content and alkalinity of surfaces to be painted in accordance with paragraph above titled Field Conditions.
- .3 Inspect surfaces to be coated for gouges, marks, nibs, and other defects and properly prepare patching, filling, smoothing or other surface preparation necessary to ensure satisfactory finish.
- .4 Report in writing any condition adversely affecting work of this section.
- .5 Proceed with work only when surfaces and conditions are satisfactory. Remove dust, grease, rust, scale and extraneous matter, tool and machine marks and insects from surfaces which could be detrimental to a satisfactory and acceptable finish.

3.2 Preparation

- .1 Comply with manufacturer's written requirements and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- .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 Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, mildew, grease, and incompatible paints, encapsulants, and other deleterious materials.
- .4 Paint surfaces when moisture content or alkalinity of surfaces to be painted comply with paragraph 3.5 Field Quality Control / Standard of Acceptance.
- .5 Concrete substrates: Remove release agents, curing compounds, efflorescence, and chalk.
- .6 Shop-primed steel substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- .7 ZF75 and ZF120 galvanized-metal substrates: Remove grease and oil residue from galvanized sheet metal by methods to produce clean surfaces that promote adhesion of subsequently applied paints.

Painting

- .8 Z275 galvanized-metal substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- .9 Aluminum substrates: Remove loose surface oxidation.
- .10 Wood substrates for paint finish:
 - .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.
- .11 Existing painted substrates:
 - .1 Clean substrates as indicated above.
 - .2 Sound existing paint surfaces and remove paint surfaces that are not sound, loose or are otherwise stained, cracked, wrinkled, peeling, or defective.
 - .3 Dull hard or glossy surfaces by sanding or other abrasive methods prior to finishing.
 - .4 Apply tie-coat primer product that compatible with substrate as recommended by paint coatings manufacturer.
 - .5 Follow with paint finish coats as specified for like substrate materials specified herein.

3.3 Installation

- .1 Do not paint unless substrates are acceptable and/or until Field Conditions (heating, ventilation, lighting and completion of work of other sections) are acceptable for applications of Products.
- .2 Apply primer, paint or stain in accordance with MPI Manual Premium Grade finish requirements.
- .3 Apply paint and coatings within an appropriate time frame after cleaning when Field Conditions encourage flash-rusting, rusting, contamination or manufacturer's paint specifications require earlier applications.
- .4 Painting coats specified are intended to cover surfaces satisfactorily when applied at proper consistency and in accordance with manufacturer's recommendations.
- .5 Tint each coat of paint progressively lighter to enable confirmation of number of coats.
- .6 Unless otherwise approved by Contract Administrator, apply a minimum of 4 coats of paint where deep or bright colours are used to achieve satisfactory results.
- .7 Sand and dust between each coat to provide an anchor for next coat and to remove defects visible from a distance up to 1000 mm (39").
- .8 Do not apply finishes on surfaces that are not sufficiently dry. Unless manufacturer's directions state otherwise, each coat shall be sufficiently dry and hard before a following coat is applied.

Painting

- .9 Prime coat of stain or varnish finishes may be reduced in accordance with manufacturer's directions.
- .10 Paint finish shall continue through behind wall-mounted items (i.e. chalk and tack boards) and exposed/ visible in complete work including interiors of cupboards and closets, tops of doors, trim, and the like, whether in sight line or not, including behind surface mounted fixtures and heating units.
- .11 Contract Administrator shall have right to make changes in colour tone of finishes prior to final coat to obtain desired results without additional cost to Owner.
- .12 Access doors, prime coated butts and other prime painted hardware, registers, radiators and covers, exposed piping and electrical panels shall be painted to match adjacent surfaces in terms of colour, texture and sheen, unless otherwise indicated.

3.4 Mechanical and Electrical Items

- .1 Finish paint primed mechanical and electrical items with 2 coats of paint. Include for the following list unless otherwise indicated:
 - .1 Air handling units.
 - .2 Convectors.
 - .3 Conduit.
 - .4 Diffusers.
 - .5 Ductwork.
 - .6 Grilles.
 - .7 Hangers.
 - .8 Heaters.
 - .9 Fire hose cabinets.
 - .10 Fire extinguisher cabinets.
 - .11 Louvres.
 - .12 Radiators.
 - .13 Stacks.
 - .14 Vents.
- .2 Prime and paint exposed insulated and bare pipes. Prime and paint exposed conduits and electrical raceways, fittings, outlet boxes, junction boxes, pull boxes and similar items. Use heat resistant epoxy paint on pipes and surfaces where operating surface temperature exceeds 65°C.
- .3 Coordinate the painting of pipes, and coverings with mechanical contractor applying colour banding, flow arrows and pipe identification after the painting of pipes and coverings.
- .4 Paint work to match adjacent walls and ceilings unless directed otherwise.
- .5 Paint interior surfaces of air ducts and pipe trenches including heating pipes and elements that are visible through grilles and louvres with one coat of flat metal paint to limit of sight-line. Paint to be black or white as directed by Contract Administrator.

Painting

- .6 Gas pipes, whether concealed or exposed, shall be painted in accordance with gas code.
- .7 Paint and finish wall surfaces behind convectors. Walls to be finished prior to installation of convector covers. Touch up walls after covers are installed as necessary to make good installation damage.
- .8 Air diffusers shall be primed and finished with 2 coats of paint of same colour and sheen as ducts and/or ceiling.

3.5 Field Quality Control / Standard of Acceptance

- .1 Conduct quality control in accordance with Section 01 45 00.
 - .1 Field tests and inspections:
 - .1 Paint and Coating Quality Assurance Inspections:
 - .1 Field quality control shall be in accordance with Section 01 45 00.
 - .2 Moisture and alkalinity testing:
 - .1 Check moisture content of surfaces to be painted using properly calibrated electronic moisture meter approved by paint manufacturer, and Contract Administrator, or other approved method. Maximum moisture contents shall be in accordance with manufacturer's recommendations and as follows:
 - .1 Concrete and concrete masonry (clay and concrete brick/block): Maximum 12%.
 - .2 Gypsum board and plaster: Maximum 12%.
 - .3 Wood: Maximum 15%.
 - .2 Conduct moisture tests on concrete floors using cover patch test method.
 - .3 Test concrete, masonry and plaster surfaces for alkalinity.
 - .3 Painted interior surfaces shall be considered to lack uniformity and soundness if any of the following defects are apparent to the Contract Administrator:
 - .1 Brush / roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas, and foreign materials in paint coatings.
 - .2 Evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners and re-entrant angles.
 - .3 Damage due to touching before paint is sufficiently dry or any other contributory cause.
 - .4 Damage due to application on moist surfaces or caused by inadequate protection from weather.
 - .5 Damage and/or contamination of paint due to blown contaminants (dust, spray paint, etc.).
- .4 Painted surfaces shall be considered unacceptable if any of the following are evident under natural lighting source for exterior surfaces and final lighting source (including daylight) for interior surfaces to the Contract Administrator:

Painting

- .1 Visible defects are evident on vertical and horizontal surfaces when viewed at normal viewing angles from a distance of not less than 1000 mm (39").
- .2 Visible defects are evident on ceiling, soffit and other overhead surfaces when viewed at normal viewing angles.
- .3 When final coat on any surface exhibits a lack of uniformity of colour, sheen, texture, and hiding across full surface area.
- .5 Painted surfaces rejected by the Contract Administrator shall be made good at the expense of the Subcontractor. Small affected areas may be touched up; large affected areas or areas without sufficient dry film thickness of paint shall be repainted. Runs, sags of damaged paint shall be removed by scraper or by sanding prior to application of paint.
- .6 Painting Subcontractor shall obtain from Contractor written confirmation of specific surface preparation procedures and primers used for fabricated steel items from the fabricator/Supplier to ascertain appropriate and manufacturer compatible finish coat materials to be used before painting any such work.

3.6 Adjusting and Cleaning

- .1 Promptly as work proceeds and on completion of Work, remove paint where spilled, splashed or spattered during the progress of the Work. Keep the premises free from unnecessary accumulation of tools, equipment, surplus materials and debris; at the conclusion of the work leave the premises clean.

3.7 Interior Paint Systems

- .1 System references listed are based on MPI Manual and are Premium Grade, Low VOC (Green Seal GS-11), High Performance Architectural, unless otherwise indicated:
 - .1 Primed ferrous metal; touch-up and finish coats required under this section:
 - .1 Ferrous metal fabrications: Prepared and primed in accordance with Section 05 50 00.
 - .2 INT 5.1R High performance architectural latex; gloss level G5.
 - .2 Galvanized metal: (doors, frames, misc. steel, , pipes, overhead decking, ducts, etc.)
 - .1 INT 5.3M High performance architectural latex; gloss level G5.
 - .3 Dressed lumber: (including doors, door and window frames, casings, mouldings, etc.)
 - .1 INT 6.3A High performance architectural latex; gloss level G5.
 - .4 Plaster and gypsum board: (gypsum wallboard, drywall and textured finishes)
 - .1 INT 9.2B High performance architectural latex finish:
 - .1 Gloss level:
 - .1 Walls, except as otherwise indicated: G3.
 - .2 Ceilings, except as otherwise indicated: G1.
 - .3 Wet and service areas; walls and ceilings: G5.

Painting

- .2 Use high-hide primer sealer type at glass mat finished gypsum board.

END OF SECTION

Visual Display Surfaces

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Tackboards; TBD1, TBD2, TBD3.
 - .2 Related trim, adhesives, and fastenings.

1.2 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Show proposed system of anchorage and materials being supplied on shop drawings submitted for review.
 - .2 Show dimensional layouts, hardware items, anchorage devices, dimensions, description of materials and finishes, and all other pertinent information.
- .4 Samples:
 - .1 Submit 305 mm x 305 mm (12" x 12") samples of each Product specified, diagonally cut to show cross section through assembly, complete with accessories and trim.

1.3 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.

1.4 Quality Assurance

- .1 Qualifications:
 - .1 Installers / applicators / erectors:
 - .1 Erection of materials to be carried out by competent workers supervised by a foreperson with at least 10 years' experience in this specialized field and approved in writing by manufacturer for installation of their Product.

1.5 Delivery, Storage, and Handling

- .1 Package Products to prevent distortion in shipment and handling. Label and protect finish surfaces by sturdy wrappings.

1.6 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.

Visual Display Surfaces

- .2 Provide manufacturer's standard product warranty.

PART 2 - PRODUCTS

2.1 Design/Performance Requirements

- .1 Trademarks and labels:
 - .1 No trademarks or labels will be accepted on exposed finished work.

2.2 Tackboards; TBD1, TBD2, TBD3

- .1 Forbo cork tackboard: 12.7 mm (1/2") factory prelaminated consisting of 6 mm (1/4") thick Forbo 'Bulletin Board' linoleum cork laminated to 6 mm (1/4") particle board substrate under mechanical pressure in maximum panel sizes of 1524 mm x 4876 mm (5'-0" x 16'-0"). Bonding of materials by a waterproof adhesive that will not delaminate or rupture at the contact surfaces.
 - .1 Colour: Refer to Material/Equipment/Product Tag Schedule.
 - .2 Acceptable Products: Refer to Material/Equipment/Product Tag Schedule
- .2 Aluminum trim: in accordance with Trim Components paragraph below.

2.3 Trim Components

- .1 Aluminum trim:
 - .1 Acceptable Products:
 - .1 ASI 'Series 9100 Radius Corner' trim.
 - .2 Substitutions: in accordance with Section 01 25 00.
 - .2 Extruded aluminum components, AA6063 T5 or approved alternative, 25 mm x 25 mm x 3 mm (1" x 1" x 1/8"), mitred corners.
 - .3 Finish: etched and clear anodized 0.051 mm (0.002") satin finish free from extruding draw marks and surface scratches.
 - .4 Reveal: Provide 3.2 mm (1/8") reveal between board finish and aluminum frame.
 - .5 Final assembly to have seamless/welded flush and level butt joints. No visible joints accepted and no intermediate trim.

2.4 Attachment Hardware

- .1 Use manufacturer's standard mounting hardware.

PART 3 - EXECUTION

3.1 Installation

- .1 Install in accordance with manufacturer's written installation requirements.
- .2 Locate seams as directed by the Contract Administrator.

3.2 Installation - Trim Components

- .1 Install in accordance with manufacturer's written installation requirements.

Visual Display Surfaces

3.3 Installation Tolerances

- .1 Install plumb, level, tight and secured. Comply with the following maximum tolerances:
 - .1 Within 1.5 mm (1/16") of plumb and level, and flush with adjacent panels.
 - .2 Within 25 mm (1") variation from indicated position.

3.4 Adjusting and Cleaning

- .1 Verify under work of this section that installed Products function properly, and adjust them accordingly to ensure satisfactory operation.
- .2 Do not remove protective coatings until final cleaning, or earlier if directed by Contract Administrator.
- .3 Refinish damaged or defective work so that no variation in surface appearance is discernible. Refinish work at Place of the Work only if approved.

END OF SECTION

Washroom and Janitor Accessories

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Washroom accessories.
 - .2 Janitor room accessories.

1.2 Administrative Requirements

- .1 Coordination:
 - .1 Supply manufacturer's handling instructions, anchorage information, roughing-in dimensions, templates and service requirements for installation of the work of this section, and assist or supervise, or both, the setting of anchorage devices and construction of other work incorporated with Products specified in this section in order that they function as intended.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Samples:
 - .1 Submit 3 samples of each finish specified.
- .4 Shop drawings:
 - .1 Include plans, elevations, hardware, and installation details.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.

1.5 Delivery, Storage, and Handling

- .1 Package or crate, and brace products to prevent distortion in shipment and handling. Label packages and crates, and protect finish surfaces by sturdy wrappings.
- .2 Deliver products to location at the Place of the Work designated by Contractor.

PART 2 - PRODUCTS

2.1 Accessories

- .1 Incorporate reinforcing, fastenings and anchorage required for building-in of Products.
- .2 All accessories shall be brushed stainless steel (no chrome).

Washroom and Janitor Accessories

- .3 Washroom accessories: in accordance with Washroom Accessories Schedule.

2.2 Fabrication

- .1 Fabricate Products with materials and component sizes, metal gauges, hardware, reinforcing, anchors, and fastenings of adequate strength to ensure that washroom accessories will remain free of warping, buckling, opening of joints and seams, and distortion within limits of intended use.

PART 3 - EXECUTION

3.1 Preparation

- .1 Verify that rough-in dimensions and blocking or back-up has been provided to comply with product manufacturer's written requirements.

3.2 Installation of Washroom and Janitor Accessories

- .1 Supply manufacturer's handling instructions, anchorage information, roughing-in dimensions, templates and service requirements for installation of the work of this section, and assist or supervise, or both, the setting of anchorage devices and construction of other work incorporated with Products specified in this section in order that they function as intended.
- .2 Comply with product manufacturers written requirements.
- .3 Install and secure fixtures rigidly in place using expansion shields in solid masonry or concrete, toggle bolts in hollow masonry or sheet metal screws at metal studs.
- .4 Insulate surfaces to prevent electrolytic action due to contact with dissimilar metals, or concrete or masonry as applicable. Use bituminous paint or other approved means.
- .5 Install on built-in concealed solid backing materials. Grab bar installation shall be able to withstand 250 kg downward force.
- .6 Verify locations and mounting heights with Contract Administrator before roughing-in.

3.3 Barrier Free Installation Heights

- .1 Install accessories to permit operable parts and controls to be accessed in accordance with authorities having jurisdiction.

3.4 Installation Tolerances

- .1 Install accessories plumb, level, straight, tight and secured, centred between joints on masonry and tile walls to the following maximum tolerances:
 - .1 Plumb and level: 3 mm (1/8").
 - .2 Variation from indicated position: 3 mm (1/8").

3.5 Adjusting and Cleaning

- .1 Verify under work of this section that installed Products function properly, and adjust them accordingly to ensure satisfactory operation. Test mechanisms, hinges, locks, and latches and adjust and lubricate to ensure washroom accessories are in perfect working order.

Washroom and Janitor Accessories

- .2 Do not remove protective coatings until final cleaning, or earlier if directed by Contract Administrator.
- .3 Refinish damaged or defective work so that no variation in surface appearance is discernible. Refinish work at Place of the Work only if approved.

END OF SECTION

Prefinished Metal Lockers

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Prefinished metal lockers; LKR1.

1.2 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
- .3 Shop drawings:
 - .1 Indicate thicknesses of metal, fabricating methods, assembled banks of lockers, bases, trim, numbering, filler panels, end panels, and tops.
- .4 Samples:
 - .1 Submit sample of colour and finish on actual base metal.

PART 2 - PRODUCTS

2.1 Materials

- .1 Lockers: to CAN/CGSB 44.40-2001 AMEND.
 - .1 Type: 3-tier locker.
 - .2 Size (width x depth x height): 305 mm x 380 mm x 1830 mm (12" x 15" x 72").
 - .3 Locking system: suitable for padlocks.
 - .4 Metal materials: to ASTM A1008/A1008M-13, free of imperfections.
 - .5 Frame: 1.6 mm (0.0625") thick (16 gauge).
 - .6 Door: minimum 1.0 mm (0.0375") 20 gauge outer panel and 24 gauge liner, hollow core or honeycomb.
 - .7 Shelves: minimum 0.6 mm (0.025") thick (24 gauge).
 - .8 Hooks: three single prong coat hooks.
 - .9 Body: minimum 0.6 mm (0.025") thick (24 gauge).
 - .10 Sloped top: minimum 20 gauge, mitred at corners.
 - .11 Ventilation: Airflow shall be achieved through louvers or perforates in the vertical frame members or door.
 - .12 Base:
 - .1 Built-up curb: in accordance with Section 09 22 00/09 29 00.

Prefinished Metal Lockers

- .13 Number plates: Each door shall have a number plate riveted onto body or door pull, numbered sequentially starting at "1" for each locker Type as directed by the Contract Administrator.
- .14 Locker finish; exposed and semi-exposed surfaces: baked on polymer powder or alkyd enamel, colour to later selection by the Contract Administrator. Frame colour shall match door colour unless otherwise indicated.
- .15 Acceptable manufacturers/Products:
 - .1 Refer to Furniture Schedule.
 - .2 Substitutions: in accordance with Section 01 25 00.

PART 3 - EXECUTION

3.1 Installation

- .1 Assemble and install lockers complete with metal base in accordance with manufacturer's written installation requirements.
- .2 Securely fasten at least every third locker through to wall studs, masonry or concrete substrate.
- .3 Install trim and filler panels where required for continuous appearance and where obstructions occur. Specific conditions as indicated.
- .4 Install finished end panels to exposed ends of locker banks.

3.2 Installation Tolerances

- .1 Install plumb, level, tight and secured. Comply with the following tolerances:
 - .1 Plumb and level: 3 mm (1/8").
 - .2 Variation from indicated position: plus/minus 3 mm (1/8").

END OF SECTION

Appliances

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Appliances.

1.2 Administrative Requirements

- .1 Coordination:
 - .1 Submit templates to Contractor for use by installers and fabricators as required for proper location and installation of hardware.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
 - .2 Include furnished accessories.
- .3 Shop drawings:
 - .1 Indicate layout in plan and elevation, installation details, and hardware.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.

1.5 Delivery, Storage, and Handling

- .1 Package or crate, and brace products to prevent damage during shipment and handling. Label packages and crates, and protect finish surfaces
- .2 Conform to manufacturer's written temperatures, relative humidity for storage of appliances.

1.6 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.

Appliances

PART 2 - PRODUCTS

2.1 Appliances - Supply and Install

- .1 Colour: White, unless otherwise indicated.
- .2 Electrical services: in accordance with Divisions 26, 27, and 28.
- .3 Mechanical services: in accordance with Divisions 21, 22, and 23.

2.2 Suite Appliances - Product Schedule

- .1 Refer to Furniture, Fixture & Equipment Responsibility Matrix schedule.

2.3 Accessories

- .1 Provide standard manufactures accessories for models as specified.

PART 3 - EXECUTION

3.1 Examination

- .1 Examine substrates, installation areas, and conditions for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of appliances.
- .2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Preparation

- .1 Accept delivery, unload appliances from delivery trucks and uncrate.

3.3 Installation

- .1 Install appliances in accordance with appliance manufacturer's written installation requirements.
- .2 Install where scheduled or indicated, clean, connect, and level and test.
- .3 Built-in appliances:
 - .1 Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.
- .4 Freestanding appliances:
 - .1 Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- .5 Supply and connect approved cord and attachment plugs required by authorities having jurisdiction.

3.4 Installation Tolerances

- .1 Install plumb, level, tight and secured. Comply with the following maximum tolerances:

Appliances

- .1 Plumb and level: 3 mm (1/8").
- .2 Variation from indicated position: 3 mm (1/8").

3.5 Adjusting and Cleaning

- .1 Verify under work of this section that installed Products function properly, and adjust them accordingly to ensure satisfactory operation. Test mechanisms, hinges, latches and adjust and lubricate to ensure appliances are in perfect working order.
- .2 Do not remove protective coatings until final cleaning, or earlier if directed by Contract Administrator.
- .3 Refinish damaged or defective work so that no variation in surface appearance is discernible. Refinish work at Place of the Work only if approved.

3.6 Closeout Activities

- .1 Demonstration:
 - .1 Before acceptance of appliances, arrange for demonstration of appliances with authorized representatives of Owner, to be performed by factory-authorized service representative to assure proper function, adjustment, operation and explanation of appliances including maintenance requirements.

END OF SECTION

Roller Window Shades

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - .1 Roller window sun shades at interior locations; WS.

1.2 Administrative Requirements

- .1 Conduct a pre-installation meeting in accordance with Section 01 31 19.

1.3 Submittals

- .1 Submit required submittals in accordance with Section 01 33 00.
- .2 Product data sheets:
 - .1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.
 - .2 Submit flammability performance data.
 - .3 Submit manufacturers' installation instructions.
- .3 Shop drawings:
 - .1 Submit shop drawings or fully dimensioned catalogue cuts.
 - .2 Window treatment schedule: Use same designations indicated on Agreement, Drawings, Schedules, and Specifications.
 - .3 Clearly indicate general construction, configurations, jointing methods and locations, fastening methods, handing of controls, required blocking locations, banding (tandem shades), and installation details.
- .4 Samples:
 - .1 Submit samples of each material and finish colour selected and each accessory.

1.4 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 00.
- .2 Operation and maintenance data:
 - .1 Submit manufacturer's operation and maintenance instructions for inclusion in the operation and maintenance manuals.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Manufacturers:
 - .1 Company specializing in manufacturing the Products specified in this section, with 10 years' experience minimum.
 - .2 Installers / applicators / erectors:

Roller Window Shades

- .1 Work of this section shall be by forces in the direct employ or under control of the system manufacturer, skilled, trained, and experienced in work of similar scope and complexity.
- .2 Mock-ups:
 - .1 Erect 1 full size mock-up each roller shade type at the Place of the Work for review. Completed and accepted mock-up shall act as the standard to which balance of the work of this section will be judged.

1.6 Delivery, Storage, and Handling

- .1 Before delivery to the Place of the Work, check each shade for operation; remove finger marks and smudges.
- .2 Package Products to prevent distortion in shipment and handling. Label packages and crates, and protect finish surfaces by sturdy wrappings.

1.7 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - .1 Labour, materials, and workmanship for work of this section.
 - .2 Duration: 2 years.

PART 2 - PRODUCTS

2.1 Manufacturers

- .1 Subject to compliance with requirements, provide Products by one of the following manufacturers:
 - .1 Altex.
 - .2 Elite Window Fashions.
 - .3 MechoShade Systems, Inc.
 - .4 Mermet.
 - .5 Solarfective Products by Legrand Global.
 - .6 Sun Glow Window Covering Products of Canada Ltd.
 - .7 Substitutions: in accordance with Section 01 25 00.

2.2 Hardware - Manual Controlled Shades

- .1 Chain operated, with infinite positioning. Right hand operation and banding as applicable to suit Place of the Work condition.
 - .1 Drive assembly:
 - .1 Allow finger tip control and include a built in shock absorber system to prevent chain breakage under normal operating conditions;
 - .2 Capable of being field adjusted from the exterior of the shade unit without having to disassemble the hardware.

Roller Window Shades

- .3 Drive Chain: No. 10 stainless steel bead chain formed in a continuous loop. The chain shall have passed a 40 kg (90 lb) load test.

- .1 Provide retainers to hold loose chain with tension device to restrain looped cords taut to reduce the risk of entanglement from loose chain.

2.3 Assembly

- .1 Provide fully factory assembled shade unit consisting of 2 shade brackets, one piece extruded aluminum shade tube, extruded aluminum fascia, aluminum profile hembars, extruded vinyl fabric spline, and fabric as specified.
- .2 Fabric shall hang straight, without shifting sideways more than 3 mm (1/8") in either direction due to warp distortion or weave design.
- .3 Factory modify housings where necessary to bypass columns.
- .4 End brackets: a two piece moulded ABS construction with nylon drive sprocket. Bracket colour shall coordinate with the fascia colour.
- .5 Shade tube: Minimum 1.52 mm (0.060") thick extruded aluminum with three equally spaced continuous stiffening fins, non-sag design, maximum deflection under full load of fabric L/700.
- .6 Fascia: Minimum 1.5 mm (1/6") thick extruded aluminum.
- .7 Hembar: Extruded aluminum with matching plastic end finials.
- .8 Mounting: Removal of shade system shall not require the disassembly of the shade unit.

2.4 Shade Mounting System

- .1 Design extruded aluminum bracket to accept preassembled shade system.
 - .1 Use brackets to facilitate the alignment with shade opening.
- .2 Modular construction: Shades shall be removable as a complete modular unit without any component disassembly required.

2.5 Aluminum Finish

- .1 Exposed aluminum: Clear anodized AA-M12C22A31.
- .2 Unexposed aluminium: Mill finish.

2.6 Shade Fabric Types

- .1 Sun control fabric; dimensionally stable shade fabric:
 - .1 Acceptable Products; 3% open area:
 - .1 Refer to Material/Equipment/Product Tag Schedule.
 - .2 Substitutions: in accordance with Section 01 25 00.
 - .2 Colour: as selected by Contract Administrator from manufacturer's standard range.
- .2 Fabric:
 - .1 Hang flat, without buckling or distortion. Edge, where trimmed, shall hang true and straight, without shifting sideways more than 3 mm (1/8") in either direction due to warp distortion or weave design.

Roller Window Shades

- .2 Colour fast, retain its shape, and not be affected by moisture or heat.
- .3 Flammability performance:
 - .1 Certified by an independent laboratory, shade fabric shall pass CAN/ULC S109-14.

2.7 Fabrication

- .1 Finished assemblies: Square, true to size and free from distortion, twist, or other defects that could affect their strength, operation or appearance.
- .2 Factory applied finish: Uniform, smooth and without blemishes.

PART 3 - EXECUTION

3.1 Installation

- .1 Install shade systems in plumb, squared, adequately anchored, maintaining uniformed clearances, accurate alignment levels, and parallel with the window plane. Fabric shall not travel more than 3 mm (1/8") in either direction within channels after installation.
- .2 Fabric shall be pre-measured and manufactured off-site.
- .3 Shades shall be snapped into place without screws or visible fasteners.
- .4 Incorporate reinforcing, fastening and anchorage required for installation of shades.
- .5 Securely attach installation fittings to their mounting surfaces with stainless steel or hardened aluminum screws of proper length and type, and durable anchors.
- .6 Install shade roller true and level, and with cloth to hang flat without buckling or distortion.
- .7 Room darkening shades (black-out) to be installed to eliminate passage of light from exterior.
- .8 Electrical wiring, hook-up, switches; motorized shades: in accordance with Divisions 26, 27, and 28.

3.2 Adjusting and Cleaning

- .1 Verify that installed shade system functions properly, and adjust it accordingly to ensure satisfactory operation.
- .2 Refinish damaged or defective work so that no variation in surface appearance is discernible.

END OF SECTION

Exterior Site Furnishings

PART 1 - PART 1 GENERAL

1.1 Summary

- .1 Section includes:
 - 1. Exterior site furnishing products and manufactured items including:
 - .1 Exterior children's play kitchens.
 - .2 Elevated planting box.
 - .3 Moveable log stump seating.
 - .4 Play and balance logs.
 - .5 Sand box covers.
 - .6 Padded column covers.

1.2 Submittals

- .1 Submit product data in accordance with Section 01 33 00.
- .2 Provide maintenance data for care and cleaning of site furnishings for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.3 Standards, Codes and Acts

- .1 Comply with the latest edition of CAN/ULC Z614.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal: paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Separate for reuse and/or recycling and place in designated containers for steel, metal, and plastic waste in accordance with Waste Management Plan.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 - PRODUCTS

- .1 Exterior children's play kitchens

Exterior Site Furnishings

1. Description: movable, child-safe wood counter with heavy duty stainless steel sink and stopper and shelf.
2. Manufacturer: Nature's Instruments.
 - .1 Model name: NI-PG-507-01.01.
 - .2 Height: 458 mm.
 1. Quantity: 2.
 - .3 Model name: NI-PG-507-01.02.
 1. Height: 508 mm.
 2. Quantity: 1.
- .2 Elevated planting box.
 1. Model name: "Eden."
 2. Material: cedar.
 3. Model: RGT-23, SKU 1001161853.
 4. Distributer: Home Depot Canada.
 5. Dimensions: 1220 mm long x 915 mm wide x 812 mm high
- .3 Moveable log stump seating.
 1. Description: de-barked, white oak log stump seat.
 2. Manufacturer: Nature's Instruments.
 - .1 Model Name: NI-PG-702.
 - .2 Diam: 610 mm.
 1. Height: 305 mm.
 - .1 Quantity: 6.
 2. Height: 252 mm.
 - .1 Quantity: 6.
 - .4 Play and balance logs.
 - .5 Sand box covers: mildew-resistant, weighted and breathable scrim
 1. Material: woven polyester scrim per ASTM D3776.

Exterior Site Furnishings

2. Weight: 0.305152 kilograms per square metre
3. Colour: white
4. Manufacturer: Play Clean Playground Services Limited.
5. Size: to suit coverage of full length and width of sand boxes
- .6 Padded column covers.

PART 3 - Execution

3.1 Installation

- .1 Assemble products in accordance with manufacturer's instructions.

END OF SECTION

PROJECT MANUAL

Issued for 100% Final Design Package

Volume 2

New Daycare 55 John Street, Toronto

55 John Street, Toronto, Ontario M5V 3C6

Diamond Schmitt Architects and Salter Pilon Architects

Project No. 211018

February 26, 2024

Document Responsibility and Project Directory

1.1 Document Responsibility

- .1 Refer to Project Manual, Section 00 01 10 - Table of Contents, for indication of document responsibility (DR). Abbreviations for entity responsible for document preparation are as follows:
 - .1 A - Denotes documents prepared by Architect.
 - .2 CE - Denotes documents prepared by Communications Engineer.
 - .3 E - Denotes documents prepared by Electrical Engineer.
 - .4 M - Denotes documents prepared by Mechanical Engineer.
 - .5 ES - Denotes documents prepared by Electronic Safety and Security Engineer.
 - .6 O - Denotes documents prepared by Owner.
 - .7 S - Denotes documents prepared by Structural Engineer.
- .2 Professional seals if applied next to company names in the project directory (below) govern only those specification sections and schedules identified by the corresponding document responsibility (DR) abbreviation in Section 00 01 10.

1.2 Project Directory

- .1 Owner:

City of Toronto
Metro Hall – 55 John Street, 2nd Floor
Toronto, Ontario
M5V 3C6

Tel: 416-338-6611
- .2 Architect (the Contract Administrator):

Diamond Schmitt Architects
384 Adelaide Street West, Suite 100
Toronto, Ontario
M5V 1R7

Tel: 416-862-8800
Fax: 416-862-5508

Salter Pilon Architects
151 Ferris Lane, Suite 400
Barrie, Ontario
L4M 6C1

Tel: 705-737-3530

Document Responsibility and Project Directory

.3 Structural Engineer:

Reed Jones Christoffersen Limited

100 University Avenue, North Tower Suite 300
Toronto, Ontario
M5J 1V6

Tel: 416-977-5335

.4 Mechanical Engineer:

The HIDI Group Inc.

155 Gordon Backer Road, Suite 200
Toronto, Ontario
M2H 3N5

Tel: 416-364-2100

.5 Electrical Engineer:

The HIDI Group Inc.

155 Gordon Backer Road, Suite 200
Toronto, Ontario
M2H 3N5

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DIVISION 20 – GENERAL MECHANICAL
SPECIFICATIONS
FOR THE
CITY OF TORONTO - DAYCARE CENTRE (METRO HALL)
55 JOHN STREET
TORONTO, ONTARIO

Prepared by:

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Our Project No. 2021-0245

Issued for Approval
Design Development

January 26, 2024

DISCIPLINES MECHANICAL
ELECTRICAL
PLUMBING
LIGHTING DESIGN
COMMUNICATIONS & AV
SECURITY & RISK
COMMISSIONING
ENERGY SERVICES



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Project No.: 2021-0245
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1 **GENERAL**

1.1 GENERAL

1.1.1 Conform to the conditions stated in the Contract Form Document CCDC 2 – 2008, Supplementary Conditions and Division 01 - General Requirements of these Specifications.

1.1.2 The General Mechanical Requirements apply to all Sections of this Division and of Divisions 21, 22, 23 and 25.

1.1.3 The Specifications are arranged generally in accordance with the MasterFormat 2004 Edition. Sections of this Division are not intended to delegate functions or to delegate work to any specific Subcontractor(s).

1.2 DEFINITIONS

1.2.1 “Provide” means to supply and install the Products and services specified in the Contract Documents.

1.2.2 “The Work” means the total construction and related services required by the Contract, and it includes all labour, products, and services.

1.2.3 “Products” means all material, machinery, equipment, and fixtures forming part of the Work but does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work which is normally referred to as construction machinery and equipment.

1.2.4 “This Division” means all Subcontractors performing work under the Mechanical Contract, including Divisions 21, 22, 23 and 25.

1.2.5 “Other Divisions” means other Subcontractors not included in this Division.

1.2.6 “Balancing Subcontractor” means the Subcontractor responsible for the balancing work.

1.3 INTENT

1.3.1 Provide all work, including items, articles, materials, operations, and methods listed, mentioned, and scheduled in the Contract Documents. Include all labour, equipment, tools, scaffolds, and other incidentals necessary and required for the complete installation.

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- 1.3.2 Consider the Specifications and city of Toronto standards as an integral part of the Drawings, which accompany them. Do not use the Drawings or the Specifications or city standards alone. Consider any item or subject omitted from one, but mentioned or reasonably implied in the other, as properly and sufficiently specified and provided under the work of this Division.
- 1.3.3 This installation shall be made in strict accordance with the Drawings, Specifications, and all applicable codes, regulations, standards, bylaws, including the Ontario Building Code, requirements of local authorities having jurisdiction, Owner's Insurers', and NFPA regulations. Codes, standards, and regulations referenced by these Specifications shall be the latest edition as applicable at the time of building permit application unless noted otherwise or specifically defined under the OBC.
- 1.3.4 All equipment and devices used shall be UL/cUL listed and/or CSA certified where applicable.
- 1.3.5 Each Subcontractor is considered an expert in their field.
- 1.4 **EXAMINATION OF SITE AND CONTRACT DOCUMENTS**
- 1.4.1 Before tendering, visit the Site of the proposed Work and obtain all information as to existing conditions and limitations.
- 1.4.2 Examine the Specifications and all Drawings including the Specifications and Drawings of all other Divisions before commencing any portion of the work to this Division.
- 1.4.3 No allowance will be made for any consideration that may have been overlooked.
- 1.4.4 Unless exceptions are specifically noted in the Contract Documents at the time of Tender, the submission of a bid confirms that the Contract Documents and the Site conditions are accepted without qualification.
- 1.5 **SCOPE**
- 1.5.1 Major aspects of the work of this Division shall include, but not necessarily be limited to, the following items. Refer to Contract Drawings for the full scope of the Work included in the Contract.
- 1.5.1.1 Heating, Ventilation, and Air Conditioning (HVAC) systems, consisting of modifications to the existing air handling unit system,

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conversion to VAV system, perimeter fan coil units, general exhaust and sanitary exhaust systems, associated ductwork, grilles, diffusers, and controls.

- 1.5.1.2 Plumbing systems, including tenant connections with water meters, domestic cold water, sanitary drain and vent risers.
- 1.5.1.3 Plumbing fixtures for public washrooms, kitchens,
- 1.5.1.4 Fire protection systems including modifications to existing wet sprinkler system throughout the building and fire standpipe system
- 1.5.1.5 Noise control and vibration isolation systems.
- 1.5.1.6 Pool water treatment system.
- 1.5.1.7 DDC building automation system.
- 1.5.1.8 Testing, adjusting and balancing.
- 1.5.1.9 Commissioning of mechanical systems and equipment.

1.6 PERMITS, FEES AND INSPECTIONS

- 1.6.1 Apply for, obtain, and pay for all permits, licenses, inspections, examinations, and fees required.
- 1.6.2 Arrange for inspection of all work by the authorities having jurisdiction over the Work. On completion of the Work, present to the Owner the final unconditional certificate of approval of the Inspection Authorities.
- 1.6.3 Comply with requirements of the edition as applicable at the time of building permit application, of the relevant CSA standards, the requirements of the authorities, Federal, Provincial and Municipal codes, the applicable standards of the Underwriters' Association and all other authorities having jurisdiction. These codes and regulations constitute an integral part of these Specifications. In case of conflict between the Codes and the Contract Documents, the more stringent requirement shall apply.
- 1.6.4 In no instance reduce the standard established by the Drawings and Specifications by applying any of the codes referred to herein.
- 1.6.5 Before starting any work, submit the required number of copies of the Drawings and Specifications to the authorities for their approval and comments. Comply with any changes requested as part of the

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Contract, but notify the Owner immediately in writing of such changes for proper processing of these requirements. Prepare and furnish any additional drawings, details or information as may be required.

1.7 CONTRACT DRAWINGS

1.7.1 The Drawings for the mechanical work are diagrammatic performance drawings, intended to convey the scope of the Work, and indicate general arrangement and approximate location of apparatus, fixtures, and pipe runs. The Drawings do not intend to show architectural and structural details.

1.7.2 Do not scale drawings, but obtain information involving accurate dimensions to structure from dimensions shown on architectural and structural drawings, or by site measurements. Consult general construction Drawings as well as detail Drawings to become familiar with all conditions affecting the Work and verify spaces in which the Work will be installed.

1.7.3 Make, at no additional cost to the Owner, any changes or additions to materials and/or equipment necessary to accommodate structural conditions (runs around beams, columns, etc.).

1.7.4 Alter at no additional cost to the Owner, the location of materials and/or equipment as directed, provided that the changes are made before installation and do not necessitate additional material.

1.7.5 Install all ceiling mounted components (diffusers, grilles, sprinklers) in accordance with reflected ceiling drawings reviewed by the Consultant.

1.7.6 Leave space clear and install all work to accommodate future materials and/or equipment as indicated and to accommodate equipment and/or material supplied by another Division of Work or Contract. Verify spaces in which Work is to be installed. Install all pipe runs, etc., to maintain headroom and clearances and to conserve space in shafts and ceiling spaces.

1.7.7 Confirm on the Site the exact location of outlets and fixtures. Confirm location of outlets for equipment supplied under other Divisions of Work or Contracts.

1.8 CONSTRUCTION DRAWINGS

1.8.1 Prepare dimensioned co-ordination drawings in conjunction with all

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Subcontractors concerned, showing sleeves, access door locations, and openings through structure and all insert sizes and locations. Show all weights on load points. Show all electrical systems, mechanical systems, conduit, and ductwork.

1.8.2 Prepare drawings of pump pits, equipment bases, anchors, inertia slabs, floor and roof curbs pertaining to the Mechanical Work. Base drawings upon reviewed Shop Drawings. Indicate all loads transferred to the structure.

1.8.3 Submit drawings approved by all trades, to the Consultant and include one complete set in each operating and maintenance instruction manual.

1.9 SHOP DRAWINGS

1.9.1 Submit Shop Drawings and samples for material and equipment as listed in the Specifications. Provide one (1) electronic pdf file. Each Shop Drawing shall have a clear margin equal to the half of a 216 mm x 280 mm (8-1/2" x 11") size sheet for the application of all necessary approval stamps.

1.9.2 Contractor shall provide a shop drawing submission schedule at the start of the project. Schedule shall indicate the description of each shop drawing and the date of submission to the Consultant.

1.9.3 The Consultant will only consider Shop Drawings bearing the stamp of approval of the Contractor and all Sub-Contractors involved when applicable. Check for all pertinent information such as physical dimensions, make, performance, electrical characteristics, and indicate the intended use and location before stamping these drawings approved.

1.9.4 Assume responsibility for accuracy of equipment dimensions related to available space and accessibility for maintenance and service, and compliance with Codes and Inspection Authorities.

1.9.5 Submit Shop Drawings showing the following:

1.9.5.1 Project name.

1.9.5.2 Project tag number.

1.9.5.3 Manufacturer's name and model number.

1.9.5.4 Supplier's name.

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- 1.9.5.5 Approval agencies.
- 1.9.5.6 Shipping and working weight.
- 1.9.5.7 Performance characteristics.
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- 1.9.5.9 Electrical characteristics.
- 1.9.5.10 Materials used in manufacture and type of finish.
- 1.9.5.11 Time required to fabricate and to deliver.
- 1.9.5.12 All variations from Tender Documents.
- 1.9.5.13 Construction and field connection details.
- 1.9.5.14 Motor locations.
- 1.9.6 Shop Drawings for packaged equipment shall be submitted as complete packages, including all equipment components and details (wiring diagrams, control diagrams, etc.).
- 1.9.7 The Consultant's review shall not relieve the Contractor from responsibility for deviations from the Consultant's Drawings and Specifications, unless they have in writing, called the Consultant's attention to such deviations at the time of submission of drawings. The Consultant's review shall be construed to apply to and only to general arrangement and shall not relieve the Contractor from the entire responsibility for correctness of details and dimensions. Any fabrication, erection, setting out or other work done in advance of the receipt of stamped drawings shall be done entirely at the Contractor's risk.
- 1.9.8 Shop Drawings will be marked by the Consultant for action by the Contractor as follows:

<p>Consultant's <u>Markings</u></p> <p>Not reviewed</p>	<p>Action by <u>Contractor</u></p> <p>Product does not fall under this Division's scope and it does not affect this Division's Work in any way</p>
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Reviewed	Proceed with work
Reviewed as Noted	Proceed in accordance with mark-up. Resubmit revised drawings for record
Revise and Resubmit	Submit revised drawings for review before proceeding

1.10 SCHEDULING

1.10.1 Comply with the Contractor's construction schedule.

1.10.2 Provide in the tender price any costs for premium time outside of normal working hours to complete the work on schedule.

1.11 RECORD DRAWINGS

1.11.1 Obtain electronic copy of the Drawings, Specifications & Contract Documents in PDF format and AutoCAD/Revit drawing files from a central project management website. If such a website is not set-up for the project, obtain electronic copy of the Drawings, Specifications & Contract Documents in PDF format and AutoCAD/Revit drawing files from the Consultant via email or other electronic file transfer tool used by the Consultant, after returning Consultant's waiver signed. As the job progresses, produce white prints of the relevant drawings and mark the prints to accurately indicate installed work. Have the white prints available for inspection at the site at all times, and present for scrutiny at job meeting. Transfer all information onto the AutoCAD drawing files/Revit model. Drawing files shall retain all original layering standards. Submit one (1) set of AutoCAD drawing files/Revit model files and one (1) set of pdf files, via email or other mutually agreed electronic file transfer tool, of final "Record" documents (drawings and specifications) to the Consultant for review. Note that the consultant's AutoCAD drawing files/Revit model files are copyrighted and may not be used for any other purpose other than that described above.

1.11.2 The drawing files shall be provided solely to assist the Subcontractor in the preparation of "Record" drawings. The Consultant assumes no liability for any errors, omissions, incomplete information, incorporation of latest changes, or other instructions.

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- 1.11.3 While the Consultant takes precautions to ensure that no computer virus is transmitted, scanning for viruses upon receipt is recommended.
- 1.11.4 Prepare Record Drawings showing the following:
 - 1.11.4.1 Inverts of all services entering and leaving the building and at property lines.
 - 1.11.4.2 Dimensions of underground services in relation to building lines at key points of every run.
 - 1.11.4.3 Elevations of underground services in relation to Ground floor level of the building.
 - 1.11.4.4 Dimensioned location of all services embedded in the structure.
 - 1.11.4.5 Dimensioned location of all services left for future Work.
 - 1.11.4.6 All Addendum changes.
 - 1.11.4.7 All changes to the work due to Change Orders.
 - 1.11.4.8 All changes to the Work during construction.
 - 1.11.4.9 Location and designation of all electrically supervised valves and smoke dampers.
 - 1.11.4.10 Location and designation of all items requiring access or service in a hidden location.
 - 1.11.4.11 All changes to Specifications, details and equipment schedules.
 - 1.11.4.12 All duct traverse points and associated airflow rates as reported in final Air Balancing reports.
- 1.11.5 Identify each "Record" drawing as follows, "Record Drawing: This drawing has been revised to show all systems as installed. Remove references to the Consultant.
- 1.11.6 Prior to Testing, Adjusting and Balancing, provide print copies of all current record drawings to the Balancing Subcontractor and the Commissioning Agent.
- 1.12 **PRODUCTS**
- 1.12.1 Provide only new Products. Where manufacturer is not specified

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provide Products of high commercial standard and quality consistent with the standards of these Specifications.

1.12.2 All Products must bear the approval of the CSA or have special approval of the inspection authority having jurisdiction for their respective functions and environments.

1.12.3 Provide products of same manufacture for similar applications unless noted otherwise in the Contract Documents.

1.12.4 Refer to equipment performance schedules in the respective Specification Section and on the Drawings.

1.13 ALTERNATES AND SUBSTITUTIONS DURING PROGRESS OF WORK

1.13.1 Substitute Products will only be considered when Products specified in the Contract Documents become unobtainable.

1.13.2 Provide detailed Specifications and Shop Drawings with complete performance characteristics of the proposed alternate with the submission to the Consultant.

1.13.3 Assume responsibility and pay for any additional installation costs incurred by the work of all Divisions resulting from the substitution.

1.14 VALUATION OF CHANGES

1.14.1 For each change submit a complete itemized breakdown of labour and material.

1.14.2 Only the net difference between an extra and a credit will be subject to overhead and profit mark-up. Overhead and profit shall be as shown on the Tender Form.

1.15 APPLICATION FOR PAYMENT

1.15.1 Conform to the Consultant's method of submission of application for payment, which will be issued after the award of Contract.

1.16 SUPERINTENDENCE

1.16.1 The supervisory staff assigned to the project shall be fully competent to implement efficiently all requirements for scheduling, coordination, field engineering reviews, inspections and submittals defined in the Specifications.

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1.17 INSTALLATION REQUIREMENTS

1.17.1 The Consultant's Drawings and instructions govern the general location of all items.

1.17.2 Install all equipment and apparatus to allow free access for maintenance, adjustment and replacement.

1.17.3 Install all Products and services in accordance with the manufacturer's requirements and/or recommendations.

1.17.4 Do not use explosive activated tools.

1.17.5 Install all services capped for future to allow easy access for future tie-in.

1.17.6 All equipment installed in parking structure floor slabs, ramps and driving areas shall meet all requirements of CAN/CSA-S413-07 with regard to corrosion protection:

1.17.6.1 The use of dissimilar materials shall be avoided, or if unavoidable, electric contact shall be prevented.

1.17.6.2 Embedded materials used for floor drains, pipes and other hardware shall be:

1.17.6.2.1 Non metallic, or;

1.17.6.2.2 A low copper aluminum alloy or an equally corrosion resistant metal, coated on surfaces in contact with concrete to prevent galvanic corrosion with steel reinforcing, or;

1.17.6.2.3 Protected against the corrosive effects of de-icing chemicals by an effective and durable coating.

1.17.7 Install equipment neatly to the satisfaction of the Consultant. Unless noted otherwise in the Contract Documents, install all Products and services to follow building planes. Installation shall permit free use of space and maximum headroom.

1.17.8 Cap off and seal all open ends of installed ductwork, piping and conduits to prevent entrance of foreign matter.

1.17.9 Do not install piping in a location or manner, which might result in freezing.

1.18 TEMPORARY SERVICE

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- 1.18.1 Refer to Section 01 50 00 regarding temporary services, Contractor's shop, storage and other facilities.
- 1.18.2 Do not use any of the permanent mechanical systems during construction, unless specific written permission is obtained from the Consultant or unless allowed elsewhere in the Contract Documents.
- 1.18.3 The use of permanent facilities for temporary construction service shall not affect in any way the commencement of the warranty period. The warranty period shall commence as specified in the Contract Documents.
- 1.19 COOPERATION
- 1.19.1 Confer with all Subcontractors installing equipment that may affect the work of this Division, and arrange equipment in proper relation with equipment installed under other Divisions of the Contract.
- 1.19.2 Furnish all items to be built in, in time, complete with all pertinent information, commensurate with the progress of the work.
- 1.19.3 Store materials neatly and out of the way and clean up daily all refuse caused by the work.
- 1.19.4 Coordinate work with the work of all other Divisions. Relocate equipment and/or material installed, but not coordinated with the work of other Divisions, as directed by the Consultant, at no extra cost. Inform other Divisions of the locations of openings, chases, sleeves, supports, services, connections, etc. to be incorporated into the work.
- 1.20 PROTECTION
- 1.20.1 Protect building and structure from damage due to carrying out this work.
- 1.20.2 Protect all mechanical work from damage. Keep all equipment dry and clean at all times.
- 1.20.3 Cover all openings in equipment and materials.
- 1.20.4 Be responsible for and make good any damage caused directly or indirectly to any walls, floors, ceilings, woodwork, brickwork, finishes, etc.
- 1.21 FIELD REVIEW

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- 1.21.1 The Consultants will make periodic visits to the Site during construction to ascertain reasonable conformity to plans and specifications. The Consultant is not responsible for quality control. Contractor shall maintain their own quality control and will be responsible for the execution of their work in conformity with the Contract Documents and with the requirements of authorities.
- 1.21.2 The Owner and Consultant shall have access to the Site at all times for periodic inspections. Maintain a complete set of contract documents on Site for field reference by the Consultant.
- 1.21.3 Provide all gauges, instruments, and other equipment necessary for field review by the Consultant.
- 1.21.4 Application for final review will be considered when the Work has been completed and written declarations submitted that all commissioning, adjustment, set up and documentation is complete. Final review shall be done when:
 - 1.21.4.1 All reported deficiencies have been corrected.
 - 1.21.4.2 All systems have been balanced, tested, commissioned and are operational.
 - 1.21.4.3 The Owner has been instructed in the operation and maintenance of all equipment.
 - 1.21.4.4 All reports have been submitted and reviewed.
 - 1.21.4.5 All instruction manuals have been submitted and reviewed.
 - 1.21.4.6 All tags and nameplates are in place and all data submitted and reviewed.
 - 1.21.4.7 Cleaning up is finished in all respects.
 - 1.21.4.8 All spare parts and replacement parts specified have been provided.
 - 1.21.4.9 All record drawings have been submitted and reviewed.
- 1.22 **SERVICES TO EQUIPMENT SUPPLIED BY OTHERS**
 - 1.22.1 Provide all necessary connections required for equipment supplied by the Owner and the work of other Divisions. Examine all the Drawings and Specifications and identify all requirements.

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- 1.22.2 Provide valves, unions, caps, and vibration isolation for all services.
- 1.22.3 The Contractor shall be responsible to verify, adjust and coordinate the type, size and location of mechanical services required for all equipment supplied by the Owner and the work of other Divisions.
- 1.23 PROVISION FOR FUTURE EQUIPMENT AND CONSTRUCTION
- 1.23.1 Spaces designated for future equipment or building expansion shall be left clear.
- 1.23.2 Provide services for future extensions complete with Products necessary for present termination and to permit future extension.
- 1.23.3 Identify each service by a permanent marker at its termination point.
- 1.24 CUTTING AND PATCHING
- 1.24.1 Inform all other Divisions in time, concerning required openings. Where this requirement is not met, bear the cost of all cutting and patching, including layout, x-rays, ferros scanning at premium time. Obtain the permission of the Consultant before doing any cutting.
- 1.24.2 Do all necessary cutting and patching of existing work. X-ray all proposed floor-opening locations prior to core drilling. Refer to Section 20 00 55 – Work in Existing Buildings.
- 1.24.3 Obtain the Consultant’s approval before doing any cutting and patching. Any structural modifications must not affect structural, fire barrier or vapor barrier integrity.
- 1.24.4 Coordinate with Architectural Section 01 33 00 for all fire stopping requirements.
- 1.25 METALS
- 1.25.1 Metal construction required for the mechanical work and shown on the Structural Drawings will be carried out by Division 05 – Metals.
- 1.25.2 Provide all other metal work necessary for the mechanical work, such as, but not limited to, equipment bases, platforms, catwalks, supports, lintels, ladders, pit and trench covers. Have such work carried out in accordance with Division 05 – Metals.
- 1.25.3 Provide platforms and catwalks complete with safety rails, 6mm

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($\frac{1}{4}$ ") checkered plate or grating cover, suitable for minimum 750mm (30") wide. Provide removable sections where required for equipment removal.

1.25.4 Provide ladders using 13mm by 50mm ($\frac{1}{2}$ " by 2") steel bar stringers and 19mm ($\frac{3}{4}$ ") diameter steel bar rungs fastened through and welded to stringers at 300mm (12") on centers. Fabricate ladders 450mm (18") wide and locate 150mm (6") clear of wall face. Secure stringers at top and bottom and at minimum every 1.8m (6 ft) using welded steel brackets.

1.26 CONCRETE

1.26.1 Concrete work required for mechanical work and shown on the structural Drawings will be carried out by Division 03 – Concrete.

1.26.2 Provide all other concrete work specified but not shown on structural Drawings, necessary for the mechanical work including but not limited to inertia slabs, housekeeping pads, and pipe cradles. Have such work carried out in accordance with Division 03 – Concrete.

1.26.3 Ensure that the ultimate compressible strength after 28 Days shall not be less than:

1.26.4 13,790 kPa (2,000 psi) for pipe encasing and backfill or excessive excavations.

1.26.5 20,665 kPa (3,000 psi) for all other work.

1.27 EXCAVATION AND BACKFILLING

1.27.1 All excavation and backfilling required for the mechanical work will be done under Division 31 – Earthwork of the Specifications, except as noted below. Refer to soil report regarding the type of soil.

1.27.2 Ensure that bottom of pipe trench is graded as required.

1.27.3 In firm, undisturbed soil, excavation will be carried out under Division 31 – Earthwork, to within 150mm (6") of the bottom of pipes. Excavate under this Division to desired grade, lay pipes directly on the soil and shape soil to fit the lower $\frac{1}{3}$ segment of all pipes and pipe bells. Ensure even bearing along the barrels.

1.27.4 In rock and shale and where noted, excavation will be carried out under Division 31 – Earthwork, to 150mm (6") below and minimum

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200mm (8") to either side of the pipe. Fill back under this Division, a bedding of 9mm ($\frac{3}{8}$ ") crushed stone or granular 'A' gravel.

- 1.27.5 In unstable soil, in fill and in all cases where pipe bedding has been removed in earlier excavation, particularly near perimeter walls of building and at catch basins, excavation will be carried out to 200mm (8") below the pipe under Division 31 – Earthwork. Compact to maximum possible density under this Division of Work and support the pipe by a 200mm (8") thick concrete cradle spanning full length, between firm supports. Install reinforcing steel in cradle or construct piers at maximum 2400mm (8 ft) spacing. Provide a minimum of one pier per length of pipe, down to solid load bearing strata. Use same method where pipes cross. Do all excavation for such piers.
- 1.27.6 Provide support over at least the bottom $\frac{1}{3}$ segment of the pipe in all bedding methods.
- 1.27.7 Before backfilling, obtain approval from Consultant.
- 1.27.8 Backfill trenches within the building to a compacted level of 300mm (12") above the top of pipes with clean, sharp sand in individual layers, maximum 150mm (6") thick, hand compacted to a density of 95% Modified Proctor.
- 1.27.9 Backfill trenches outside the building to a compacted level of 300mm (12") above the top of the pipes with individual layers of material up to 150mm (6") thick, hand compacted to a density of 95% Modified Proctor, using Granular 'A' gravel.
- 1.27.10 Obtain written approval of all backfilling done under this Division from Consultant before work commences on additional backfilling under Division 31 – Earthwork.
- 1.28 **PAINTING**
- 1.28.1 Provide all exposed ferrous metal work and Products, except ductwork and piping, with at least one (1) factory prime coat or paint one prime coat on site. Clean up or wire brush all equipment before painting. Unless otherwise noted finish painting will be done under Division 09 – Finishes of these Specifications.
- 1.28.2 If not factory coated or galvanized, clean, wire brush and paint all ferrous supports and hangers concealed in ceiling spaces of kitchens or other similar high humidity areas.

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- 1.28.3 Repaint or refinish all damaged factory applied finishes.
- 1.28.4 Provide oil-base red oxide primer applied as per manufacturer's recommendations.

1.29 ABBREVIATIONS

- 1.29.1 Abbreviations with respect to government agencies, testing agencies, technical societies, approval agencies and technical terminologies are as listed below:

AGA	American Gas Association
AHRI	Air-Conditioning, Heating, and Refrigeration Institute
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
API	American Petroleum Institute
ARI	Air Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Safety Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
BAS	Building Automation System
BC	National or State (US) Building Codes
CGA	Canadian Gas Association
CRN	Canadian Registration Number
CSA	Canadian Standards Association
DDC	Direct Digital Control
ECM	Electronically Commutated Motor
EEMAC	Electrical Equipment Manufacturers Association of Canada

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FM	Factory Mutual
IAO	Insurers' Advisory Organization (CGI Information Systems and Management Consultants Inc.)
IEEE	Institute of Electrical and Electronics Engineers
ISTA	International Safe Transit Association
MERV	Minimum Efficiency Reporting Value
MICA	Midwest Insulation Contractors Association
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry
NBC	National Building Code
NBFU	National Board of Fire Underwriters (currently American Insurance Association)
NC	Noise Criterion
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NPT	National Pipe Thread
OBC	Ontario Building Code
OESC	Ontario Electrical Safety Code
OSHA	Occupational Safety and Health Administration
PID	Proportional–Integral–Derivative
PSC	Permanent-Split Capacitor
PWM	Pulse-Width Modulation
SCR	Silicon Controlled Rectifier
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
TEMA	Tubular Exchanger Manufacturers Association
ULC/cUL	Underwriters' Laboratories of Canada
VAV	Variable Air Volume

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1.30 MANUFACTURER'S CERTIFICATION

1.30.1 Submit letters from the manufacturers of all equipment certifying that their technical representatives have inspected and tested their equipment, have approved the methods of installation and operation. Where existing systems are extended, provide letters covering both new and existing equipment and connections.

1.30.2 These letters shall state the names of persons present at the inspection and testing, methods used and a list of functions performed with location and room numbers where applicable.

1.30.3 Refer to the respective equipment sections for requirements for letters.

1.31 TRIAL USAGE

1.31.1 The Owner has the privilege of the trial usage of mechanical systems or parts thereof for the purpose of testing and learning the operational procedures.

1.31.2 Carry out the trial usage over a length of time as deemed reasonable by the Consultant, at no extra cost.

1.31.3 Carry out the operations only with the express knowledge and under supervision of the Contractor and/or appropriate Subcontractors who shall not waive any responsibility because of trial usage.

1.31.4 Trial usage shall not be construed as acceptance by the Owner.

1.32 INSTRUCTION TO OWNER

1.32.1 Instruct the Owner's representatives in all aspects of the operation of systems and equipment. Refer to requirements for demonstration in respective equipment sections.

1.32.2 Arrange for, and pay for services of service engineers and other manufacturer's representatives required for instruction on specialized portions of the installation.

1.32.3 Submit to the Consultant at the time of final inspection a complete list of systems stating for each system:

1.32.3.1 Date instructions were given to the Owner's staff.

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- 1.32.3.2 Duration of instruction.
- 1.32.3.3 Names of persons instructed.
- 1.32.3.4 Other parties present (manufacturer's representative, consultants, etc.).
- 1.32.3.5 Signatures of the Owner's staff stating that they properly understood the system installation, operation and maintenance requirements.
- 1.33 EARLY OCCUPANCY
 - 1.33.1 The Owner will negotiate with the Contractor to occupy portions of the building before the Work is complete. Sufficient advance notice will be given to allow scheduling of the mechanical work to meet the Owner's requirements.
 - 1.33.2 Notify the Contractor of any scheduling problems.
 - 1.33.3 Schedule the Work and set construction priorities to satisfy the Owner's requirements.
 - 1.33.4 Schedule the Work of this Division as follows:
 - 1.33.4.1 Relevant equipment is ready for start-up as defined in these Specification Sections.
 - 1.33.4.2 Systems are balanced.
 - 1.33.4.3 Safety controls are in place.
 - 1.33.4.4 Automatic temperature controls are operational.
 - 1.33.4.5 Primary equipment is tested and started-up.
 - 1.33.4.6 All filters are in place.
 - 1.33.5 The Owner will take over individual items of equipment used for Early Occupancy and the warranty period will start when:
 - 1.33.5.1 Conditions of start-up (Item 1.33.4) have been complied with.
 - 1.33.5.2 Air and fluid systems have been balanced.
 - 1.33.6 The Consultant will issue a list of deficiencies covering the individual items of equipment used for Early Occupancy at the time

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of takeover by the Owner.

1.33.7 Early Occupancy and the Owner's takeover of individual items of equipment does not relieve the Contractor of their responsibility to test, adjust, balance, commission and demonstrate the systems in accordance with the Contract Documents.

1.34 OPERATION AND MAINTENANCE MANUALS

1.34.1 Assemble three (3) manuals, each containing data sheets, brochures, operating, maintenance, recommended spare parts, and lubricating instructions and a complete set of reviewed shop drawings and bind in hard cover. Identify cover "Operation and Maintenance Manual for _____". Manuals shall be separated with dividers in logical sections and volumes.

1.34.2 Present one (1) copy for review by Consultant. Make all corrections requested by the Consultant and forward the corrected review copy plus a duplicate to the Owner with a copy of transmittal to Consultant for their records. Include the following information in each manual:

1.34.2.1 Refrigeration Equipment

1.34.2.1.1 Operating instructions detailing the procedures to be followed for:

Charging

Start-up

Changeover from one season to another

Shutdown

Night operation

Maintenance instructions

1.34.2.1.2 Lubrication instruction for moving parts detailing type of lubricant to be used and the lubrication intervals in operation hours.

1.34.2.1.3 List of safety devices and instructions for their testing and adjusting.

1.34.2.1.4 Complete set of shop drawings showing:

Control sequence with description of the sequences of operation.

Detailed layout and sections indicating all maintenance, cleaning and lubrication points.

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- 1.34.2.1.5 List of parts (bill of material) indicating the catalogue number and manufacturer, complete with drawings indicating the location of each part in the complete assembly.
- 1.34.2.1.6 Recommended chemical analysis of chilled water.
- 1.34.2.2 Heat Exchangers and Coils
 - 1.34.2.2.1 Equipment layout (plans and section) giving all information on type of flanges, bolts, nuts, studs, tubes, etc.
 - 1.34.2.2.2 Tube replacement instructions.
 - 1.34.2.2.3 Cleaning instructions.
- 1.34.2.3 Pumps and Fans. Include for each different type and size:
 - 1.34.2.3.1 Shop drawings indicating maintenance and lubrication points.
 - 1.34.2.3.2 List of parts indicating the catalogue number and manufacturer, complete with drawings indicating the location of each part in the complete assembly.
 - 1.34.2.3.3 Performance curves.
- 1.34.2.4 Valves and Fittings
 - 1.34.2.4.1 Three (3) copies of framed valve charts for the project.
 - 1.34.2.4.2 A list of valves as per the valve chart indicating size, type, catalogue number, make of each valve, strainer and steam trap.
- 1.34.2.5 Instrumentation and Control
 - 1.34.2.5.1 Complete instrument list for all gauges, thermometers, gauge glasses and other instruments.
 - 1.34.2.5.2 Sequence and description of operation for each control system.
 - 1.34.2.5.3 Control diagram for each system complete with equipment summary giving system designation and catalogue number for each component.
 - 1.34.2.5.4 Catalogue leaflet of each component used.
 - 1.34.2.5.5 Applications programming information and programmer's manual.
 - 1.34.2.5.6 Description of operating procedures, including required actions at

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each operator position, operation of computer peripherals, input and output formats and procedures, and emergency alarm and failure recovery procedures. Descriptions of system start-up, back-up equipment operation, and execution of all system functions and operating modes shall be provided.

- 1.34.2.5.7 Provide description of data communication, including data types and formats, data link components and interfaces, and operator test.
- 1.34.2.5.8 Instructions and schedules for inspections, cleaning, lubricating and calibration.
- 1.34.2.6 Other Equipment
 - 1.34.2.6.1 Description of start-up and activating procedures, and commissioning procedures, as well as follow-up instructions to the Owner's operating staff to slowly break-in unit.
 - 1.34.2.6.2 Maintenance instructions for all other equipment containing moving parts or requiring lubrication or chemical charging.
 - 1.34.2.6.3 Include instruction list of parts indicating catalogue number and manufacturer, complete with drawings indicating the location of each part in the complete assembly; performance curves.
 - 1.34.2.7 A list of all motors serving mechanical equipment. Include in the list:
 - 1.34.2.7.1 Location of motor.
 - 1.34.2.7.2 Name of unit served by motor.
 - 1.34.2.7.3 Motor serial number, manufacturer.
 - 1.34.2.7.4 Power rating, voltage, full load current, service factor and rpm of motor (nameplate data), rating and catalogue number of motor starter thermal overload relays.
 - 1.34.2.7.5 Serial number, rpm, airflow, manufacturer, static pressure (or head) of fan or pump.
 - 1.34.2.7.6 Quantity, sizes and V-belt number of belts.
 - 1.34.2.7.7 Sizes and types of drives used.
 - 1.34.2.7.8 Type of oil or grease lubrication of gearbox, lubrication interval in

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hours of operation.

1.34.2.7.9 Type of grease lubrication for driven equipment, lubrication interval in hours of operation.

1.34.2.8 A copy of the following:

1.34.2.8.1 All reviewed sprinkler layouts and hydraulic calculations.

1.34.2.8.2 Final NFPA certification letter. Certification letter shall contain contractor's contact information, the building permit number, certification statement in regard to NFPA compliance and be stamped by a licensed professional engineer.

1.34.2.8.3 Certificates from all equipment manufacturers, duct-cleaning agents, pipe-cleaning agents, chemical treatment agents and local authorities having jurisdiction.

1.34.2.8.4 All pipe and duct pressure test reports.

1.34.2.8.5 Warranties and letters of guarantee from contractors and equipment manufacturers.

1.34.2.8.6 Copies of permits, licenses and certificates.

1.34.2.8.7 Start-up and activation and commissioning procedures and check sheets.

1.35 WARRANTY

1.35.1 Refer to General Conditions of the Contract and Specimen Warranty Form.

1.35.2 Furnish all extended warranty for equipment as required in the Specifications.

END OF SECTION

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1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 – General Requirements shall apply to and govern this Section.

1.2 SHOP DRAWINGS

1.2.1 Provide Shop Drawings for:

1.2.1.1 Access doors and panels.

1.3 MATERIALS AND EQUIPMENT

1.3.1 Use only new materials and equipment of Manufacturer as specified or shown on the Drawings. Ensure that equipment and materials for similar applications are of the same Manufacturer.

1.3.2 If the Subcontractor wishes to substitute materials of Manufacturers other than those named, they shall state in their Tender the name and a complete description of the materials to be substituted, along with the amount of change in the Contract Price.

1.3.3 Ensure that materials not specified to a specific Manufacturer are of high commercial standard and quality.

2 **PRODUCTS**

2.1 ACCESS DOORS AND PANELS

2.1.1 In plaster, gypsum board, tiled or masonry walls for exposed flush installation, provide 203mm by 203mm (8" x 8") prime coated 16 ga. access door with 18 ga. mounting frame, continuous concealed hinge, and screwdriver operated stainless steel cam latch, similar to Acudor UF-5000.

2.1.2 In plaster or tiled walls for recessed installation, provide 305mm by 305mm (12" x 12") 16 ga. access door recessed by 25mm (1"). Door to be complete with 14 ga. mounting frame, concealed pivoting rod type hinge, and flush-to-surface screwdriver operated stainless steel cam latch, similar to Acudor AT-5020.

2.1.3 In gypsum board surfaces or in acoustic tiles for recessed installation in public areas, provide 305mm by 305mm (12" x 12") bauco-plus architectural access door with concealed hardware and gypsum board inlay. Standard features include cam latch flush

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with surface, aluminum frame and glass fibre-reinforced nylon hardware, fully hinged removable door panel and integrated safety catches, perimeter gasket installed onsite.

- 2.1.3.1 In areas not accessible by public, provide 305mm by 305mm (12" x 12") 16 ga. access door recessed by 25mm (1"). Door to be complete with 14 ga. mounting frame with drywall taping bead on all sides, concealed pivoting rod type hinge, and flush-to-surface screwdriver operated stainless steel cam latch, similar to Acudor DW-5015.
- 2.1.4 In fire rated walls, provide 305mm by 305mm (12" x 12") 16 ga. rated access door, ULC listed "B" label for 1-1/2 or 2 hours. Door to be complete with 16 ga. mounting frame, concealed hinge, spring closer, and knurled knob operated universal self-latching bolt, similar to Acudor FB-5060.

2.2 BEARINGS AND GEAR BOXES

- 2.2.1 Provide bearings suitable for application and environment, i.e., dust, corrosive atmospheres, high temperatures, etc. Bearings shall have a lifetime guarantee of not less than five (5) years.

3 **EXECUTION**

3.1 FLASHING

- 3.1.1 Provide galvanized or aluminum sleeves for piping through roof.
- 3.1.2 Ensure that the flashing suits roof and extends minimum 450mm (18") on all sides. Leave flashing as directed by the Contractor, to be built into roofing, rendering a watertight connection.
- 3.1.3 Provide counter flashing on diesel and boiler exhaust stacks, ducts, and pipes passing through roofs to fit over flashing or curb. Coordinate with the Subcontractor responsible for the roofing work of the Contractor.
- 3.1.4 Sleeve pipes through waterproof floors.
- 3.1.5 Pay special attention to the waterproofing conditions of basement walls and floors. Co-operate at all times with the water proofing trade and do not cut or destroy any waterproofing seal without the consent of the waterproofing trade. Provide piping sleeves passing through waterproof walls with asphalt roofing felt wrapped around to leave 25mm by 50mm (1" x 2") recess on both sides of the wall.

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These recesses and the space between pipe and sleeve shall be caulked by this Division in accordance with the requirements of Division 07 – Thermal and Moisture Protection.

3.2 BEARINGS AND GEAR BOXES

3.2.1 Run-in all bearings, gearboxes and fluid couplings for a period recommended by the manufacturer. Flush out, and refill with new charge of recommended lubricant.

3.2.2 Provide all necessary lubricating materials and labour for all operating equipment until acceptable for operation and care by the Owner.

3.2.3 Provide oil-lubricated bearings and sumps with level gauge, in easily accessible location. Provide grease-lubricated bearings, if not readily accessible, with extended nipples.

3.3 BELT DRIVES, SHEAVES AND GUARDS

3.3.1 Provide all belt-driven equipment with V-belt drive, designed for at least 130 percent of motor nameplate power rating, and in accordance with manufacturer's recommendations for type of service intended. Belt drives to be at least 95 percent efficient. Balance and properly align drives. Provide matched sets of belts for multiple belt assemblies. Select belts to suit starting torque for driver. Use single belt drives only for motors 1.5kW (2.0 HP) and smaller.

3.4 INSERTS, SLEEVES, ESCUTCHEONS AND CURBS

3.4.1 Use only factory made, threaded, or toggle type inserts as required for supports and anchors, properly sized for the load to be carried. Place inserts only in portions of the main structure and not in any finishing material.

3.4.2 Use factory made expansion shields where inserts cannot be placed, but only where permission is given by the Consultant.

3.4.3 Do not use powder-activated tools except with written permission from the Consultant.

3.4.4 Supply and locate inserts, holes, anchor bolts, and sleeves in time when walls, floors and roof are erected.

3.4.5 Sleeves shall be concentric with pipe and be a minimum of 50mm (2") larger than pipe size.

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- 3.4.6 Pass insulation unbroken where pipe or duct is insulated, except through fire rated walls and floors. Size sleeves to provide 13mm (½") clearance all around.
- 3.4.7 Use the following sleeving material for pipe sleeves:
 - 3.4.7.1 Through interior walls use Schedule 10 steel pipes, machine cut, flush with finished structure. Check room-finish schedules.
 - 3.4.7.2 Through exterior walls above grade use Schedule 10 steel pipes, machine cut, flush with finished structure inside and to suit flashing on outside.
 - 3.4.7.3 Through exterior walls below grade and other waterproof walls use extra heavy weight cast iron or PVC sleeves, machine cut. Check flashing details for further information.
 - 3.4.7.4 Through waterproof floors, through janitor's closets, mechanical rooms, compartment mechanical rooms, showers, kitchens, washrooms, and through roofs, use Schedule 40 sleeves, machine cut. As an alternative, copper DWV sleeves up to and including 150mm (6") sleeve size and rolled 32 ounce copper sleeves for larger than 150mm (6") sleeve size may be used. Extend sleeves 100mm (4") above finished floor upwards and cut flush with underside of floor. Refer to flashing details through waterproof floors.
 - 3.4.7.5 Through other interior floors use Schedule 10 steel pipes, machine cut, flush with finished structure on both sides. Check room-finish schedules for further information.
 - 3.4.7.6 Ensure that watertight concrete curbs, 100mm (4") high by 100mm (4") wide with 19mm (¾") chamfered edges, are furnished around pipes passing through waterproof floors except where furred in. Read Division 03 – Concrete for further information.
- 3.4.8 Pack spaces between the insulated pipe and the sleeve or where uninsulated, between the pipe and the sleeve, with ULC listed fire rated foam. Maintain vapour barrier on cold lines. Seal the annular space both sides as follows:
 - 3.4.8.1 For horizontal sleeves in exposed areas, use a seal equal to or better fire rated than the wall to be sealed. Use "Fire barrier" as distributed by Double A/D Distributors Ltd. (UL No. 4 U 18.7 approved).

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- 3.4.8.2 For horizontal concealed sleeves through firewalls and through walls separating areas of different air pressure, use a permanently resilient (silicone base or equal) sealing compound.
- 3.4.8.3 For vertical sleeves through roofs, janitor's closets, equipment rooms, and where required to provide fire rated separation, use permanently resilient (silicone base or equal) sealing compound, non-flammable and waterproof. Ensure that the seal is compatible with floor and ceiling finishes. Check the room-finish schedules for further information.
- 3.4.8.4 All fire stop materials and methods must be approved in accordance with CAN/ULC-S115-11, and be ULC listed.
- 3.4.8.5 Seal is not required for other sleeves.
- 3.4.9 Cover exposed floor and wall pipe sleeves in finished areas with satin finish chrome or nickel plated solid brass or with satin finish stainless steel escutcheons with non-ferrous set screws. Split cast plates of the screw locking type may be used. Do not use stamped steel friction type split plates.
- 3.4.10 Use the following sleeving for ducts:
 - 3.4.10.1 Unless otherwise noted, use minimum 1.3mm (18 gauge) galvanized steel sleeves.
 - 3.4.10.2 For rectangular duct openings through walls and floors provide a removable wood box-out of the required size.
 - 3.4.10.3 Through firewalls, build fire dampers into wall.
 - 3.4.10.4 Through floors where ducts are not furred in or enclosed in a duct-shaft, ensure the 100mm (4") high by 100mm (4") wide watertight concrete curbs are provided, with 19mm ($\frac{3}{4}$ ") chamfered edges all around. Extend sleeves where used, flush to top of curb. Read Division 03 – Concrete, for further information.
 - 3.4.10.5 Through floors where ducts are enclosed in a duct shaft or furred in, provide the watertight concrete curbs at the extreme top and bottom ends of the shaft only.
 - 3.4.10.6 Through roofs, provide curbs and sleeves as shown on the detail drawings and to suit flashing requirements.
- 3.4.11 After ducts are installed, pack the opening and seal both sides as follows:

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- 3.4.11.1 Use fiberglass insulation for packing, except through curbed concrete floors use “Fire barrier” as distributed by Double A/D Distributors Ltd. (UL No. 4 U 18.7 Approved).
- 3.4.11.2 Seal the packing in openings through floors with permanently resilient (Silicone base or equal) compound, non-flammable and waterproof. Press duct supports firmly into caulking before bolting down to curb.
- 3.4.11.3 Through all vertical walls seal the fibreglass packing using a permanently resilient (silicone base or equal) sealing compound.
- 3.4.11.4 All fire stop materials and methods must be approved in accordance with CAN/ULC-S115-11, and be ULC listed.
- 3.4.11.5 Seal is not required for other packings.
- 3.4.12 Brace duct sleeves and box-outs to retain their position and shape during the pouring of concrete and other work.
- 3.4.13 Provide bracing for each duct at every passing through structure to prevent sagging.
- 3.4.14 Cover exposed duct sleeves and openings in exposed areas only. Use 1.3mm (18 gauge) galvanized steel escutcheons in form of a duct collar. Over curbs extend the collar 25mm (1") down the side of the curb, similar to counter flashing. Fix collar in position with cadmium plated screws.
- 3.5 **ACCESS DOORS AND PANELS**
- 3.5.1 Install all concealed mechanical 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 “As Built” drawings.
- 3.5.2 Provide the work of respective Division with panels, doors or the frames therefore; complete with all pertinent information for installation. Arrange with and deliver to the Subcontractor(s) 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.
- 3.5.3 Prepare detailed and coordinated drawings showing location and type of all access doors. Submit these drawings to the Consultant

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to review.

3.5.4 Size all access doors to provide adequate access and commensurate with the type of structure and architectural finish, minimum size 150mm (6") by 150mm (6). Should it be necessary for persons to enter, provide a minimum 600mm (24") by 450mm (18") size doors.

3.5.5 Ensure proper fire rating of access doors in fire separations, fire-rated walls and ceilings.

3.5.6 Lay-in type tiles, properly marked, may serve as access panels.

3.6 DRIP PANS

3.6.1 Construct drip pans of min. 1.0mm (20 gauge) galvanized steel sheet with sealed connections. Provide drain lines from drip pans to nearest hub drain, funnel floor drain, janitor's sink or appropriate approved location.

3.6.2 Provide drip pans at the following locations:

3.6.2.1 Beneath all pipes passing through electrical, battery, UPS, elevator machine, diesel generator, and telephone rooms, over horizontal runs of bus ducts, and in locations as indicated on the Drawings.

3.7 WORKMANSHIP

3.7.1 Install ducts and pipes parallel and perpendicular to the building planes and concealed in chases, behind furring or above ceiling, except in unfinished areas. Install all exposed systems neatly and group together, to present a neat appearance.

3.7.2 Install all equipment and apparatus requiring maintenance, adjustment, or replacement with sufficient clearance for servicing.

END OF SECTION

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1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 – General Requirements, shall apply to and govern this section.

1.2 CO-ORDINATION BETWEEN NEW AND EXISTING INSTALLATIONS

1.2.1 Check and co-ordinate all systems in the new building addition which are extended to or from existing systems to ensure their proper operation.

1.2.2 Provide interfacing components between new and existing systems as necessary for proper performance and operation.

1.3 PENETRATIONS IN EXISTING STRUCTURE

1.3.1 Do all cutting and core drilling for the Work of this Division. Obtain Consultant's approval before proceeding.

1.3.2 Provide sleeves and follow Consultant's instructions where necessary to completely penetrate existing floors, walls, ceiling, roof or structural members.

1.3.3 X-ray all proposed penetrations of concrete slabs to locate hidden services before penetrating existing structure. Advise Consultant of any interference.

1.3.4 Do all necessary patching and repairing. Maintain integrity of fire ratings.

1.3.5 Flash all parts passing through or built into a roof, outside wall or waterproof floor.

1.3.6 If any fire proofing material or insulation on building structure is damaged where mechanical equipment has been removed or added, Contractor to repair at this Division's expense.

1.4 USE OF EXISTING MATERIAL AND EQUIPMENT

1.4.1 Test existing equipment, which is to remain in areas being renovated for proper operation. Identify required repairs in written report to Consultant.

1.4.2 Clean, test for proper operation and repair existing equipment to be

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relocated before being put back into service. Identify required repairs in written report to Consultant.

- 1.4.3 Repair or replace, without adjustment to the Contract price, all existing equipment, which is damaged in process of relocation.
- 1.4.4 Unless noted otherwise provide additional equipment of the same type and manufacturer where required to supplement existing equipment.
- 1.4.5 Review existing equipment on site to determine operating conditions prior to Tender.
- 1.5 SALVAGE MATERIALS
- 1.5.1 Remove from the site all materials in renovated areas of the existing building which are not to remain or be reused, unless noted as remaining the property of the Owner.
- 1.6 EXISTING SERVICES
- 1.6.1 Disconnect and remove all existing products, which are abandoned.
- 1.6.2 Remove all piping, which is abandoned except inaccessible piping in furred-in space. Cut and cap piping below finished surfaces.
- 1.6.3 Plug and cap all abandoned drain and vent points in systems, which are being reused. Plug and cap to the approval of the local authorities.
- 1.6.4 Allow for all work necessary to complete the alterations, rerouting and/or repositioning of existing services and equipment, and all interconnections of new and existing systems.
- 1.6.5 Verify the location and size of all existing services before proceeding with the work.
- 1.6.6 Maintain heating and cooling in the building as required to protect the building and equipment or to provide comfort conditions for the occupants.
- 1.6.7 Keep all sprinkler, standpipe and other fire and life safety protection systems in operation at all time.
- 1.7 INTERRUPTION OF SERVICES

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- 1.7.1 Co-ordinate all work with the use of the building by the Owner.
- 1.7.2 Maintain all mechanical services to all parts of the building which are in use. Provide temporary services as necessary.
- 1.7.3 Obtain Owner's written approval before interrupting any service.
- 1.7.4 Request permission to interrupt services in writing not less than two (2) weeks in advance and state time(s) and duration(s) of interruptions.
- 1.8 PREMIUM TIME
- 1.8.1 Include cost of premium time in Tender Price for work during nights, weekends or other time outside normal working hours necessary to maintain all mechanical services in operation.
- 1.9 FIRE PROTECTION
- 1.9.1 Maintain fire protection at all times in accordance with governing authorities' rules and regulations.

END OF SECTION

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Project No.: 2021-0245
Section Name: **Electric Motors**
Section No.: **20 05 13**
Date: January 26, 2024

1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 – General Requirements, shall apply to and govern this Section.

2 **PRODUCTS**

2.1 MOTORS

2.1.1 Supply and install all motors for Mechanical Equipment.

2.1.2 All motors shall be 60 cycle, 1750 rpm, except where noted otherwise.

0.37kW (1/2 HP) and smaller: 120V, 1 Ph, 60 Hz.

0.56kW (3/4 HP) and larger: 575V, 3 Ph, 60 Hz.

2.1.3 Motors shall be squirrel-cage induction motors, built to CEMA and NEMA motor and generator standards. 2-speed motors shall be single winding variable torque.

2.1.4 The minimum requirement for three phase motors shall be CEMA Design B; Class B insulated for maximum 40°C (104°F) ambient.

2.1.5 Single-phase motors shall be capacitor types, for minimum 10 starts per hour.

2.1.6 Motors 44.7kW (60 HP) and over shall be with inherent overheat protection, consisting of thermistors embedded in each phase of the stator winding and wired to the motor conduit box.

2.1.7 Select motors for quiet, continuous operation to suit loads, which may be imposed by equipment. Recognize that motor powers specified and scheduled are minimum sizes. If larger motors are required, ensure that extra costs of larger motors, starters, power wiring, and additional control wiring are included in the work.

2.1.8 All motor 0.75kW (1 HP) to 373kW (500 HP), unless otherwise specified, shall be T-frame AC three phase, and equal or exceed the motor efficiency levels as tested to CSA-C390-M or the nominal efficiency noted in Tables 10.4.1.A.(a) or 10.4.1.A.(b) of SB-10 of the OBC (premium efficiency/energy efficient), whichever is the highest. Motors to be approved under Canadian Electrical Safety Code.

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- 2.1.9 Motor enclosures shall be as follows:
 - 2.1.9.1 If protected from the weather and entraining moisture, use open drip-proof, service factor 1.15.
 - 2.1.9.2 Motors located in air streams shall be selected to operate satisfactorily at maximum temperature and moisture levels of surrounding air. Use drip-proof motors with encapsulated windings and weatherproof terminal box.
 - 2.1.9.3 For all other locations, use totally enclosed fan-cooled, service factor 1.0.
 - 2.1.9.4 Use explosion-proof motors where scheduled.
- 2.1.10 All motors shall be fitted with sealed for life bearing requiring no periodic lubrication.
- 2.1.11 Submit an accurate schedule of all motors. Include for each motor, the motor capacity, speed, nameplate current, equipment served, location, electrical characteristics, and identification number.
- 2.1.12 Provide each motor with a terminal box sized to accommodate the conductors connected thereto. Locate the terminal box to face the outside of the equipment assembly.
- 2.1.13 Provide EEMAC adjustable sliding bases for motors used with belt drives.
- 2.1.14 All motors driven by Variable Frequency Drives (VFD's) shall be NEMA31 design, have class F insulation, and be rated for inverter duty. Refer to Section 20 09 49 – Variable Frequency Drives.

3 EXECUTION

Not Used.

END OF SECTION

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Section Name: **Electrical Wiring**
Section No.: **20 05 14**
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Section No.: **20 05 14**
Date: January 26, 2024

1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 - General Requirements, shall apply to and govern this Section.

1.2 SCOPE OF WORK

1.2.1 Division 26 - Electrical will do all line side power wiring for equipment provided by Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – HVAC and Division 25 – Integrated Automation, up to the respective starter, motor control center, control panel, disconnect or VFD, also provided under Divisions 21, 22, 23 and 25. Load side power wiring shall be under Divisions 21, 22, 23 and 25.

1.2.2 Divisions 21, 22, 23 and 25 shall provide all disconnect switches for mechanical equipment as required by code. Provide weatherproof switches for all outdoor locations.

1.2.3 Field control wiring of local safeties and interlocks for packaged equipment shall be provided under the respective Sections unless otherwise specified.

1.2.4 Conduit and wiring materials and methods shall be in strict accordance with the requirements of Division 26 - Electrical.

1.2.5 Check all wiring diagrams and control diagrams submitted in shop drawing form. Before submitting these shop drawings to the Consultant, submit these drawings to Division 26 - Electrical Contractor for approval. Have these drawings stamped by Division 26 - Electrical Contractor as verification of their approval before forwarding to the Consultant. Co-operate in the commissioning of all electrically driven equipment with Division 26 - Electrical.

2 **PRODUCTS**

2.1 GENERAL

2.1.1 Conduit and wiring materials and methods shall be in strict accordance with the requirements of Division 26 - Electrical.

3 **EXECUTION**

3.1 GENERAL

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3.1.1 Refer to Division 26 - Electrical.

END OF SECTION

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Project No.: 2021-0245
Section Name: **Meters and Gauges**
Section No.: **20 05 19**
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1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 - General Requirements, shall apply to and govern this Section.

1.2 SCOPE OF WORK

1.2.1 Provide all labour, materials, tools, equipment, training, and certification required to complete the work as shown on the Drawings and specified in this Section, including:

1.2.1.1 Temperature gauges

1.2.1.2 Pressure gauges

1.3 SHOP DRAWINGS

1.3.1 Submit Shop Drawings for the following equipment:

1.3.1.1 Temperature gauges

1.3.1.2 Pressure gauges

2 **PRODUCTS**

2.1 TEMPERATURE GAUGES

2.1.1 Provide thermometers of 229mm (9") straight shank, immersion type, with red liquid fill and adjustable pivot, installed complete with non-ferrous separable well. Provide 150mm (6") long extension neck socket for insulated pipes. Thermometers with plastic case are not acceptable.

2.1.2 Select all thermometers to suit the expected range of temperatures of the medium and ensure that normal working temperature occurs approximately at mid scale.

2.2 GAUGE GLASSES

2.2.1 Provide gauge glasses on all liquid reservoirs, normally not completely filled.

2.2.2 Provide fail-safe type gauge glasses with shut off valve, ball check, flushing facilities, and white enamelled brass backplates, suitable for the intended service.

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2.2.3 Provide gauge glasses complete with tri cocks. Extend tank gauge glasses the full tank height, if necessary through use of multiple gauge glasses in staggered arrangement.

2.3 PRESSURE GAUGES

2.3.1 Provide pressure gauges of the Bourdon type, minimum one percent accuracy through the entire range, complete with bronze Bourdon tube, brass socket, brass rotary movement, bronze bushings, tube and movement independently mounted from case, stainless steel case and ring, inherent shock protection. Furnish gauges having 114mm (4-½") dial, black graduations, black case, silver brazed joints, and adjustable black pointer.

2.3.2 Select gauges to suit fluid working pressure and, if possible, test pressure. If test pressure falls outside safe instrument range, attach a note to this effect on the installation instructions. Ensure that the normal working pressure occurs approximately at mid scale.

2.3.3 Install each gauge complete with DN6 (1/8") or DN8 (1/4") bar stock valve, rated 150°C (300°F) and 6,895 kPa (1,000 psi). Provide pressure snubber on all pump services and coil syphon for steam, air, gas service. Install pressure gauges as noted.

2.3.4 Provide a valved and capped gauge connection at inlet and discharge of all coils and tube bundles in heat exchangers.

2.3.5 Submit a schedule in shop drawing form showing service, location, range, make, and catalogue number for gauges.

3 **EXECUTION**

3.1 PRESSURE GAUGES

3.1.1 Install pressure gauges in the following locations and where shown or specified in the Contract Documents.

3.1.1.1 Suction and discharge of all pumps.

3.1.1.2 High and low sides of all pressure reducing or regulating stations (water, steam, air).

3.1.1.3 Where shown

3.1.2 Provide valved and capped gauge connection at:

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- 3.1.2.1 Entering and leaving side of heat exchangers.
- 3.1.2.2 Entering and leaving side of heating water coils in air supply units.
- 3.1.2.3 Supply and return lines of condenser, chilled, and heating water systems at each branch.
- 3.1.2.4 Where shown.
- 3.2 THERMOMETERS
- 3.2.1 Thermometers to be installed with thermal paste to ensure accurate reading.
- 3.2.2 Install thermometers in the following locations and where shown or specified:
 - 3.2.2.1 Entering and leaving sides of all condenser, chilled, and hot water coils in air supply units.
 - 3.2.2.2 Return lines of main branches of heating, chilled, and condenser water systems.
 - 3.2.2.3 Entering and leaving sides of mixing valves.
 - 3.2.2.4 Supply and return lines at hot water boilers.
 - 3.2.2.5 Supply and return lines on primary heating water loops.
 - 3.2.2.6 Entering and leaving lines of heat exchangers.
 - 3.2.2.7 Where shown in the Contract Documents.

END OF SECTION

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1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 - General Requirements, shall apply to and govern this Section.

1.2 SHOP DRAWINGS

1.2.1 Provide Shop Drawings for:

1.2.1.1 Hangers and supports

2 **PRODUCTS**

2.1 PIPE ATTACHMENTS

2.1.1 For pipe attachments, review Specification Section 20 07 00 - Mechanical Insulation. Otherwise, adhere to the following:

2.1.1.1 For uninsulated fire servicing piping – ULC and FM approved -, use Taylor Fig. 41 swivel ring hanger.

2.1.1.2 For uninsulated steel pipes, use Taylor Fig. 22Z adjustable clevis up to and including 100mm (4") pipe size, and Taylor Fig. 24 adjustable clevis for sizes 125mm (5") and larger.

2.1.1.3 For uninsulated copper pipes, use Taylor Fig. 52 epoxy coated copper-gard clevis hanger up to and including 100mm (4") pipe size.

2.1.1.4 For uninsulated copper tubing, use Taylor Fig. 42 epoxy coated copper-gard swivel ring hanger up to and including 25mm (1") pipe size.

2.1.1.5 For insulated pipes where the insulation is around the hanger and continuous vapour barrier is not required, use the same hangers as for uninsulated pipes.

2.1.1.6 For insulated pipes where hanger is around insulation, provide galvanized sheet metal insulation shield minimum 250mm (10") long, 1.3mm (18 gauge), between covering and Taylor Fig. 22Z or Fig. 24 clevis, or Taylor Fig. 24L extended clevis, sized to include insulation.

2.2 UPPER ATTACHMENTS

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- 2.2.1 Provide upper attachments as follows:
 - 2.2.1.1 Standard beam clamp for normal service, Taylor Fig. 425.
 - 2.2.1.2 Top beam clamp Taylor Fig. 407.
 - 2.2.1.3 C clamp with locknut, Taylor Fig. 301.
 - 2.2.1.4 Side beam bracket for light duty side mounting, Taylor Fig. 120.

2.3 PIPE SUPPORT

- 2.3.1 For vertical adjustment of hanger rods, provide Taylor Fig. 68 forged steel turnbuckle.
- 2.3.2 Where trapeze hanger is used for a group of pipes, use Taylor Fig. 14 U bolts, except where roller type hanger is indicated on the drawings or in the specifications.
- 2.3.3 For roller type hangers on both hot and cold pipes, provide Taylor Fig. 70 to 75 protection saddles to suit covering thickness. Use Taylor Fig. 93 adjustable roller hanger for pipe sizes up to and including 150mm (6") over insulation. For pipes 200mm (8") and larger over insulation, use Taylor Fig. 95 adjustable 2-rod roller hanger. On trapeze hangers and where pipe is supported from below, use Taylor Fig. 280S adjustable pipe roller stand.
- 2.3.4 For vertical pipe support, provide Taylor Fig. 82Z zinc plated steel riser clamp for steel pipe, and Taylor Fig. 85 epoxy coated copper-gard riser clamp for copper pipe.
- 2.3.5 For guides on vertical pipes, use manufactured pipe alignment guides (e.g. Flexonics). For horizontal pipes, use Taylor Fig. 255 pipe alignment guide. Field fabricated guides with rolled T-section welded to the pipe and guiding shoe, are also acceptable.

3 **EXECUTION**

3.1 GENERAL

- 3.1.1 Provide supports required for the erection and support of the mechanical work. Construct supports of steel, masonry or concrete, as noted or required. Ensure that steel supports in contact with water or high humidity are galvanized members bolted together using cadmium plated bolts, all others primed steel.
- 3.1.2 Ensure that housekeeping pads or concrete bases are provided for

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floor mounted equipment. Make the minimum size, 100mm (4") high for bases or pads, keyed to the floor slab, extending at least 100mm (4") all around the equipment, with 19mm (¾) chamfered edges. Where concrete is provided by Division 03 – Concrete, provide all anchor bolts and setting templates to Division 03 – Concrete.

- 3.1.3 Support suspended equipment from the bottom. Support tanks and other equipment with cast or welded steel saddles having proper curvature and inherent beam strength. Support plenums and sheet metal type air-handling units from auxiliary frames or beams under equipment. Support fans from structural steel frames with steel base plate. Read Division 05 – Metals, for further information.
- 3.1.4 Provide supports and suspended bases having ample strength to safely carry the load under all operating conditions and during testing. Submit support and base details to the Consultant for review. Design supports except springs with a minimum factor of safety of five (5) based on ultimate tensile strength at operating temperature.
- 3.1.5 Ensure that the load onto structures does not exceed the maximum loading as shown on structural drawings or as directed by the Consultant.
- 3.1.6 Take special care in locating hangers and supports to avoid introduction of undue reaction forces onto the structure of the building, to flanges of pumps and equipment, to expansion joints and to the pipe.
- 3.1.7 Install all piping supported from hangers or supports in a manner to ensure that building construction is not weakened or over-stressed, that pipes are secure, vibration free, free to expand and contract and properly graded, and that vertical adjustment of horizontal piping is possible after erection.
- 3.2 HANGERS
 - 3.2.1 For structure attachments, adhere to the following:
 - 3.2.1.1 Support hangers directly from the structure only. Do not support pipes or equipment from other pipes, ducts, equipment, suspended ceiling, etc.
 - 3.2.1.2 Suspend hanger rods generally from certified inserts in concrete or

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by beam clamps. Before welding to steel structure members obtain prior permission of welding method from the Consultant and ensure that loads do not exceed the limit set by the Consultant. Ensure that hanging from floors and roofs made from pre-cast concrete members is from inserts originally cast into the members and provided by this contractor, or by rods passing between the members connected to a steel plate resting on the upper surface.

- 3.2.2 Sliding guides must have sliding surfaces cleaned of all dirt, paint or corrosion and, except for Teflon, have coating of graphite paste added during erection. Adjust guides to allow for free sliding at operating conditions. After assembly, provide these guides with temporary protective cover or wrapping added to keep them free of debris during extent of construction work. When piping is ready to be put into service, remove this protective covering, blow out guides clean of all debris and add paste where applicable. Care must be taken that ample clearance is provided so as not to obstruct free sliding of guide.
- 3.2.3 Install copper, brass, and stainless steel pipes with 3mm ($\frac{1}{8}$ ") thickness of di-electric packing between the pipe and the pipe attachment or use Taylor plastic coated pipe attachments.
- 3.2.4 Install guides on pipes with expansion movement next to expansion joints. Consult expansion joint manufacturer's recommendations and follow their instructions for number and spacing of guides. Use a minimum of two guides on each side of expansion joints.
- 3.2.5 Set hanger rods on steel and copper lines with expansion movement out of plumb in ambient temperature position, a distance equal to one-half pipe movement calculated from anchor point. Base movement on 25mm (1") expansion per 30m (100 ft) of pipe length and 37°C (67°F) temperature difference. Use toggle type insert of beam clamp for such locations.
- 3.2.6 Use roller type hanger only where shown on the drawings.
- 3.2.7 Install all hangers close to points where pipes change direction or where branch piping drops or rises from main.
- 3.2.8 Install vertical riser suitably anchored and guided with manufactured or fabricated guides to maintain accurate vertical position. Protect insulated pipes with 2.2mm (12 gauge) galvanized steel jacket at guides. Guide pipes with expansion movement and definite anchor points up to and including 100mm

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(4") sizes, at every floor or 3m (10 ft). Guide larger pipes and vertical cast iron pipes at every second floor or 7.5m (25 ft).

- 3.2.9 For horizontal cast iron, glass, or polypropylene pipes where packed or friction type mechanical joints are used, provide a support at every joint in straight runs with maximum 1.5m (5 ft) between supports. Where fittings are joined together (elbows, wyes, etc.) provide a separate support for a minimum of every second fitting.
- 3.2.10 For horizontal cast iron, pipes where screwed or bolted type joints are used, the spacing or supports may be increased not to exceed 2.4m (8 ft) between supports, but provide a support for every joint and every second fitting as described above.
- 3.2.11 Use lockwasher with single nut on all bolted connections for pipe supports, anchors, guides and support steel, or use double nuts.
- 3.2.12 During hydrostatic test on all air and vapour piping supported by springs or counterweights, install temporary rigid supports, blocking, etc., or lock the spring against movement to prevent excessive strain on piping or equipment.
- 3.2.13 Use spring hangers where vertical movement of the horizontal pipes may occur due to expansion or contraction. Refer to Sections 20 05 16 – Expansion Compensation and 20 05 48 – Vibration Isolation, for further information.
- 3.2.14 For rod hangers use round steel threaded rod supports on horizontal pipes, spaced at the following maximum intervals and having the minimum diameter as directed.
- 3.2.14.1 For Steel Pipes:

Pipe Diameter mm (in)	Horizontal Spacing of Supports mm (ft)	Single Rod Diameter mm (in)	Double Rod Diameter mm (in)
DN15 (½)	1,524 (5)	9 (¾)	9 (¾)
DN20 (¾)	1,829 (6)	9 (¾)	9 (¾)
DN25 (1)	2,134 (7)	9 (¾)	9 (¾)

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Pipe Diameter mm (in)	Horizontal Spacing of Supports mm (ft)	Single Rod Diameter mm (in)	Double Rod Diameter mm (in)
DN32 (1-¼)	2,438 (8)	9 (¾)	9 (¾)
DN40 (1-½)	2,743 (9)	9 (¾)	9 (¾)
DN50 (2)	3,048 (10)	9 (¾)	9 (¾)
DN65 (2-½)	3,048 (10)	13 (½)	9 (¾)
DN80 (3)	3,658 (12)	13 (½)	9 (¾)
DN100 (4)	4,268 (14)	16 (⅝)	13 (½)
DN125 (5)	4,877 (16)	16 (⅝)	13 (½)
DN150 (6)	5,182 (17)	19 (¾)	16 (⅝)
DN200 (8)	5,791 (19)	22 (⅞)	19 (¾)
DN250 (10)	6,706 (22)	22 (⅞)	19 (¾)
DN300 (12)	7,010 (23)	22 (⅞)	19 (¾)
DN375 (15) and over	max. 7,620 (25)	to suit weight	to suit weight

3.2.14.2 For Copper or Stainless Steel Tubing:

Pipe Diameter mm (in)	Horizontal Spacing of Supports mm (ft)	Single Rod Diameter mm (in)	Double Rod Diameter mm (in)
DN15 (½)	1,524 (5)	9 (¾)	9 (¾)
DN20 (¾)	1,829 (6)	9 (¾)	9 (¾)
DN25 (1)	1,829 (6)	9 (¾)	9 (¾)
DN32 (1-¼)	2,134 (7)	9 (¾)	9 (¾)
DN40 (1-½)	2,438 (8)	9 (¾)	9 (¾)
DN50 (2)	2,743 (9)	9 (¾)	9 (¾)

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Pipe Diameter mm (in)	Horizontal Spacing of Supports mm (ft)	Single Rod Diameter mm (in)	Double Rod Diameter mm (in)
DN65 (2-½)	3,048 (10)	13 (½)	9 (¾)
DN80 (3)	3,048 (10)	13 (½)	9 (¾)
DN100 (4)	3,658 (12)	16 (5/8)	13 (½)

- 3.2.15 Do not use pipe hooks, chains, or perforated straps.
- 3.2.16 Use angle or channel iron welded frames for trapeze hangers.
- 3.2.17 For all drain pipe installed under structural slab on disturbed soil (up fill), suspend piping via galvanized clevis hangers embedded in structural slab. Hanger spacing shall be per pipe manufacturer recommendations, with minimum of two (2) hangers per pipe length.
- 3.3 **ANCHORS**
 - 3.3.1 Design pipe anchors to restrain the movement of pipes in all directions.
 - 3.3.2 Take special care in locating anchors to avoid introduction of undue reaction forces into the structure of the building, to flanges of pumps and equipment, to expansion joints and to the pipe.
 - 3.3.3 Fabricate anchors and guides of structural steel channels, angles or plates secured to building structure. Size cylindrical type guides for full pipe insulation.
 - 3.3.4 Submit for review by the Consultant prior to installation, a detailed design prepared in conjunction with the expansion joint manufacturer for anchors, guides, and their proposed connection to the structure, including reaction forces and loads imposed on structure. All Drawings must be signed by a Professional Engineer registered in the Province of Ontario. Do not proceed with installation until after receipt of reviewed drawings.
- 3.4 **DUCT SUPPORT**
 - 3.4.1 Provide all foundations and supports required for the proper

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erection of the ductwork. Use concrete, masonry, and steel as specified, shown or required. Provide lightweight concrete fill around buried ductwork.

- 3.4.2 Co-operate with Division 03 – Concrete and Division 05 – Metals, and co-ordinate the work under this Division with those Divisions to ensure that opening required in floors, walls and partitions for the ducts are provided in the exact location required.
- 3.4.3 Where possible, use beam clamps, pre-set sleeves, and inserts for attachment to or passage through work under other Divisions. Do not weld to or cut into the work of other Specification Sections unless with the special permission of the Consultant.
- 3.4.4 Where vibration mountings are required, make necessary provisions in accordance with the recommendations of the equipment manufacturer. Refer to Sections 20 05 16 – Expansion Compensation and 20 05 48 – Vibration Isolation, for further information.
- 3.4.5 Install ducts securely supported from hangers or supports, in a manner to ensure that building construction is not weakened or over-stressed, that ducts are secure, free of vibration, free to expand and contract and properly graded.
- 3.4.6 Bolt steel frames to galvanized steel ducts. Rivet aluminum frames to aluminum ducts. Bolt steel frames to soldered lugs on copper ducts. Use di-electric gaskets. Bolt steel frames to welded lugs on stainless steel ducts.
- 3.4.7 Extend angles 50mm (2") to either side of ducts. For non-ferrous ducts, use di-electric gasket between duct and support. For additional stainless steel ducts use supports not directly attached to the duct. For watertight ducts, use supports not attached to the duct.
- 3.4.8 Support vertical ducts as follows:
 - 3.4.8.1 Support vertical ducts in duct shafts at the top and the bottom of the shafts and at every floor in between. Supply auxiliary steel structural steel, sized as required.
 - 3.4.8.2 Support other vertical ducts at the passage through every floor.
- 3.4.9 Support round and oval ducts using a 38mm by 3mm (1-1/2" x 1/8") split ring bolted at each end, extending minimum 75mm (3") on

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each side.

- 3.4.10 Support rectangular ducts using a bolted or tack welded frame on 38mm by 38mm by 3mm (1-1/2" x 1-1/2" x 1/8") angle steel.
- 3.4.11 In T-bar ceilings, attach diffusers connected to flexible duct directly to the ceiling suspension system main runners. Use this method for diffusers or mechanical items weighing less than 9 kg (20 lbs.). Support diffusers or equipment weighing more than 9 kg (20 lbs.) directly from the roof or floor.
- 3.5 EQUIPMENT SUPPORT
- 3.5.1 Place all suspended equipment on welded steel bases of up to 150mm (6") profile steel, stiffened with 3mm (1/8") checkered steel plate. Co-ordinate with Division 05 – Metals.
- 3.5.2 Place floor plates on 100mm (4") concrete housekeeping pads. Ensure that the load on the structure does not exceed 488 kg per square meter (100 lbs. per square feet) projected floor area within the perimeter of the supports.

END OF SECTION

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1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 - General Requirements, shall apply to and govern this Section.

1.2 SCOPE OF WORK

1.2.1 Provide all labour, materials, tools equipment, training commissioning and certification required to complete the work as shown on the Drawings and specified in this Section, including:

1.2.1.1 All necessary vibration isolation elements for piping and equipment, and vibration isolation bases for equipment to prevent noise levels from exceeding the room criteria listed in Table 1, Chapter 48 of the ASHRAE 2011 HVAC Applications Handbook.

1.2.2 Manufacturer of vibration isolation equipment shall have the following responsibilities:

1.2.2.1 Determine vibration isolation sizes and locations.

1.2.2.2 Provide piping and equipment isolation systems as scheduled or specified in the Contract Documents.

1.2.2.3 Guarantee specified isolation system deflection.

1.2.2.4 Provide installation instructions, drawings, and field supervision to assure proper installation and performance.

1.2.3 In addition to the work of this Section, comply with description of individual systems and general requirements of all other Specification Sections of this Division.

1.3 SUBMITTALS

1.3.1 The Contractor shall supply to the manufacturer approved drawings of all equipment to be isolated.

1.3.2 The manufacturer shall supply shop drawings of all vibration control components to be used on the project.

1.3.3 As a minimum provide the following information:

1.3.3.1 Catalogue cuts and data sheets on specific vibration isolators to be utilized showing compliance with the specifications.

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- 1.3.3.2 An itemized list showing the items of equipment or piping to be isolated, the isolator type of model number selected, isolator loading and deflection, and reference to specific drawings showing base and construction where applicable.
- 1.3.3.3 Grooved joint couplings and fittings shall be shown on drawings and product submittals, and shall be specifically identified with the applicable style or series designation.
- 1.3.3.4 Written approval of the base design to be used, obtained from the equipment manufacturer.
- 1.3.3.5 Drawings showing equipment base constructions for each machine, including dimensions, structural member sizes and support point locations.
- 1.3.3.6 Drawings showing methods for isolation of pipes and ductwork piercing walls and slabs.
- 1.3.4 Submit letter from manufacturer certifying that vibration isolation equipment have been installed in accordance with their recommendations and the Contract Documents, and that it operates to their satisfaction.
- 1.4 **QUALITY ASSURANCE**
- 1.4.1 It is the objective of this Specification Section to provide the necessary design for the control of excessive noise and vibration in the Building due to the operation of machinery or equipment, and/or due to interconnected piping, ductwork, or conduit. The installation of all vibration isolation units, and associated hangers and bases, shall be under the direct supervision of the vibration isolation manufacturer's representative.
- 1.4.2 All vibration isolators shall have either known undeflected heights or calibration markings so that, after adjustment, when carrying their load, the deflection under load can be verified, thus determining that the load is within the proper range of the device and that the correct degree of vibration isolation is being provided according to the design.
- 1.4.3 All isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer and must be linear over a deflection range of not less than 50% above the design deflection.

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- 1.4.4 The theoretical vertical natural frequency for each support point, based upon load per isolator and isolator stiffness, shall not differ from the design objectives for the equipment as a whole by more than "10%.
- 1.4.5 All neoprene mountings shall have a Shore hardness of 30 to 60 "5, after minimum aging of 20 days or corresponding oven-aging.
- 1.4.6 All grooved joint couplings and specialties shall be the products of a single manufacturer.

2 **PRODUCTS**

2.1 GENERAL

- 2.1.1 All vibration isolation devices shall be the product of a single manufacturer.

2.2 TYPE A SPRING ISOLATORS

- 2.2.1 Spring isolators shall be free standing and laterally stable without any housing and complete with a molded neoprene cup or 6mm (1/4") neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection.
- 2.2.2 Corrosion resistance where exposed to corrosive/outdoor environment shall be with:
 - 2.2.2.1 Springs neoprene coated.
 - 2.2.2.2 Hardware cadmium plated.
 - 2.2.2.3 All other metal parts hot-dip galvanized.
- 2.2.3 Designed and installed so that ends of springs remain parallel.
- 2.2.4 Non-resonant with equipment forcing frequencies or support structure natural frequencies.
- 2.2.5 Submittals shall include spring diameters, deflection, compressed spring height and solid spring height.

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2.2.6 Type A spring isolators to be Mason Type SLF.

2.3 TYPE B SPRING ISOLATORS

2.3.1 Isolators shall be same as Type A, except:

2.3.1.1 Provide built-in resilient vertical limit stops.

2.3.1.2 All restraining bolts shall have large rubber grommets to provide cushioning in the vertical as well as horizontal modes. The hole through the bushing shall be a minimum of 20mm (0.75") larger in diameter than the restraining bolt. Horizontal clearance on the sides between the spring assembly and the housing shall be a minimum of 12mm (0.5") to avoid bumping and interfering with the spring action. Vertical limit stops shall be out of contact during normal operation.

2.3.1.3 Provide tapped holes in top plate for bolting to equipment.

2.3.1.4 Isolators shall be capable of supporting equipment at a fixed elevation during equipment erection.

2.3.2 Housings and springs shall be powder coated and hardware electro-galvanized.

2.3.3 Type B spring isolators to be Mason Type SLR.

2.4 TYPE C SPRING HANGER ROD ISOLATORS

2.4.1 Hangers shall be manufactured with minimum characteristics as Type A isolators, but without the neoprene element:

2.4.1.1 Springs are seated in a steel washer reinforced neoprene cup that has a neoprene bushing projecting through the bottom hole to prevent rod to hanger contact.

2.4.1.2 Spring diameters and the lower hole sizes shall be large enough to allow the hanger rod to swing through a 30° arc from side to side before contacting the cup bushing.

2.4.1.3 If ducts are suspended by flat strap iron, the hanger assembly shall be modified by the manufacturer with an eye on top of the box and on the bottom of the spring hanger rod to allow for bolting to the hanger straps.

2.4.2 Submittals on either of the above hangers shall include a scaled drawing of the hanger showing the 30° capability.

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2.4.3 Where operating weight differs from installed weight provide built-in adjustable limit stops to prevent equipment rising when weight is removed. Stops shall not be in contact during normal operation.

2.4.4 Type C spring hanger rod isolators to be Mason Type 30 or for straps W30.

2.5 TYPE D ELASTOMETER MOUNTING TYPES

2.5.1 Neoprene mountings shall have a minimum static deflection of 9mm (0.35"). All metal surfaces shall be oil-resistant neoprene covered and have friction pads both top and bottom. Bolt holes shall be provided on the bottom and a tapped hole and cap screw on top. Steel rails shall be used above the mountings under equipment such as small vent sets to compensate for the overhang.

2.5.2 Neoprene to be compounded to hardness no greater than 70 durometer.

2.5.3 Mounts to have straight line deflection curve.

2.5.4 Type D elastomer isolators to be Mason Type ND.

2.6 TYPE E ELASTOMETER HANGER ROD ISOLATORS

2.6.1 Isolators shall incorporate a moulded unit type neoprene element and steel retainer box encasing the neoprene mounting.

2.6.2 Neoprene to be compounded to hardness no greater than 70 durometer.

2.6.3 Isolator to have sufficient clearance between mounting hanger rod and steel retainer box.

2.6.4 Type E hanger rod isolators to be Mason Type HD.

2.7 TYPE F PAD TYPE ELASTOMETER MOUNTINGS

2.7.1 Elastomer pads to incorporate the following:

2.7.1.1 20mm (3/4") minimum thickness per layer of pad.

2.7.1.2 Suitable top bearing plate provided to uniformly distribute load.

2.7.1.3 Ribbed or waffled design.

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- 2.7.1.4 15% deflection.
- 2.7.1.5 Standard neoprene with moderate oil-resistance, compounded to hardness no greater than 70 durometer.
- 2.7.1.6 1.6mm (16 ga.) galvanized steel plate between multiple layers of pad thickness.
- 2.7.1.7 Bolts through equipment and pad shall be oversized and provided with resilient washers and bushings.
- 2.7.2 Type F pad to be Mason Type Super W.
- 2.8 TYPE G PAD TYPE ELASTOMETER MOUNTINGS
- 2.8.1 Elastomer pads to incorporate the following:
 - 2.8.1.1 High quality bridge bearing neoprene.
 - 2.8.1.2 3mm (1/8") deflection.
 - 2.8.1.3 Maximum loading 6,895 kPa (1000 psi).
 - 2.8.1.4 Suitable bearing plate to distribute load.
 - 2.8.1.5 Minimum thickness 25mm (1").
- 2.8.2 Type G pad to be Mason Type BBNR.
- 2.9 TYPE H COMBINATION SPRING/ELASTOMETER HANGER ROD ISOLATORS
- 2.9.1 Hangers shall consist of rigid steel frames containing minimum 32mm (1-1/4") thick neoprene elements at the top and a steel spring with general characteristics as described in Type C, seated in a steel washer reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. In order to maintain stability the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30° arc from side to side before contacting the cup bushing and short circuiting the spring.
- 2.9.2 Neoprene to be compounded to hardness no greater than 70 durometer.

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- 2.9.3 Submittals shall include a hanger drawing showing the 30° capability.
- 2.9.4 Type H isolator to be Mason Type 30N.
- 2.10 INTEGRAL STRUCTURAL STEEL BASE, TYPE B-1
- 2.10.1 Base to be reinforced as required to prevent base flexure at start-up and misalignment of drive and driven units. Rectangular bases are preferred for all equipment. Centrifugal refrigeration machines and pump bases may be T or L shaped. Pump bases for split case pumps shall be large enough to support suction and discharge elbows. Centrifugal fan bases to be complete with motor slide rails, drilled for drive and driven unit mounting template.
- 2.10.2 All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Base depth need not exceed 350mm (14") provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to provide a base clearance of 25mm (1").
- 2.10.3 Type B-1 base to be Mason Type WF.
- 2.11 CONCRETE INERTIA BASE, TYPE B-2
- 2.11.1 Concrete inertia bases shall be formed in a structural steel perimeter base, reinforced as required to prevent flexure, misalignment of drive and driven unit or stress transferal into equipment.
- 2.11.2 The base shall be complete with motor slide rails, pump base elbow supports, and complete with equipment bolting provisions and isolators. Bases shall be a minimum of 1/12 of the longest dimension of the base but not less than 150mm (6"). The base depth need not exceed 300mm (12") unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of 12mm (1/2") bars welded in place on 150mm (6") centers running both ways in a layer 40mm (1-1/2") above the bottom. Forms shall be furnished with steel templates to hold the anchor bolt sleeves and anchor bolts while concrete is being poured. Height saving brackets shall be employed in all mounting locations to maintain a 25mm (1") minimum clearance between base and housekeeping pad. Wooden formed bases leaving a concrete rather than a steel finish are not acceptable.

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2.11.3 Minimum thickness of the inertia base shall be according to the following tabulation:

<u>Motor Size</u> kW (hp)	<u>Min. Thickness</u> mm (inches)
up to 11 (15)	150 (6)
15-37 (20-50)	200 (8)
45-55 (60-75)	250 (10)
75-185 (100-250)	300 (12)
225-375 (300-500)	400 (16)

2.11.4 Type B-2 inertia base to be Mason Type BMK or K.

2.12 SPRING ISOLATED ROOF CURB, TYPE B-3

2.12.1 Structural roof curb assembly to have a top and bottom frame resiliently connected by spring isolator complying with specification Type A.

2.12.2 The lower member shall consist of a sheet metal Z section containing adjustable and removable steel springs that support the upper floating section. The upper frame must provide continuous support for the equipment and must be captive so as to resiliently resist wind forces. All directional neoprene snubber bushings shall be a minimum of 6mm (1/4") thick. Steel springs shall be laterally stable and rest on 6mm (1/4") thick neoprene acoustical pads. Hardware must be plated and the springs provided with a rust resistant finish. The curb's waterproofing shall consist of a continuous galvanized flexible counter flashing nailed over the lower curb's waterproofing and joined at the corners by EPDM bellows. All spring locations shall have access ports with removable waterproof covers. Lower curbs shall have provision for 50mm (2") of insulation.

2.12.3 Type B-3 curb to be Mason Type RSC.

2.13 MOUNTING TYPES AND STATIC DEFLECTION SCHEDULE

Equipment	Slab on Grade	Suspended Slabs
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Type	Category	HP or Other	RPM	Base Type	Isolator Type	Min. Defl. mm (in.)	Base Type	Isolator Type	Min. Defl. mm (in.)		
Refrigeration Machines and Chillers	Reciprocating	All	All	(1)	D	6 (1/4")	(1)	B	38 (1-1/2")		
	Centrifugal scroll	All	All	(1)	F	6 (1/4")	(1)	B	38 (1-1/2")		
	Screw	All	All	(1)	F	25 (1")	(1)	B	64 (2-1/2")		
	Absorption	All	All	(1)	F	6 (1/4")	(1)	B	38 (1-1/2")		
	Air-cooled recip, scroll	All	All	(1)	D	6 (1/4")	(1)	B	38 (1-1/2")		
	Air-cooled screw	All	All	(1)	B	25 (1")	B-1	B	64 (2-1/2")		
Air Compressors and Vacuum Pumps	Tank-mtd horiz.	≤10	All	(1)	A	19 (3/4")	(1)	A	38 (1-1/2")		
		≥15	All	B-2	A	19 (3/4")	B-2	A	38 (1-1/2")		
	Tank-mtd vert.	All	All	B-2	A	19 (3/4")	B-2	A	38 (1-1/2")		
		All	All	B-2	A	19 (3/4")	B-2	A	38 (1-1/2")		
Pumps	Close coupled	≤7.5	All	B-1	D	6 (1/4")	B-2	A	19 (3/4")		
		≥10	All	B-2	A	19 (3/4")	B-2	A	38 (1-1/2")		
	Inline	5 to 25	All	(1)	A	19 (3/4")	(1)	A	38 (1-1/2")		
		≥30	All	(1)	A	38 (1-1/2")	(1)	A	38 (1-1/2")		
	End suction, double suction	≤40	All	All	B-2	A	19 (3/4")	B-2	A	38 (1-1/2")	
		50 to 125	All	All	B-2	A	19 (3/4")	B-2	A	38 (1-1/2")	
split case	≥150	All	All	B-2	A	19 (3/4")	B-2	A	64 (2-1/2")		
Package pump	All	All	All	(1)	A	19 (3/4")	B-2	A	38 (1-1/2")		
Cooling towers	All	All	≤300	(1)	G	6 (1/4")	(1)	B	89 (3-1/2")		
			301to500	(1)	G	6 (1/4")	(1)	B	64 (2-1/2")		
			≥501	(1)	G	6 (1/4")	(1)	B	19 (3/4")		
Boilers	Fire-tube	All	All	(1)	F	6 (1/4")	B-1	B	38 (1-1/2")		
	Water-tube	All	All	(1)	F	3 (1/8")	(1)	F	3 (1/8")		
	Steam	All	All	(1)	F	6 (1/4")	B-1	B	38 (1-1/2")		
Fans: axial, plenum, cabinet, inline	≤ 22 in dia.	All	All	(1)	D	6 (1/4")	B-2	A	19 (3/4")		
	≥ 24 in dia.			≤2 in SP	≤300	B-1	A	64 (2-1/2")	B-2	A	89 (3-1/2")
				>2 in SP	301to500	B-1	A	19 (3/4")	B-2	A	64 (2-1/2")
	≥501				B-1	A	19 (3/4")	B-1	A	38 (1-1/2")	
	≤300				B-2	A	64 (2-1/2")	B-2	A	89 (3-1/2")	
	301to500				B-2	A	38 (1-1/2")	B-2	A	64 (2-1/2")	
Centrifugal fans	≤ 22 in dia.	All	All	(1)	D	6 (1/4")	B-1	A	19 (3/4")		
	≥ 24 in dia.			≤40	≤300	B-1	A	64 (2-1/2")	B-1	A	89 (3-1/2")
				≥50	301to500	B-1	A	38 (1-1/2")	B-1	A	64 (2-1/2")
	≥501				B-1	A	19 (3/4")	B-1	A	19 (3/4")	
	≤300				B-2	A	64 (2-1/2")	B-2	A	89 (3-1/2")	
	301to500				B-2	A	38 (1-1/2")	B-2	A	64 (2-1/2")	
Propeller	Wall-mounted	All	All	(1)	F	6 (1/4")	(1)	F	6 (1/4")		

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fans	Roof-exhauster	All	All	(1)	F	6 (1/4")	B-3	B	38 (1-1/2")
Heat pumps, fan coils, CRAC units	All	All	All	(1)	A	19 (3/4")	(1)	A	19 (3/4")
Condensing units	All	All	All	(1)	F	6 (1/4")	(1)	B	38 (1-1/2")
AHUs, AC, heating and ventilation units	All	≤10	All	(1)	A	19 (3/4")	(1)	A	19 (3/4")
	All	≤15, ≤4 in SP	≤300	(1)	A	19 (3/4")	B-2	A	89 (3-1/2")
			301to500	(1)	A	19 (3/4")	(1)	A	64 (2-1/2")
			≥501	(1)	A	19 (3/4")	(1)	A	38 (1-1/2")
		>15, >4 in SP	≤300	B-1	A	19 (3/4")	B-2	A	89 (3-1/2")
			301to500	B-1	A	19 (3/4")	B-2	A	64 (2-1/2")
		≥501	B-1	A	19 (3/4")	B-2	A	38 (1-1/2")	
Packaged RTUs	All	All	All	(1)	G	6 (1/4")	B-3	A	19 (3/4")
Ducted rotating equipment	Small fans, fan powered boxes	≤600 cfm		(1)	A	13 (1/2")	(1)	A	13 (1/2")
		>600 cfm		(1)	A	19 (3/4")	(1)	A	19 (3/4")
Generators	All	All	All	(1)	A	19 (3/4")	B-2	A	64 (2-1/2")
Heat exchangers, tanks	Plate and frame			(2)	F	3 (1/8")	(2)	F	3 (1/8")
Piping (see specs)	Floor supported			-	B	25 (1")	-	B	25 (1")
	Suspended						-	H	32 (1-1/4")
Transformer, dry type	Floor mounted			(2)	D	6 (1/4")	(2)	D	6 (1/4")
	Suspended						(2)	E	6 (1/4")
	Wall mounted						(2)	D	6 (1/4")

2.13.1

Notes:

- (1) No base, isolator directly attached to equipment.
- (2) Base as recommended and/or provided by manufacturer.

3

EXECUTION

3.1

GENERAL

3.1.1

Have all materials and systems for vibration isolation designed and supplied by one company, referred to in this Section as the 'manufacturer'.

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- 3.1.2 Install all products in accordance with manufacturer's written instructions. Vibration isolators must not cause any change or position of equipment or piping resulting in piping stresses or misalignment.
- 3.1.3 Provide through the manufacturer all vibration isolation equipment work and measures to prevent the transmission of objectionable vibration to the building structure and from one area to another area. Provide all necessary drawings indicating isolator locations and base dimensions. Have the installation directed and supervised by the manufacturer. Supply to the manufacturer the necessary copies of all drawings of equipment to be isolated.
- 3.1.4 Consider the areas classified as follows for selection of vibration control devices:
 - 3.1.4.1 Mechanical rooms or equipment locations in basement or sub-basement areas only and not bordering areas regularly occupied are 'non-critical'.
 - 3.1.4.2 Mechanical rooms or equipment locations bordering habitable suites, boardrooms, conference rooms, private offices are 'ultra-critical'. This shall include all mechanical penthouses and all mechanical compartment rooms.
- 3.1.5 Vibration isolation is not required for the following equipment between equipment and building only, but provide isolated connection to these for pipes and ducts:
 - 3.1.5.1 Fire pumps
 - 3.1.5.2 Sump pumps, sewage pumps
- 3.1.6 All piping and ductwork to be isolated shall freely pass through walls and floors without rigid connections. Penetration points shall be sleeved using acoustical sleeves, or otherwise formed to allow passage of piping or ductwork, and maintain 20mm ($\frac{3}{4}$ ") to 32mm ($1\frac{1}{4}$ ") clearance around the outside surfaces. This clearance space shall be tightly packed with fiberglass, and caulked airtight after installation of piping or ductwork.
- 3.1.7 No rigid connections between equipment and building structure shall be made that degrades the noise and vibration isolation system specified in this Section.
- 3.1.8 Electrical conduit connections to isolated equipment shall be

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flexible to allow free motion of isolated equipment.

- 3.1.9 Do not install any equipment, piping, or conduit, which makes rigid contact with the building unless permitted in this Specification. Building includes, but is not limited to, slabs, beams, columns, studs, and walls.
- 3.1.10 Coordinate work with other trades to avoid rigid contact with the building. Inform other trades following work, such as plastering or electrical, to avoid any contact which would reduce the vibration isolation.
- 3.1.11 Bring to the Consultant's attention prior to installation any conflicts with other trades, which will result in unavoidable rigid contact with equipment or piping as described herein, due to inadequate space or other unforeseen conditions. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.
- 3.1.12 Obtain inspection and approval of any installation to be covered or enclosed, prior to such closure.
- 3.1.13 Diagonal restraints shall be attached at the centerline of thrust.
- 3.1.14 Vertical piping loads, including water strainers, valves between pump base elbow supports and the suction and discharge header piping, shall be supported by the pump base spring isolators without stress or strain to the pump housing.
- 3.1.15 Correct, at no additional cost, all installations, which are deemed defective in workmanship or materials.
- 3.2 **EQUIPMENT ISOLATORS**
- 3.2.1 Mount floor mounted equipment on 100mm (4") concrete housekeeping pads over complete floor area of equipment. Mount vibration isolating devices and related inertia blocks on concrete pad.
- 3.2.2 Each fan and motor assembly shall be supported on a single structural steel frame. Provide all ductwork connected to vibration-isolated equipment at both inlet and outlet with flexible connectors having sufficient length and flexibility to eliminate vibration transmission and to not short circuit the effectiveness of the vibration isolation. Make flexible connections of glass fibreglass cloth sleeves, sealed to prevent air leakage. Install a minimum

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length of flexible connection on both sides equal to static pressure of the fan in inches but not less than 150mm (6").

- 3.2.3 The machine to be isolated shall be supported by a structural steel frame or concrete inertia base.
- 3.2.4 Brackets shall be provided to accommodate the isolator. The vertical position and size of the bracket shall be specified by the isolation manufacturer.
- 3.2.5 The minimum operating clearance between the equipment frame or rigid steel base frame and the housekeeping pad or floor shall be 25mm (1"). Minimum operating clearance between concrete inertia and base and housekeeping pad or floor shall be 50mm (2").
- 3.2.6 The equipment structural steel or concrete inertia base shall be placed in position and supported temporarily by blocks or shims, as appropriate, prior to the installation of the machine or isolators.
- 3.2.7 The isolators shall be installed without raising the machine and frame assembly.
- 3.2.8 After the entire installation is complete and under full operational load, the isolators shall be adjusted so that the load is transferred from the blocks to the isolators. When all isolators are properly adjusted, the blocks or shims shall be barely free and shall be removed.
- 3.2.9 Air handling equipment and centrifugal fans shall be protected using horizontal thrust restraints against excessive displacement weight which results from high air thrust when thrust forces exceed 10% of the equipment.
- 3.2.10 Rooftop equipment isolators must be bolted to the equipment and structure. Mountings must be designed to resist 160 km/h (100mph) wind loads.
- 3.2.11 Isolation mounting deflection shall be the minimum as specified or scheduled on the Drawings.
- 3.2.12 Verify that all installed isolator and mounting systems permit equipment motion in all directions. Adjust or provide additional resilient restraints to flexibly limit start-up equipment lateral motion to 6mm (¼").

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3.2.13 Prior to start-up, clean out all foreign matter between bases and equipment. Verify that there are no isolation short circuits in the base or isolators.

3.3 PIPING ISOLATORS

3.3.1 All piping isolators are included under this Section.

3.3.2 Where piping connects to mechanical equipment install expansion joints, or stainless hoses if expansion joints are not suitable for the service. All piping passing through the equipment walls, floors or ceilings shall be protected against sound leakage by means of an acoustical seal.

3.3.3 Isolate piping outside the shafts as follows:

3.3.3.1 All water piping in machine rooms, including strainers, filters, valves and associated equipment with water systems.

3.3.3.2 Piping and associated equipment where exposed on roof.

3.3.3.3 Water piping within 12.2m (40 ft) or 100 x pipe diameters, whichever is greater, from connected rotating equipment, using Type H hangers with the same static deflection as specified for the equipment. If piping is connected to equipment located beneath occupied spaces and hangs from ceilings under occupied spaces, the first four hangers shall have a minimum deflection of 20mm ($\frac{3}{4}$ ") for pipe sizes up to and including 75mm (3"), 40mm (1-1/2") deflection for pipe sizes over 75mm (3") and up to and including 150mm (6"), and 65mm (2-1/2") deflection thereafter.

3.3.4 The isolators shall be installed with the isolator hanger box attached to, or hung as close as possible to, the main structural elements of the building.

3.3.5 The isolators shall be suspended from substantial structural members, not from slab diaphragm unless specifically permitted.

3.3.6 Hanger rods shall be aligned to clear the hanger box.

3.3.7 Horizontal suspended pipe 50mm (2") and smaller and all steam piping shall be suspended by Type E isolator with a minimum 6mm ($\frac{1}{4}$ ") deflection. Water pipe larger than 50mm (2") shall be supported by Type H isolator with a minimum 32mm (1-1/2") static deflection.

3.3.8 Horizontal pipe floor supported at slab shall be supported via Type

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A or B, with a minimum static deflection of 25mm (1") or same deflection as isolated equipment to which pipe connects whichever is the greater.

3.3.9 All vertical risers shall be supported by spring isolators designed to support the riser filled with water, if it is a water line. Assigned loads must be within the building design limits at the support points. Neutral central resilient anchors shall direct movement up and down. The anchors shall be capable of holding an upward force equal to the water weight when the system is drained. If one level cannot accommodate this force, anchors can be located on two or three adjacent floors. Resilient guides shall be spaced and sized properly depending on the pipe diameter. The initial spring deflection shall be a minimum of 20mm ($\frac{3}{4}$ ") or four times the thermal movement at the isolator location, whichever is greater. Proper provision shall be made for seismic protection in seismic zones. Support spring mountings shall be Type A, anchors and telescoping guides as described under the Products section.

3.3.10 Pipe sway braces, where required, shall utilize two (2) neoprene elements (type D to accommodate tension and compression forces).

3.3.11 Pipe extension and alignment connectors: Provide connector at riser takeoffs, cooling and heating coils, and elsewhere as required to accommodate thermal expansion and misalignment.

3.4 DUCT ISOLATORS

3.4.1 All air ducts with a cross section of 0.19m² (2ft²) or larger shall be isolated from the building structure by Type C hangers or Type A floor supports with a minimum deflection of 20mm ($\frac{3}{4}$ "). Isolators shall continue for minimum 15m (50 ft) from the equipment. If air velocity exceeds 5.3 mps (1000 fpm), hangers or supports shall continue for an additional 15m (50 ft) or as shown on the Drawings

3.5 ISOLATOR POSITION

3.5.1 Close to building structure.

3.5.2 Between building structure and supplementary steel if required.

3.5.3 Suspend isolators from rigid and massive support points.

3.5.4 Supplementary steel to be sized for a maximum deflection of 1.6mm ($\frac{1}{16}$ ") at center span.

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3.5.5 Support piping in shafts and floor supports entering shaft with Type B isolators or Type H hangers depending on piping loads and support point space conditions within shafts.

3.5.6 Guide piping in shafts as required with approved mounting designs incorporating Mason Type ADA mountings to building. Prevent direct contact of piping with building structure.

3.6 MANUFACTURER'S REVIEW

3.6.1 On completion of installation of all vibration isolation and expansion compensation devices specified in this Section, the manufacturer shall inspect the completed system; check the vibration levels in the areas as requested by the Consultant, and report in writing any installation error, improperly selected isolation devices, or other faults in the system that could affect the performance of the system. A written report shall be submitted outlining corrective work necessary to comply with the above specifications. Corrective work shall be the responsibility of the installing Subcontractor.

END OF SECTION

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1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 - General Requirements, shall apply to and govern this Section.

2 **PRODUCTS**

Not Used

3 **EXECUTION**

3.1 PIPE SYSTEMS

3.1.1 After finished painting is complete, identify each pipe with stencils and stencil paint. Alternatively, use SMS Coil-Mark or adhesive style building service pipe markers.

3.1.2 Use capital letters minimum 51mm (2") high for DN80 (3") diameter piping or larger, including insulation, and 19mm ($\frac{3}{4}$ ") size capital letters on smaller diameters.

3.1.3 Use flow arrows to indicate direction of flow. Use double arrow where flow is reversible. Arrow shall be solid black or white; minimum 152mm (6") long by 51mm (2") wide for DN80 (3") diameter piping or larger, including insulation, and 102mm (4") long by 19mm ($\frac{3}{4}$ ") wide on smaller diameters.

3.1.4 Locate identification and flow arrows as follows:

3.1.4.1 Behind each access door.

3.1.4.2 At each change of direction and take-off.

3.1.4.3 Not more than 12.2m (40 ft) apart on all pipes exposed and/or located behind accessible ceiling.

3.1.4.4 On both sides of sleeves.

3.1.4.5 Adjacent to valves.

3.1.4.6 Above each floor or platform for vertical exposed pipes approximately 1,524mm (5 ft.) above floor.

3.1.5 Stenciling to be performed in a neat, quality manner. Upon completion of project, provide one complete set of stencils used for

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the Owner.

3.1.6 Use wording shown on the Legend on the Drawings or as instructed by the Consultant. Special system designations and abbreviations shall be submitted to Consultant for approval prior to use.

3.1.7 Colour coding to be as per the following schedule. For all other services, provide colour coding in conformance with CAN/CGSB-24.3 and ANSI A131.

MARKER LEGEND

**CLASSIFICATION
COLOUR**

Description and Service	Primary	Secondary
City Water	Green	
Cold Water	Green	
Cooling Tower Water	Green	
Chilled Water	Green	
Ice Water	Green	
Domestic Hot Water	Green	
Domestic Hot Water Recirculation	Green	
Low Temp. Heating Water (Up To 121°C / 250°F)	Yellow	Black
High Temp. Heating Water (Over 121°C / 250°F)	Yellow	Black
Make-Up Water	Yellow	Black
Boiler Feed Water	Yellow	Black
Condensate	Yellow	Black
Blow-Off Water	Yellow	Black
Treated Water	Green	
Brine	Green	
Waste Water	Green	

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MARKER LEGEND

CLASSIFICATION COLOUR

Description and Service	Primary	Secondary
Storm Water	Green	
Acid Drain	Yellow	Black
Fire Protection Water	Red	White
Sprinkler Water	Red	White
Carbon Dioxide (Fire Protection)	Red	White
Plumbing Vent	Green	
Heating Vent	Yellow	Black
Low Pressure Steam (103 kPa / 15 psi Or Less)	Yellow	Black
High Pressure Steam (Above 103 kPa / 15 psi)	Yellow	Black
Hydraulic Oil	Yellow	Black
Instrument Air	Green	
Diesel Exhaust	Yellow	Black
Fuel Oil	Yellow	Orange
LP Gas	Yellow	Orange
Natural Gas	Yellow	Orange
Chlorine	Yellow	Black
Nitrogen	Blue	Yellow
Vacuum	Green	
Compressed Air (690 kPa / 100 psi Or Less)	Green	
Compressed Air (Above 690 kPa / 100 psi)	Yellow	Black

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3.1.8 Use primary colours for full length of piping or in minimum 914mm (36") long sections; use minimum 457mm (18") long sections on each side of valves. Use secondary colours in min. 51mm (2") wide bands.

3.1.9 Install pipe identification in accordance with the manufacturer's recommendations.

3.2 VALVES

3.2.1 Supply and attach to each valve (except fixture stops) a lamacoid tag 32mm (1-¼") in diameter or 38mm (1-½") square, similar to SMS RP/SP-1500 series. The system code to be 5mm (³/₁₆") high characters on the top line, valve numbers to be 9mm (³/₈") high on the bottom line. Tags to be colour coded in conformance with piping system colours as per CAN/CGSB-24.3.

3.2.2 Attach tag to valve with a brass chain.

3.2.3 Schedule the valve numbers using a sequential numbering system. For fire protection valves, co-ordinate valve numbers with the annunciator panel numbering system.

3.2.4 Prepare and submit valve directories and charts giving number, size, location, purpose, and normal position (opened or closed) for each valve.

3.2.5 Provide two (2) framed copies of the valve charts and locate where directed by the Consultant.

3.2.6 All control, drain, and test connection valves shall be provided with signs indicating their purpose.

3.3 EQUIPMENT

3.3.1 Identify all fans, pumps, controls, starters, switches, pushbuttons, and all other equipment as to service by a white lamacoid engraved nameplate on black background. Submit sample plates and lettering to the Consultant. Attach plates only after all painting work is completed. Use mechanical fastening devices acceptable to the Consultant.

3.3.2 Manufacturer's nameplates shall be affixed to all equipment, serial number and all information usually provided, including voltage, cycle, phase, motor power, etc., name of the manufacturer and their address. All stamped etched or engraved lettering on plates

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shall be perfectly legible. Do not paint over nameplates and, where apparatus is to be concealed, attach the nameplates in an approved location on the equipment support or frame.

- 3.3.3 Identify all equipment with the corresponding remote controls.
- 3.3.4 Equipment plates shall have 9mm ($\frac{3}{8}$ ") capital letters; starter plates shall have 3mm ($\frac{1}{8}$ ") capital letters. All plates shall be sized to accommodate required description. Locate plates conspicuously and secure with self-tapping sheet metal screws where possible, or with double sided adhesive tape. Recognizable abbreviations will be acceptable, other proposed abbreviations to be approved by Consultant.
- 3.4 **DUCTWORK**
- 3.4.1 Identify all ductwork with 51mm (2") high stencils using black or white ink to contrast surface being identified.
- 3.4.2 Identification location shall conform to guidelines for pipe systems, and shall indicate flow medium, function, and direction.
- 3.4.3 Stenciling to be performed in a neat, quality manner. Upon completion of project, provide one complete set of stencils used for the Owner.

END OF SECTION

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1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 - General Requirements, shall apply to and govern this Section.

1.2 GENERAL REQUIREMENTS

1.2.1 Test, balance and adjust all systems to the Drawings and Specifications, in accordance with the intent and requirements of the ASHRAE Guide - Testing, Adjusting and Balancing (TAB) (Chapter 38, 2011 ASHRAE Application Handbook).

1.3 QUALIFICATION

1.3.1 The Testing, Balancing and Adjusting (TAB) Contractor must be a member in good standing with the National Environmental Balancing Bureau (NEBB), the Canadian Associated Air Balance Council (CAABC) or the National Building Comfort Testing Association (NBCTA).

1.4 SCOPE OF WORK

1.4.1 The TAB Contractor shall:

1.4.1.1 Within fourteen (14) days after award of contract, submit proof of certification for CAABC / NBCTA / NEBB.

1.4.1.2 Within thirty (30) days after award of contract, submit a report to the consultant summarizing the TAB Contractor's comments and recommendations regarding their review of the contract documents. Meet with the Contractor, Owner and Consultant as necessary to discuss.

1.4.1.3 Within thirty (30) days after Contract award, submit an outline of proposed TAB procedures, or alternatively, provide a copy of the latest edition of CAABC / NBCTA / NEBB Procedural Standards.

1.4.1.4 Conduct ongoing reviews of all related construction documentation, including co-ordination Drawings and shop drawings.

1.4.1.5 Visit the Site a minimum of once per month during construction, commencing when the pipe and/or duct installation starts. Submit a written report to the Consultant, including date of visit, areas

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observed, and any anticipated problems, which could adversely affect the TAB work.

- 1.4.1.6 Prior to commencing the TAB work, the TAB Subcontractor shall submit the list of instruments they will use on the project, together with a record of calibration dates and procedures.
- 1.4.1.7 Perform all prebalancing work as specified in respective procedures.
- 1.4.1.8 Furnish all TAB labour, instruments and services necessary to complete the TAB work for air systems and water systems to achieve the required air and water flow rates. For fans with fixed drives, provide preliminary balance for first set of sheaves, advise the Division 23 - HVAC Subcontractor of results, install new sheaves, and rebalance system following installation of second set of sheaves. Adjust adjustable drives for required rpm and airflow. Adjust VAV box minimum and maximum airflows. Adjust and set all volume control devices to achieve proper air distribution, pressures and patterns in all parts of supply return and exhaust air systems. Adjust and set all pumps, balancing valves and other flow devices to achieve optimum water distribution in all parts of the circulating water systems.
- 1.4.1.9 Document any deficiencies that prevent the system from being properly balanced and advise the respective installing Subcontractor (Division 21, 22 or 23). Rebalance all affected systems following correction by the respective installing Subcontractor (Division 21, 22 or 23) at no additional cost to the Owner.
- 1.4.1.10 Record the existing capacities of all existing fans, pumps, main duct branches, and partial systems remaining as part of the renovated work, before demolition occurs. Provide a separate report to the Consultant summarizing all measurements.
- 1.4.1.11 Balance all existing air and water systems altered under this project in accordance with values on the drawings and/or predemolition measurements made by the TAB Subcontractor.
- 1.4.1.12 Report on any noise and vibration problems that are discovered during the course of balancing.
- 1.4.1.13 Submit a Balancing Report to the Consultant.
- 1.4.1.14 Repeat the balancing procedures for up to 10% of the system at

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the request of the Consultant. Should the retest data differ by more than $\pm 5\%$ from the originally reported values, the TAB Contractor shall be obligated to repeat the balancing of the entire system or systems at no additional cost to the Owner, if so requested by the Consultant.

1.4.1.15 Include for premium time where schedule requires that TAB work be undertaken after hours.

1.5 CO-ORDINATION

1.5.1 The respective installing Subcontractor (Division 21, 22 or 23) shall be responsible to ensure that all systems are complete and ready for testing, balancing and adjusting by the TAB Contractor. The respective installing Subcontractor (Division 21, 22 or 23) shall:

1.5.1.1 Confirm the complete operational readiness of the building, including sealed walls, doors, and ceilings to allow the balancing to be performed and required pressures to be set and maintained.

1.5.1.2 Allow access to all components requiring testing, balancing, and servicing. This includes permanently installed ladders and catwalks.

1.5.1.3 Maintain a construction schedule that allows the test and balance (TAB) firm to complete contract work prior to occupancy.

1.5.1.4 Verify the installation conformity to the design drawings and specifications.

1.5.1.5 Promptly correct deficiencies of materials and work that may delay completion of the TAB work.

1.5.1.6 Provide operation and maintenance manuals. Manuals must include the following:

1.5.1.6.1 The manufacturers' method for adjusting and setting components for correct operation under actual load conditions.

1.5.1.6.2 The manufacturers' recommended tolerance for maximum and minimum operating conditions.

1.5.1.6.3 The recommended correction or A_k factors, to allow adjustment of flow, rpm, etc.

1.5.1.6.4 A list of spare parts, identification numbers, and diagrams of their proper locations.

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- 1.5.1.6.5 Pressure drops for air and hydronic flows through the component or unit at design flow rate.
- 1.5.1.7 Start up all HVAC systems, according to the following conditions:
 - 1.5.1.7.1 Proper lubrication of rotating or sliding parts is verified.
 - 1.5.1.7.2 Motors, fans, and all HVAC equipment have the correct rotation.
 - 1.5.1.7.3 Installation of the correct drive (package) is checked.
 - 1.5.1.7.4 Belt tension is appropriate for the type of drive.
 - 1.5.1.7.5 Vibration isolators and bases are properly installed and are the correct type.
 - 1.5.1.7.6 Smoke and fire damper operation (left in full open position) is correct.
 - 1.5.1.7.7 Volume and control dampers (left in a neutral or wide-open position) function properly.
 - 1.5.1.7.8 Verification that duct-leakage test has been performed and ducts are sealed to the minimum tolerance specified in the Contract Documents.
 - 1.5.1.7.9 Verification that all registers, grilles, and diffusers are of the correct type, are properly installed, and are in the open position.
 - 1.5.1.7.10 Verification that all terminal boxes are the correct type and are properly installed according to the manufacturer's recommendations.
 - 1.5.1.7.11 Verification that motors, starters, and variable speed controllers with overload safety devices are the correct size and are operating properly.
 - 1.5.1.7.12 Verification that automatic controls are installed correctly and include all components specified, including interlocks, freeze stats, damper controllers, minimum positioning switches, control valves, actuators, and sensors.
 - 1.5.1.7.13 Verification that hydronic pumps and related components are properly installed and operate correctly.
 - 1.5.1.7.14 Verification that strainers are clean and that the system is vented and free of air.

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- 1.5.1.7.15 Verification that expansion tanks are properly installed and working.
- 1.5.1.7.16 Verification that coils are piped correctly and are clean.
- 1.5.1.7.17 The motor, amps, volts, and rpm, are compared with nameplate data and are adjusted within a motor-rated hp or amperes.
- 1.5.1.7.18 Verification that fan and pump power and speed are within design range.
- 1.5.1.7.19 Verification that the controls are complete and operational.
- 1.5.1.7.20 Verification of the correct type, quantity, and cleanliness of installed filters.
- 1.5.2 During testing and balancing; the respective installing Subcontractor (Division 21, 22 or 23) shall:
 - 1.5.2.1 Operate and maintain all systems requiring balancing during the balancing period.
 - 1.5.2.2 Ensure that the control system responds to the testing and balancing requirements. Provide all necessary personnel, equipment and software to make adjustments to controls as required to achieve design condition.
 - 1.5.2.3 Furnish and install drives and motors as required to accomplish design requirements.
 - 1.5.2.4 Provide all equipment, labour, instruments and incidentals and pay for all power and fuel to carry out the tests.
- 1.5.3 Start-Up Report:
 - 1.5.3.1 The Contractor shall provide a copy of a detailed start-up report, including initial tabulated data required for the start-up of systems, to the test and balance agency for reference in the balancing work.
- 1.5.4 Joint effort of Contractors:
 - 1.5.4.1 Upon completion of balancing, the TAB Subcontractor shall provide flows, pressures, and temperatures to the control contractor for final calibration of the automatic control system. The Division 25 – Integrated Automation Subcontractor shall provide access to computerized data and equipment and/or provide operating personnel.

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1.5.4.2 After balancing, the TAB Subcontractor shall provide water flow rates, etc. to the chiller, cooling tower, and boiler suppliers for final setup and performance verification.

2 **PRODUCTS**

Not Used

3 **EXECUTION**

3.1 GENERAL

3.1.1 TAB work shall be undertaken in accordance with the following descriptions. Procedures not specifically described herein or requiring amplification shall be in accordance with CAABC / NBCTA / NEBB standards, as applicable.

3.2 AIR SYSTEM BALANCING

3.2.1 Air quantities in main ducts shall be measured by Pitot tube traverses of the entire cross section area of the duct. Openings in ducts for Pitot tube insertion shall be sealed with approved plugs. Outlet and inlet air quantities shall be determined in accordance with CAABC / NBCTA / NEBB procedures.

3.2.2 Total air quantities shall be obtained by adjustment of fan speeds. Branch duct air quantities shall be adjusted by volume dampers. Damper positions shall be permanently marked after TAB work is complete.

3.2.3 For systems handling outdoor air, the system shall be balanced at the normal minimum outdoor air condition. Where the system is designed to deliver 100% return air or a variable amount of outdoor air, the total airflow tests shall be repeated for 100% maximum outdoor air and shall agree with conditions measured under minimum outdoor air operation before the system is considered to be in balance.

3.2.4 Adjusting of individual outlets shall be performed as per CAABC / NBCTA / NEBB procedures or as otherwise approved by the Consultant. Outlets shall be set for the air pattern required and all main supply air dampers shall be adjusted and set for the design indicated. All required changes in air patterns or setting necessary to achieve correct air balance and to minimize drafts shall be performed by the TAB Subcontractor.

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- 3.2.5 All measured air quantities shall be within $\pm 5\%$ of design air quantities where achievable.
- 3.2.6 Each Variable Air Volume (VAV), Fan Powered VAV (both Series and Parallel type), and Constant Volume (CV) supply, return air and exhaust terminal unit shall be adjusted to deliver the maximum and minimum air quantities specified in all specified modes of operation. (Use the prescribed procedures for each type terminal device). The individual supply outlets for each zone shall be adjusted after the respective control unit is manually set (Pneumatic and/or Direct Digital Control (DDC)) to design airflow settings (Minimum and Maximum). Factory calibration of all types of VAV and High Velocity Fan Powered/Reheat Units shall be verified and reset as required by the TAB Subcontractor.
- 3.2.7 The TAB Subcontractor shall perform the test and compile the data required. In addition to the tabulation forms, the TAB Subcontractor shall provide schematic diagrams showing all system components cross-referenced to form tabulations. The lists provided hereinafter shall be considered minimum requirements. All information required to prove system balance shall be provided by the TAB Subcontractor.
- 3.2.8 Air Handling Equipment Tests and Data
- 3.2.8.1 Tabulate design conditions from documents and installed conditions from shop drawings:
- 3.2.8.1.1 Fan, unit or system number.
- 3.2.8.1.2 Location.
- 3.2.8.1.3 Area served.
- 3.2.8.1.4 Manufacturer, model and serial number of air unit, motor(s), pulley and belts.
- 3.2.8.1.5 Motor nameplate power (kilowatts), amperage, voltage, phase, hertz, frame type, and service factor.
- 3.2.8.1.6 Sheave Manufacturer, model number, grooves, and pitch diameter, adjustable or fixed. Include pitch diameter settings on adjustable sheaves.
- 3.2.8.1.7 Fan and motor rpm.
- 3.2.8.1.8 Fan or unit static pressure profile. Measure and record pressure

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differentials across coils, filters, dampers, etc.

- 3.2.8.1.9 Total airflow, Outdoor Air, Return Air, Exhaust Air, Relief Air, and Outlet Air (Maximum and Minimum).
- 3.2.8.1.10 Terminal Manufacturer and type.
- 3.2.8.1.11 Outlet or inlet size, effective area and A_k Factor, except when using a direct reading flow hood.
- 3.2.8.1.12 Design temperature differences.
- 3.2.8.1.13 Design brake horsepower (kilowatts).
- 3.2.8.1.14 Check that stratification has been eliminated before taking measurements. Make temperature traverse readings after each mixing compartment. Advise the Division 23 – HVAC Subcontractor if any stratification is present.
- 3.2.8.2 Tabulate from equipment field tests.
 - 3.2.8.2.1 Fan and motor rpm.
 - 3.2.8.2.2 Motor amperage for each phase.
 - 3.2.8.2.3 Voltage for each phase.
- 3.2.8.3 Tabulate from air data from field test (for each required condition).
 - 3.2.8.3.1 Total air quantity for each outlet or inlet and for Supply air, Return Air, Exhaust Air, Relief Air and Outdoor Air for each system.
 - 3.2.8.3.2 Pressure reading at most distant point of system (Pa / mm w.g. for VAV systems only).
 - 3.2.8.3.3 Pressure drops across filters, boxes, coils and air-to-air heat exchangers.
 - 3.2.8.3.4 Supply, Return and Exhaust fan pressure differentials.
 - 3.2.8.3.5 Temperature differences across coils and air-to-air heat exchangers.
 - 3.2.8.3.6 Traverse locations and grid with actual velocities. Record duct static pressure at each traverse location. Provide traverses at all points necessary for balancing.

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3.3 WATER SYSTEM BALANCING

- 3.3.1 Water flows shall be balanced by venturi and calibrated orifices with portable type flow meters, where provided by the respective installing Subcontractor (Division 21, 22 or 23), or calibrated meters provided by the TAB Subcontractor.
- 3.3.2 Pump flow capacities shall be determined by venturies, orifices, or multi-duty valves. All settings of balancing valves shall be permanently marked after balance is complete.
- 3.3.3 The TAB Subcontractor shall compare design documents with the shop drawings. If discrepancies are found, TAB Subcontractor shall submit a request for information to resolve the discrepancies.
- 3.3.4 Pump Test and Data.
 - 3.3.4.1 Tabulate tests and data: (Confirm in field)
 - 3.3.4.1.1 Pump number and service.
 - 3.3.4.1.2 Location.
 - 3.3.4.1.3 Area served and type of system served.
 - 3.3.4.1.4 Manufacturer, model, serial number of pump.
 - 3.3.4.1.5 Motor nameplate power (watts), amperage, voltage, phase, Hertz, frame type and service factor.
 - 3.3.4.1.6 Pump and motor rpm.
 - 3.3.4.1.7 Pump suction and discharge pressure at operating conditions.
 - 3.3.4.1.8 System flow.
 - 3.3.4.2 Tabulate from field tests:
 - 3.3.4.2.1 Pump and motor rpm.
 - 3.3.4.2.2 Motor amperage for each phase.
 - 3.3.4.2.3 Voltage for each phase.
 - 3.3.4.3 Tabulate from pump field test:
 - 3.3.4.3.1 Total flow.

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- 3.3.4.3.2 Discharge and suction pressure for operating and shut off conditions.
- 3.3.5 Heat Transfer Equipment Tests and Data
 - 3.3.5.1 Tabulate design conditions from documents and installed conditions from shop drawings.
 - 3.3.5.1.1 Identification, location and service.
 - 3.3.5.1.2 Transferred heat (kW).
 - 3.3.5.1.3 Manufacturer.
 - 3.3.5.1.4 Model and serial number.
 - 3.3.5.1.5 Pipe size (mm).
 - 3.3.5.1.6 Design pressure differential (kPa / psi) and flow rates (L/s / USgpm).
 - 3.3.5.1.7 Design leaving and entering conditions.
 - 3.3.5.1.8 Type motor used.
 - 3.3.5.2 Tabulate from field tests:
 - 3.3.5.2.1 Pressure differential (kPa / psi).
 - 3.3.5.2.2 Total flow (L/s / USgpm).
 - 3.3.5.2.3 Entering and leaving temperature and conditions.
 - 3.3.5.3 For heating systems where automatic control valves are not used for each radiator or convactor, adjust to equal temperature drop through each unit. Submit the temperature readings taken by contact pyrometer on inlet and outlet pipes to the top and bottom units on each riser.
- 3.3.6 Cooling Tower Test and Tabulations:
 - 3.3.6.1 The tower water distribution system shall be balanced to ensure an even water flow to each tower cell. The fan(s) speed, rotation, motor voltage and amperage shall be checked and recorded.
 - 3.3.6.2 The TAB Subcontractor shall perform tests on cooling towers in accordance with CAABC / NBCTA / NEBB procedures and shall

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provide the following information:

- 3.3.6.2.1 Pump and cooling tower nomenclature.
- 3.3.6.2.2 Size and capacities.
- 3.3.6.2.3 Pump motor and fan motor operating information and characteristics.
- 3.3.6.2.4 Pump flows, discharge head, and Total Dynamic Head (TDH).
- 3.3.6.2.5 Fan airflow and velocities if applicable.
- 3.3.6.2.6 Wet and dry bulb air temperatures of inlet and outlet.
- 3.3.6.2.7 Water temperature of hot water, cold water and make-up water.
- 3.3.7 Boilers and Furnaces
 - 3.3.7.1 For boilers and furnaces, test flue gas using Orsat flue gas analyzer for carbon dioxide, oxygen and carbon monoxide. Measure and record fuel consumption. Perform test at each firing rate.
- 3.3.8 Systems installed with pressure independent control valves shall not require terminal level hydronic system balancing. Total system flow shall be verified to be within +/-10% of system design. 10% of the total installed product shall be randomly checked for individual conformance. Exact locations of tested product to be coordinated with the design engineer. Any individual adjustments for the pressure independent valve assembly (valve and actuator combination) for field conditions shall be performed using the pressure independent control valve manufacturer's documented procedure following the guidelines of CAABC / NBCTA / NEBB.
- 3.4 DEMONSTRATION
 - 3.4.1 At the request of the Consultant, the TAB Subcontractor shall repeat the balancing procedure for any system or portion of a system. The TAB Subcontractor shall repeat the balancing procedure on 10% (as selected by the Consultant) of systems. If the data is within $\pm 5\%$ of the reported data, the system shall be considered acceptable and the report accepted. If the data is not within $\pm 5\%$ of the reported data, the Consultant can request that the entire system or systems be rebalanced.
- 3.5 REPORTS

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- 3.5.1 Submit written reports, during the course of construction, of potential developing problems relating to the work being provided under other sections of the specifications where such problems may adversely affect the proper balancing of the equipment or systems.
- 3.5.2 Submit written reports for review upon completion of each major phase of the balancing work.
- 3.5.3 The TAB Subcontractor shall prepare and submit three (3) copies of the Balancing Report to the Consultant for review and evaluation prior to final acceptance of the project. The Balancing Report shall include the data outlined above, but may be expanded or modified to be compatible with the requirements of the installed equipment and systems.
- 3.5.3.1 The cover of the TAB Report must show the “CAABC / NBCTA / NEBB” Logo, Name and Address of the project, Architect, Mechanical Engineer, Installing Contractor, Date the report is issued, Address and Phone Number of the TAB Subcontractor. The CAABC / NBCTA / NEBB Seal and Signature of the TAB Supervisor who is in charge of the reported project must be submitted on the “Certification” Report Form (TAB 2-98)
- 3.5.3.2 Identification of all types of instruments used and their last dates of calibration shall be submitted with the Final Report.
- 3.5.3.3 Once the Consultant’s comments have been incorporated in the report, submit four (4) copies of the Final Report to the Consultant.
- 3.6 QUALITY ASSURANCE
- 3.6.1 The Tab Subcontractor shall guarantee that all work will be performed in accordance with the applicable CAABC / NBCTA / NEBB Standards and Procedures. The TAB Subcontractor’s Certification Number must be provided to the Consultant.

END OF SECTION

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2.6	Boiler Breeching, Generator Exhaust Pipes and Muffler
2.7	Cold Equipment
2.8	Hot Equipment
3	EXECUTION
3.1	Application

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1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 – General Requirements, shall apply to and govern this Section.

1.1.2 All insulation shall comply with minimum R-value requirements listed in ASHRAE Energy Standard 90.1, 2013 edition.

1.1.3 All insulation materials and installation must meet the requirements of applicable codes and standards, and be appropriately labeled.

1.2 SCOPE OF WORK

1.2.1 Provide all labour, materials, tools, equipment, training, commissioning and certification required to complete the work as shown on the Drawings and specified in this Section, including:

1.2.1.1 Piping insulation.

1.2.1.2 Equipment insulation, including tanks.

1.2.1.3 Breeching insulation.

1.2.1.4 Engine exhaust insulation.

1.2.1.5 Thermal duct insulation.

1.2.1.6 Adhesives, tie wires, tapes.

1.2.1.7 Recovery jackets.

1.3 SUBMITTALS

1.3.1 Submit Shop Drawings for:

1.3.1.1 Insulation products.

1.3.1.2 Recovery jackets.

1.3.1.3 Adhesives and sealants.

1.3.2 Submittal to include product description, manufacturer's installation instructions, and appropriate specification compliance.

1.3.3 Submit samples of all insulation materials to the Consultant mounted on a board, and labeled for intended services, including

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'k' factors. Obtain the Consultant's comments prior to ordering insulation and proceeding with the installation.

1.4 QUALITY ASSURANCE

1.4.1 Glass mineral wool insulation products to have UL GREENGUARD Gold Certification and be formaldehyde free as certified by UL Environment; whenever possible.

1.4.2 Products shall contain no polybrominated diphenyl ethers (PBDE) such as Penta-BDE, Octa-BDE or Deca-BDE fire retardants.

1.4.3 The Contractor shall take precaution to protect insulation materials from moisture exposure or physical damage. Any glass mineral wool insulation that becomes wet or damaged shall be replaced at no additional cost.

1.4.3.1 HVAC ductwork insulation used in the air stream must be discarded if exposed to liquid water.

1.4.3.2 Pipe insulation with factory applied all service jacket with self-sealing lap (ASJ+) facing having been installed per manufacturer's installation recommendation which may experience intermittent exposure to liquid water after installation may be exempted from removal and replacement requirements.

2 **PRODUCTS**

2.1 INSULATION MATERIAL

2.1.1 Unless otherwise noted, insulating materials are based on Knauf Fiber Glass GmbH.

2.1.2 All insulation materials, adhesive sealants and coatings, shall be ULC listed, non-hygroscopic, and mould-proof. Insulation products shall not contain asbestos, lead, mercury, mercury compounds, or formaldehyde.

2.1.3 All insulation system materials inside the building must meet the requirements of NFPA 90A, with a flame spread rating of less than 25, and smoke developed rating of less than 50, when tested in accordance with CAN/ULC-S102. Insulation materials shall not flame, smolder, glow or smoke at their service temperatures.

2.1.4 Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795. Insulation materials applied to carbon steel shall be Mass Load Corrosion

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Rate (MLCR) tested per ASTM C 1617.

- 2.1.5 Pipe insulation: Knauf Earthwool™ 1000° glass mineral wool pipe insulation, UL/ULc classified, rigid, molded, k value: 0.033 (0.23) at 24°C (75°F) mean temperature; 0.049 (0.34) at 149°C (300°F) mean temperature. Maximum service temperature 538°C (1000°F). Vapor retarder jacket: ASJ+ conforming to ASTM C 1136 Type I, II, III, IV, & VIII secured with self-sealing longitudinal laps and matching ASJ+ butt strips.
- 2.1.6 Semi-rigid pipe and tank insulation: Knauf Pipe & Tank glass mineral wool insulation, limited combustible, k value: 0.036 (0.25) at 24°C (75°F) mean temperature. Maximum service temperature 454°C (850°F). Compressive strength: not less than 5.75 kPa (120 PSF) @ 10% deformation per ASTM C 165. Vapor retarder jacket: ASJ conforming to ASTM C 1136 Type II.
- 2.1.7 Semi-rigid blanket for equipment: Knauf KwikFlex™ glass mineral wool; in roll form, k value: 0.035 (0.24) at 24°C (75°F) mean temperature; 0.056 (0.39) at 149°C (300°F) mean temperature. Maximum service temperature 454°C (850°F), maximum surface temperature for faced product: 66°C (150°F), maximum thickness @ 454°C (850°F): 102mm (4"). Compressive strength: not less than 1.2 kPa (25 PSF) @ 10% deformation per ASTM C 165. Vapor retarder jacket: ASJ, FSK or PSK conforming to ASTM E 96, Procedure A.
- 2.1.8 Fitting insulation: insulate using pre-formed PVC fitting covers with glass mineral wool inserts. Alternatively, preformed molded, formaldehyde free glass mineral wool; minimum 50% post-consumer recycled glass content, or mitered glass mineral wool pipe insulation sections. These fittings shall be further protected by field-applied PVC fitting covers, metal fitting covers, or glass fabric and mastic sealed as necessary.
- 2.1.9 Duct wrap: Knauf Friendly Feel® glass mineral wool blanket; flexible, limited combustible, k value: 0.042 (0.29) at 24°C (75°F) mean temperature. Maximum service temperature: faced 121°C (250°F), unfaced 177°C (350°F). Maximum allowable compression is 25%. Density: concealed areas: minimum 12 kg/m³ (0.75 PCF); exposed areas: minimum 16 kg/m³ (1.0 PCF). Vapor retarder jacket: FSK or PSK conforming to ASTM C 1136 Type II.
- 2.1.10 Rigid duct insulation: Knauf Insulation Board, rigid glass mineral wool board. Maximum service temperature 232°C (450°F). Concealed areas: Density: Minimum 48 kg/m³ (3 PCF). k value:

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0.033 (0.23) at 24°C (75°F) mean temperature. Vapor retarder jacket: ASJ conforming to ASTM C 1136 Type I, or FSK or PSK conforming to ASTM C 1136 Type II.

Exposed Areas: Density: Minimum 96 kg/m³ (6 PCF). k value: 0.032 (0.22) at 24°C (75°F) mean temperature. Vapor retarder jacket: ASJ conforming to ASTM C 1136 Type I, or FSK or PSK conforming to ASTM C 1136 Type II in combination with protective jacket where necessary.

2.1.11 Factory applied jackets:

2.1.11.1 All service jacket with advanced closure system self-sealing lap (ASJ+). All service jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film layer leaving no paper exposed.; conforming to ASTM C 1136 Type I, II, III, IV, and VIII; vapor retarder; with a self-sealing adhesive.

2.1.11.2 All service jacket (ASJ). White kraft paper bonded to aluminum foil and reinforced with glass fibers; conforming to ASTM C 1136; vapor retarder.

2.1.11.3 Foil scrim kraft (FSK). Aluminum foil, fiberglass reinforced scrim with kraft backing; conforming to ASTM C 1136 Type 1; vapor retarder.

2.1.11.4 Poly scrim kraft (PSK). Metalized polypropylene, fiberglass reinforced scrim with kraft backing; conforming to ASTM C 1136 Type 1; vapor retarder.

2.1.11.5 Redi-Klad Jacket: VentureClad 5-ply weather and abuse resistant with self-seal lap, zero permeability per ASTM E 96-05; puncture resistance 35.4 kg (189.3 N) per ASTM D 1000; tear strength 19.4 N (4.3 lbs) per ASTM D 624; thickness 14.5 mils (0.0145"); tensile strength 306 N (31 kg)/25 mm (68.0 lb./inch) width.

2.1.12 Field applied jackets:

2.1.12.1 PVC: Proto Corporation 25/50 or Indoor/Outdoor, UV resistant fittings, jacketing and accessories, white or colored. Fitting cover system consists of pre-molded, high-impact PVC materials with glass mineral wool inserts. Glass mineral wool insert has a thermal conductivity (k value) of 0.037 (0.26) at 24°C (75°F) mean temperature. Closures: stainless steel tacks, matching PVC tape, or PVC adhesive per manufacturer's recommendations.

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- 2.1.12.2 Aluminum Jacket: Alloy 3003 or 3105, minimum thickness per ASTM C 1729, smooth, corrugated or stucco embossed with factory-applied moisture barrier. Overlap shall be 50mm (2 inch) minimum. Jacket shall be banded in place with 12mm x 5mm (½" x 0.20") aluminum strapping fastened with aluminum wing seals.
- 2.1.12.3 Stainless Steel Jacket: T-304, minimum per ASTM C 1729, smooth, corrugated or embossed with factory-applied moisture barrier. Overlap shall be 50mm (2 inch) minimum. Jacket shall be banded in place with 10mm x 5mm (⅜" x 0.20") aluminum strapping fastened with stainless steel wing seals.
- 2.1.12.4 Laminated Self-Adhesive Water and Weather Seals: permanent acrylic self-adhesive system; weather resistant, high puncture and tear resistance; meeting or exceeding requirements of UL 723; and applied in strict accordance with manufacturers' recommendations.
- 2.1.12.5 Canvas jackets: 1.83kg/m2 (6oz./sq.ft) plain weave cotton fabric sealed with dilute fire retardant, waterproof, ULC listed lagging adhesive.
- 2.1.13 Jacketing for outdoor ductwork
- 2.1.13.1 Aluminum Jacket: 0.406mm (0.016 inch) thick in smooth, corrugated, or embossed finish with factory applied moisture barrier. Overlap shall be 50mm (2 inch) minimum.
- 2.1.13.2 PVC Jacket: Proto Corporation Indoor/Outdoor, UV resistant, white. Closure shall be solvent weld adhesive or per manufacturers' recommendations.
- 2.1.13.3 Laminated Self-Adhesive Water and Weather Seals: applied per manufacturer's recommendations.
- 2.1.14 Mastics:
- 2.1.14.1 Vapor Retarder Mastics: Knauf Insulation EXPERT Mastics: KI-900 ASJ or KI-905 ASJ+; water vapor permeance:, 0.026 metric perm (0.04 perm) at 40 mil dry film thickness. Service Temperature Range: -29°C to 82.2°C (-20°F to 180°F). Color: White
- 2.1.15 Weather Barrier Mastics: Knauf Insulation EXPERT Mastics: KI-700 ASJ or KI-705 ASJ+; water vapor permeance:, 1.2 metric perm (1.8 perm). Service Temperature: -17.8°C to 82.2°C (0°F to 180°F) constant; -29°C to 93°C (-20°F to 200°F) intermittent.

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Solids: 58% by weight; 50% by volume. Color: White

2.1.16 Tapes:

2.1.16.1 ASJ Tape: Knauf Insulation EXPERT ASJ Tape or ASJ+ Tape. Width: 75mm (3 inches) or 102mm (4 inches). Thickness (Total): 0.36 mm (14.3 mil) – ASJ; 0.34mm (13.3 mil) – ASJ+. Adhesion: >840 N/m (4.8 Lbf / in.)

2.1.16.2 FSK Tape: Knauf Insulation EXPERT FSK Tape. Width: 75mm (3 inches) or 102mm (4 inches). Thickness (Total): 0.34mm (13.3 mil). Adhesion: 1,138 N/m (6.5 Lbf / in.)

2.1.16.3 Aluminum Foil Tape: Knauf Insulation EXPERT 2 Mil Foil Tape. Width: 75mm (3 inches) or 102mm (4 inches). Thickness (Total): 0.19mm (7.3 mil). Adhesion: 700 N/m (4.0 Lbf / in.)

2.2 APPLICATION

2.2.1 The following areas are designated as “exposed” where the term is applied to covering:

2.2.1.1 Mechanical and electrical equipment rooms, penthouses, parking garage, loading dock, shipping/receiving areas.

2.2.1.2 Mechanical plenum spaces.

2.2.1.3 Below suspended ceiling level in occupied areas or below slab where no ceiling occurs.

2.2.1.4 Duct shafts and/or pipe shafts serviced via “walk-in” type access doors.

2.2.1.5 Crawl spaces, tunnels.

2.2.2 Cover duct and pipes exposed to weather or dampness with 75mm (3”) thick insulation and a final application of tape adequately overlapped to render it water tight. The following areas are designated as “exposed to weather or dampness” and are applicable for this treatment:

2.2.2.1 Air intake, relief, and exhaust plenums directly connected to the outside of the building.

2.2.2.2 Underground service trenches.

2.2.2.3 Buried below ground level.

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2.2.2.4 Areas subject to high humidity.

2.2.2.5 Ductwork and piping exposed on the roof.

2.3 COLD PIPING

2.3.1 Cover 'cold' piping (operating temperature below 16°C/61°F) with rigid pipe insulation with factory applied vapour barrier jacket and aluminum foil vapour barrier with self-sealed lap. Butt joints sealed with butt strips or aluminum tape. Recover pipe in exposed areas with field applied jacket.

2.3.2 Insulation thickness shall be as follows:

- 2.3.2.1 25mm (1")
- unburied domestic cold water piping
 - chilled drinking water

 - unburied apparatus drains

 - horizontal unburied rain water piping, including the piping up to and including roof hoppers or drain fixtures

 - horizontal unburied sanitary drains

 - cast iron fittings on transite rainwater piping

 - gray water piping

 - fire standpipe, wet sprinkler and drainage piping in loading dock, parking garage and other unheated areas

 - refrigerant suction piping

 - auxiliary water piping on refrigeration compressors

 - cooling tower make-up water, overflow, bleed and drain pipes inside and outside building

 - chilled water/glycol supply and return at 5°C (41°F) and above

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- condenser water used for low temperature cooling (water side free cooling) inside building

2.3.2.2 40mm (1-½") - chilled water/glycol supply and return below 4°C (39°F) for pipes equal to or greater than DN200 (8") dia.

2.3.2.3 40mm (1-½") - chilled water/glycol supply and return below 5°C (41°F) for pipes greater than DN25 (1") dia.

2.3.2.4 50mm (2") - electrically traced piping, including drum drips of dry sprinkler system

2.3.3 Cover 'cold' piping running outside the building envelope with insulation thickness as follows:

2.3.3.1 65mm (2-½") - pipes up to and including DN50 (2") dia.

2.3.3.2 80mm (3") - pipes DN65 (2-½") up to and including DN100 (4") dia.

2.3.3.3 90mm (3-½") - pipes above DN100 (4") dia.

2.3.4 In lieu of the above specified insulation, Armstrong AP/Armaflex flexible elastomeric expanded closed-cell insulation with same thickness may be substituted for the following services:

- horizontal unburied rain water piping, including the piping up to and including roof hoppers or drain fixtures

- horizontal unburied sanitary drains

- refrigerant suction piping, 16mm (5/8") thickness

- auxiliary water piping on refrigeration

compressors

2.4 HOT PIPING

2.4.1 Cover 'hot' piping – heating water/glycol, domestic hot water supply and recirculation, condenser water, hot-gas bypass, drip and blowdown lines, steam and condensate, at operating temperatures above 41°C/106°F – with rigid pipe insulation with

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factory applied kraft paper jacket bonded to aluminum foil vapour barrier with self-sealed lap. Hold insulation in place with flare type staples. Recover pipe in exposed areas with field applied jacket.

2.4.2 Insulation thickness shall be as follows:

- 2.4.2.1 25mm (1") - 'hot' piping up to 60°C (140°F) operating temperature, for pipes less than or equal to 100mm (4") dia.
- 'hot' piping up to 93°C (180°F) operating temperature, for pipes less than or equal to 50mm (2") dia.
- 2.4.2.2 40mm (1-½") - 'hot' piping up to 60°C (140°F) operating temperature, greater than 100mm (4") dia.
- 'hot' piping up to 93°C (180°F) operating temperature, greater than 50mm (2") dia.
- 'hot' piping up to 121°C (250°F) operating temperature, less than or equal to 50mm (2") dia.
- 2.4.2.3 50mm (2") - 'hot' piping up to 121°C (250°F) operating temperature, greater than 50mm (2") dia.
- electrically traced piping

2.4.3 Cover 'hot' piping running outside the building envelope with insulation thickness as follows:

- 2.4.3.1 65mm (2-½") - pipes up to and including DN50 (2") dia.
- 2.4.3.2 80mm (3") - pipes DN65 (2-½") up to and including DN100 (4") dia.
- 2.4.3.3 90mm (3-½") - pipes above DN100 (4") dia.

2.5 DUCTS

2.5.1 Insulate round supply ducts up to 750mm (30") diameter and rectangular supply ducts up to 750mm (30") width with 25mm (1") thick flexible duct insulation. Adhere insulation to duct surface with adhesive applied in strips 150mm (6") wide on 300mm (12") centres. Use fiberglass tying cord or 16 gauge annealed wire until the adhesive sets. Butt edges of insulation tightly together, and

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seal all breaks and joints with self-adhering aluminum tape.

- 2.5.2 Insulate round supply ducts over 750mm (30") diameter and rectangular supply ducts over 750mm (30") width with 25mm (1") thick rigid duct insulation board. Fasten the insulation with welded pins and speed washers on maximum 300mm (12") centres. Use a minimum of two (2) rows of fasteners per side. Butt edges of insulation tightly together, and seal all breaks and joints with self-adhering aluminum tape.
- 2.5.3 Where angles or standing seams extend beyond the insulation and before the final finish, apply a compressed layer of 25mm (1") flexible duct insulation over the angles and standing seams. Extend the insulation 75mm (3") on each side of the angle and place tightly around the projecting leg of the angle. Apply the insulation overlapping the edge so that the vertical part of the insulated angle will project throughout the work.
- 2.5.4 Where interior acoustic insulation is required, decrease the exterior insulation by equal thickness. Overlap the exterior insulation by at least 300mm (12"), upstream and downstream.
- 2.5.5 Apply vapour barrier over insulation on cold and dual temperature ducts.
- 2.5.6 Insulate all ductwork running outside the building with 75mm (3") rigid board insulation and weatherproof jacket.
- 2.5.7 Insulate the following duct:
 - 2.5.7.1 Air conditioning supply ducts from apparatus casings to air terminal control units, reheat coils, or duct termination.
 - 2.5.7.2 Tempered air supply ducts in unheated space.
 - 2.5.7.3 Air supply duct downstream of energy/heat recovery ventilators.
 - 2.5.7.4 All rigid supply ducts downstream from air terminal control units, reheat coils and hydronic terminal units.
- 2.5.8 Air intakes and exhaust:
 - 2.5.8.1 Insulate with rigid vapour seal insulation board.
 - 2.5.8.2 Impale the insulation in place with suitable speed washers or clips. Where angles or standing seams extend beyond the insulation, apply a compressed layer of 25mm (1") flexible duct wrap over the

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angles and standing seams. The wrap shall extend 75mm (3") on each side of the angle and placed tightly around the projecting leg of the angle. Apply the insulation overlapping the edge of the wrap on the angle so that the vertical part of the insulated angle will project throughout the work.

- 2.5.8.3 Seal all breaks and joints by adhering a 75mm (3") aluminum foil vapour barrier tape with fire retardant adhesive. Cover with canvas adhered with resin base lagging adhesive. Finish with one coat of the same lagging adhesive.
- 2.5.8.4 Insulate the following intakes and exhaust:
 - 2.5.8.4.1 All outdoor air intake ductwork from outside louvres to air handling units.
 - 2.5.8.4.2 All exhaust and relief ductwork from outside louvres to 1.5m (5 ft) upstream of motorized dampers or where there are no motorized dampers, from louvre to fan discharge in 50mm (2") thickness.
 - 2.5.8.4.3 All exhaust and relief ductwork from outside louvres to heat recovery units located inside mechanical spaces/rooms in 50mm (2") thickness.
 - 2.5.8.4.4 All exhaust and relief ductwork from outside louvres to energy/heat recovery ventilators inside ceiling bulkheads and spaces in 40mm (1-1/2") thickness.
 - 2.5.8.4.5 Mixed air plenums in 50mm (2") thickness.
 - 2.5.8.4.6 Behind unused portion of louvers in 50mm (2") thickness.
- 2.5.9 Ensure that access doors of casings and plenums are supplied pre-insulated. Do not apply additional insulation.
- 2.6 BOILER BREECHING, GENERATOR EXHAUST PIPES AND MUFFLER
 - 2.6.1 Up to 482°C (900°F) operating temperature: Cover uninsulated boiler breeching, generator exhaust pipes and muffler with 128 kg/m³ (8.0 lb/ft³) density, 50mm (2") thick Roxul ProRox PS 960 pre-formed mineral fiber pipe insulation. For irregular shapes, use 50mm (2") thick Roxul MA 940 high temperature rated mineral fiber flexible wrap insulation.
 - 2.6.2 Between 482°C (900°F) and 650°C (1,200°F) operating temperature: Use the same insulation types as noted under **Error!**

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Reference source not found. however in 75mm (3") thickness.

2.6.3 Between 650°C (1,200°F) and 1,093°C (2,000°F) operating temperature: Cover uninsulated boiler breeching, generator exhaust pipes and muffler with 96 kg/m³ (6.0 lb/ft³), 25mm (1") thick Morgan Thermal Ceramics model Kaowool S ceramic fiber blanket insulation. Outside the blanket, apply 128 kg/m³ (8.0 lb/ft³) density Roxul ProRox PS 960 pre-formed mineral fiber pipe insulation in 50mm (2") thickness.

2.7 COLD EQUIPMENT

2.7.1 Cover 'cold' equipment with 25mm (1") thick Armstrong AP/Armaflex flexible elastomeric expanded closed-cell insulation. Apply to clean and dry surfaces, using 100% Armstrong 520 adhesive coverage on both surfaces to be joined. Use manufacturer's compression fit method of butt joining sheets.

2.7.2 Insulate the following equipment as 'cold' equipment. Finish insulation with two coats of Armaflex Finish. Color selection to be determined.

2.7.2.1 Refrigeration machine evaporators, suction lines, chiller shells, shell ends and sumps, except pre-insulated units

2.7.2.2 Water meters and irregular shapes.

2.7.2.3 Strainer heads in cold lines.

2.7.2.4 Cold water booster pumps.

2.7.2.5 Condensation trays.

2.7.2.6 Spray pumps, piping, valves, and fittings.

2.7.2.7 Flat plate heat exchangers.

2.7.3 Provide removable 1.3mm (16 ga.) aluminum sheet metal enclosure with insulation applied as above to inside of cover, for the following 'cold' equipment:

2.7.3.1 Chilled water pumps

2.7.3.2 Chilled water pump suction and discharge guides

2.7.3.3 Condenser water pumps

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- 2.7.3.4 Condenser water pump suction and discharge guides
- 2.7.4 Cover cooling tower sumps (if electrically traced) with 50mm (2") thick semi-rigid fiberglass board insulation with factory applied vapour barrier. Cut and mitre insulation to suit surface contours. Impale insulation on mechanically fastened pins, located at not greater than 300mm (12") centres. Apply expanded metal lath and lace edges with 1.63mm (16 ga.) galvanized annealed wire. Secure insulation and metal lath with speed washers.
 - 2.7.4.1 Recover sumps with 0.5mm (24 ga.) thick sheet aluminum fabricated to the shape of the sump. Mechanically fasten in place with bands, sheet metal screws or pop rivets. All corners shall be square and raw metal edges concealed.
- 2.7.5 Under each dehumidifier and cooling coil drip pan, place 50mm (2") thick foam glass with all joints sealed with cold adhesive cement.
- 2.7.6 Cover chilled water storage tanks with 50mm (2") thick rigid fiberglass board insulation, scored to suit curved surface. Impale insulation on suitable welded fasteners on 300mm (12") centres secured in place with speed washers. Recover with field applied jacket.
- 2.8 HOT EQUIPMENT
 - 2.8.1 Cover 'hot' equipment (for temperatures not exceeding 232°C/450°F) with 50mm (2") thick semi-rigid fiberglass board insulation. The insulation shall be held in place with 19mm (¾") metal bands on maximum 450mm (18") centres. For large, flat or irregular surfaces, impale the insulation over suitable welded fasteners on 300mm (12") centres secured in place with speed washers. Lace the metal edges that butt together with 1.63mm (16 ga.) galvanized annealed wire. Insulation shall not be compressed beyond a maximum of 5% at any point. Recover with field applied jacket.
 - 2.8.2 Insulate the following equipment as 'hot' equipment:
 - 2.8.2.1 Converters, shell and tube heat exchangers (including glycol).
 - 2.8.2.2 Domestic hot water tanks and water heaters except pre-insulated units.
 - 2.8.2.3 Refrigeration condensers, except pre-insulated units.

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2.8.2.4 Steam ancillaries.

2.8.3 Insulate flat plate heat exchangers with 25mm (1") thick Armaflex insulation. Refer to Paragraph 2.7.1 for details.

3 **EXECUTION**

3.1 APPLICATION

3.1.1 Do not apply insulation before piping ductwork and equipment has been tested and accepted.

3.1.2 All insulation shall be supplied and installed by a qualified insulation applicator in accordance with the latest MICA Commercial and Industrial Insulation Standard.

3.1.3 All insulation shall be applied in full accordance with the insulation manufacturer's recommendations, and shall present a neat professional appearance upon completion.

3.1.4 Apply all insulation in a manner to facilitate replacing and/or servicing of equipment. All insulation for equipment shall be removable and reusable.

3.1.5 Use insulation, wrapping, vapour barriers and adhesive materials having flame spread, fuel contributed and smoke developed ratings in accordance with rulings and regulations of authorities. Follow all rules, regulations, and instructions of the Fire Marshall's office and all authorities having jurisdiction.

3.1.6 Do not apply any insulation or finishing when the ambient temperature in the space is less than 10°C (50°F).

3.1.7 Apply insulation only on clean and dry surfaces.

3.1.8 On cold surfaces where a vapor seal must be maintained, insulation shall be applied with a continuous, unbroken moisture and vapor retarder. All hangers, supports, anchors, or other projections secured to cold surfaces shall be insulated and vapor sealed to prevent condensation. Wheatpaste must not be used.

3.1.9 All pipe insulation shall be continuous through walls, ceiling or floor openings or sleeves except where firestop materials are required.

3.1.10 Install multiple layers of insulation with longitudinal and circumferential joints staggered.

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- 3.1.11 Galvanized sheet metal shields, minimum 250mm (10") long and 1.3mm (18 gauge) thickness, shall be installed between hangers or supports and the piping insulation. Rigid insulation inserts shall be installed as required between the pipe and the insulation shields. Inserts shall be of equal thickness to the adjacent insulation and shall be vapor sealed as required. Inserts made of wood are not acceptable. Insulation inserts shall be no less than the following lengths:
- 3.1.11.1 40mm (1½") to 65mm (2½") IPS 250mm (10") long
- 3.1.11.2 75mm (3") to 150mm (6") IPS 300mm (12") long
- 3.1.11.3 200mm (8") to 250mm (10") IPS 400mm (16") long
- 3.1.11.4 300mm (12") and over IPS 550mm (22") long
- 3.1.12 For piping, ductwork or equipment exposed in mechanical rooms or high traffic areas, insulation shall be protected from abuse by the use of appropriate thickness of PVC jacketing, metal jacketing or laminated self-adhesive water and weather seals.
- 3.1.13 On boiler breeching, generator exhaust pipes and mufflers stagger half sections and butt one-piece sections firmly together. Recover insulation with glassfiber cloth, adhered with fire retardant and high temperature rated adhesive. Insulation shall be banded securely in place with 20mm x 0.5mm (¾" x 0.02") stainless steel bands on maximum 300mm (12") centres and recovered with metal jacketing secured using additional banding or sheet metal screws. Position bands at butt joint overlaps and in between joints to secure jacket.
- 3.1.14 Insulate over flanges and mechanical couplings with specified insulation and thickness, sized to suit flange diameters. Fill spaces between insulation and adjoining pipe insulation with similar material. Recover in exposed areas with canvas or PVC jackets.
- 3.1.15 If not using preformed insulation, wrap all valves and inline components in cold piping and in hot piping above 60°C (140°F) operating temperature with flexible duct insulation, under compression at 2 to 1 ratio. Recover in exposed areas with field applied jackets.
- 3.1.16 Cover the first 150mm (6") of hanger rods directly connected to cold piping, with block or sectional insulation. Finish to match jacket on piping. Recover in exposed areas with canvas jacket.

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- 3.1.17 Cover all insulated electrically traced piping, and all insulated piping, ductwork or equipment exposed to the outside with weatherproof field applied jacket.
- 3.1.18 Insulate all silencer casings where no internal media contacts wall.
- 3.1.19 All aluminum and PVC recovery jackets shall be removable and reusable.
- 3.1.20 Dampers, supports, anchors, etc. that are secured directly to cold surfaces must be adequately insulated and vapour sealed to prevent condensation.
- 3.1.21 Cover expansion joints first with a 0.7mm (24 gauge) galvanized metal sleeve and then insulate to provide equivalent thickness to that on adjoining pipe.
- 3.1.22 Ensure insulation is continuous through non-fire rated walls and floors. Terminate insulation neatly on either side of a fire rated barrier. Fill space between pipe and construction with fire retardant sealant. Insulation or recovery jacket shall not penetrate fire-rated construction.
 - 3.1.22.1 Outdoor ductwork or insulation shall be installed so as to shed water and not allow standing water.
- 3.1.23 Insulate electrically traced piping and equipment only after pipe tracing has been installed and tested.
- 3.1.24 Repair/replace all insulation damaged during construction with the thickness, quality, and finish of original insulation.
- 3.1.25 Make good and refinish cracks, undulation or any other deficiencies occurring in the insulation or vapour barrier. Priming or painting of insulation will be done under Division 9 – Finishes.

END OF SECTION



DIVISION 21 – FIRE SUPPRESSION
SPECIFICATIONS
FOR THE
CITY OF TORONTO - DAYCARE CENTRE (METRO HALL)
55 JOHN STREET
TORONTO, ONTARIO

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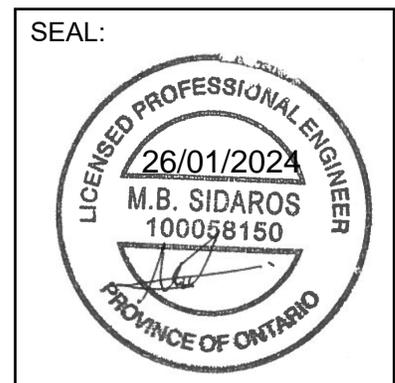
Our Project No. 2021-0245

Issued for Approval
Design Development

January 26, 2024

DISCIPLINES MECHANICAL
ELECTRICAL
PLUMBING
LIGHTING DESIGN
COMMUNICATIONS & AV
SECURITY & RISK
COMMISSIONING
ENERGY SERVICES

SEAL:



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Section 21 13 00	Sprinkler Systems

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Section Name: **Fire Protection Valves**
Section No.: **21 05 23**
Date: January 26, 2024

1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 - General Requirements, shall apply to and govern this Section.

1.2 SHOP DRAWINGS

1.2.1 Submit shop drawings for all fire protection valves.

2 **PRODUCTS**

2.1 GENERAL

2.1.1 All valves to be used on the fire protection system shall be approved by Underwriters Laboratories of Canada or Associated Factory Mutual Fire Assurance companies and shall bear identifying mark or label such as F.M., U.L.C., and I.A.O.

2.2 VALVES

2.2.1 Gate Valves

2.2.1.1 Up to DN50 (2") – shall be bronze O.S. & Y, rising spindle, double disc, 1,379kPa (200 psi).

Threaded ends - Jenkins Fig. 820J.

2.2.1.2 DN65 (2-½") and up – shall be iron body to ASTM A126-95 Class B, bronze mounted, O.S.&Y. solid wedge, rising spindle, double disc, flanged ends, 1,379kPa (200 psi) water, oil and gas.

2.2.1.3 Grooved end gate valves, DN65 (2-½") and up, shall be ductile iron body to ASTM A536, Grade 65-45-12, bronze mounted, O.S.&Y. resilient wedge, brass rising stem, cast iron, EPDM coated disc, grooved ends, 1725kPa (250 psi) CWP. Victaulic FireLock Series 771.

2.2.2 Butterfly Valves

2.2.2.1 DN65 (2-½") and up – shall be ductile iron body to ASTM A536, Grade 65-45-12, ductile iron disc with EPDM coating, weatherproof actuator with pre-wired supervisory switches, grooved ends, 2,065kPa (300 psi) CWP. Victaulic FireLock Series 705W.

2.2.3 Ball Valves

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2.2.3.1 Up to DN50 (2") – shall be bronze body, standard port, chrome-plated brass ball, stainless steel stem, TFE seats, grooved or threaded ends with brass gear box. Victaulic FireLock Series 728.

2.2.4 Check Valves

2.2.4.1 DN65 (2-½") and up – shall be iron body to ASTM A126-95 Class B, bronze mounted, swing check with renewable bronze disc and seat ring.

Flanged ends - Jenkins Fig. 477J
- Mueller 101M-AP

Valves on Siamese connection to have rubber faced disc.

Flanged ends - Jenkins Fig. 477J RD

2.2.4.2 Grooved end check valves, DN65 (2 ½") and up, shall be ductile iron body to ASTM A-536, Grade 65-45-12, non-slam aluminum bronze or elastomer coated ductile iron disc, stainless steel spring and shaft, PPS coated or welded-in nickel seat, grooved ends. Victaulic FireLock Series 717 or 717R.

2.3 ELECTRICAL SUPERVISION

2.3.1 Install supervisory switches on all system shutoff valves, suitable for operation with building fire alarm system. For OS & Y valves, switches shall be ULC, FM Potter OSYSU-A1 or OSYSI-A2 as required. All butterfly valves shall be factory assembled with ULC listed and FM approved internal monitor switches, one single-pole double-throw or two single-pole double-throw switches as required. Switches shall be installed inside the gearbox and preset at the factory.

2.3.2 Where it is impractical to use one of the switches described above (i.e., for drain valves, etc.), use Potter PMS type or System Sensor switches.

2.3.3 Wiring of valve monitors to annunciator panel shall be by Division 26 - Electrical.

3 **EXECUTION**

3.1 GENERAL

3.1.1 Valves shall be same size as line in which installed.

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- 3.1.2 Valves shall be located in such a manner that the top works, operators, and bonnets may be easily removed.
- 3.1.3 Stems of valves shall be positioned for maximum ease of use, but in no event in a manner causing a hazard, or with stem down unless specifically shown as such in the Contract Documents.
- 3.1.4 Provide valves where shown on the Drawings, or on schematic diagrams, or in details, or as specified.
- 3.2 VALVES
- 3.2.1 Provide valves on all mains and sub-mains to completely control, shut off and drain the system.
- 3.2.2 Provide all necessary drips and drains to completely empty the system.
- 3.2.3 Provide all necessary test and flushing connections. Provide sight flow connections where flow cannot be seen from shut-off valve location. Install chain operators and chains on valves 1.8m (6 ft.) or higher above floor. Keep chains out of working areas or ceilings.
- 3.2.4 Install a shut-off valve on each riser.
- 3.2.5 Shut-off valves upstream of fire pumps shall be supervised O.S.&Y. gate valves.

END OF SECTION

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1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 – General Requirements, shall apply to and govern this Section.

1.2 SCOPE OF WORK

1.2.1 Provide all labour, materials, tools, equipment, training, commissioning and certification required to complete the Work as shown on the Drawings and specified in this Section, including:

1.2.1.1 Complete fire standpipe piping system.

1.2.1.2 Connection to onsite fire hydrant, and connection to municipal water supply.

1.2.1.3 Provision of flanged connection for sprinkler systems.

1.2.2 Complete sprinkler system including piping will be provided under Section 21 13 00 – Sprinkler Systems.

1.3 REGULATORY REQUIREMENTS

1.3.1 In addition to specific requirements for pipe fittings as further specified in this document and where applicable, the equipment shall comply with the Boiler and Pressure Vessels Act and CSA Standard B51.

1.3.2 In compliance with the Act and relevant Codes, all fittings shall be registered by the manufacturer, and shall be identified by the appropriate Canadian registration number.

1.3.3 Where fittings are provided without the appropriate Canadian registration number, the Contractor shall obtain a copy of the manufacturer's Statutory Declaration as provided to the authorities having jurisdiction.

1.3.4 All welding and fabrication shall be to the requirements of the ANSI/ASME B31.1 code for pressure piping and CSA standard B51 code for the Construction and Inspection of Boilers and Pressure Vessels.

2 **PRODUCTS**

2.1 PIPES AND FITTINGS

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- 2.1.1 For 860 kPa (125 psi) or less operating pressure use 860 kPa (125 psi) rated fittings. For 860 kPa to 1,730 kPa (125 psi to 250 psi) operating pressure use 1,730 kPa (250 psi) rated fittings.
- 2.1.2 Piping shall be Schedule 40 ASTM-A53 with screwed fittings up to 65mm (2-1/2") dia. and Schedule 40 standard steel butt-welding fittings for 75mm (3") dia. pipe and above. Where approved by the Authorities, lightwall piping may be used for piping of 50mm (2") dia. and over.
- 2.1.3 Mechanical couplings such as Victaulic may be used. Couplings shall be ULC listed and FM approved.
 - 2.1.3.1 All couplings shall be by one manufacturer, suitable for pressure and temperature of respective system.
 - 2.1.3.2 Mechanical couplings shall consist of two ASTM A536 ductile iron housings, pressure-responsive synthetic rubber gasket (grade to suit the intended service) and plated steel bolts and nuts.
 - 2.1.3.3 Rigid Type Couplings: Housings shall be cast with offsetting, angle-pattern bolt pads to provide system rigidity and support and hanging in accordance with NFPA 13. Tongue and recess rigid type couplings shall only be permitted if the Subcontractor uses a torque wrench for installation. Required torque shall be in accordance with the manufacturer's recommendations. The Subcontractor shall remove and replace any improperly installed joints.
 - 2.1.3.3.1 DN30 – DN100 (1-1/4" thru 4"): "Installation Ready" rigid type coupling designed for direct "stab" installation onto grooved end pipe without prior disassembly of the coupling equal to Victaulic FireLock® EZ Style 009.
 - 2.1.3.3.2 DN125 (5") and larger: standard rigid joint, Victaulic FireLock® Style 005 or Style 07 Zero-Flex®.
 - 2.1.3.4 Flexible type couplings: use in seismic areas where required by NFPA 13. Victaulic Style 75 or 77.
 - 2.1.3.5 Grooved end fittings: ASTM A536 ductile iron, short radius, full flow (FireLock®), or standard ASTM A536 ductile iron, forged steel or ASTM A53 fabricated carbon steel fittings, factory grooved, designed to accept grooved end couplings.
 - 2.1.3.6 Grooved joint flange adapters: ASTM A536 ductile iron casting,

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flat faced, for incorporating flanged components with ANSI Class 125, 150 and 300 bolt-hole patterns to a grooved system. Victaulic Style 741, 743 or 744.

3 EXECUTION

3.1 GENERAL

- 3.1.1 Piping shall be installed in accordance with NFPA-20.
- 3.1.2 Ream all piping and keep plugged to prevent entry of dirt. Use pipes, which conform to CSA and ASTM standards.
- 3.1.3 Provide unions, couplings, or flanges at all connections to equipment or fixtures requiring servicing or replacement.
- 3.1.4 Provide Underwriter approved hangers, and support all piping from building structure. Under no circumstances shall piping be hung from ductwork or steel roof-deck. Provide secondary steel supports where piping under ducts cannot be supported directly from structure. Where pipes are hung from joists, they shall be hung from top cord.
- 3.1.5 Install piping in a professional manner and in accordance with the practices of the trade.
- 3.1.6 Consider the piping shown on the Drawings as diagrammatic, for clearness in indicating the general runs and connections and that the piping may, or may not, in all parts be shown in the true position. This does not relieve the responsibility for the proper erection of the systems of piping in every respect suitable for the work intended.
- 3.1.7 Ensure that welding is performed, using either gas or electric welding equipment. Thoroughly clean pipe surfaces and level the ends of each pipe and fitting before welding. Securely align and space piping so that the width of circumferential welds is two and one-half times the pipe wall thickness. Ensure that the deposited metal forms a gradual increase in thickness from the outside surface to the centre of the weld.
- 3.1.8 Ensure that the pipe welding is done by a welder holding a certificate from TSSA or from the Canadian Welding Bureau (CWB) for the class of piping to be welded.
- 3.1.9 When welding or cutting with a torch, take every precaution to

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prevent fire. Ensure that welding or torch cutting operators have a fully charged 4.5kg (10 lb.) carbon dioxide fire extinguisher with them, when welding or cutting in building, or tunnels. Protect wooden structures with asbestos blanket.

- 3.1.10 Ensure that fabrication, welded or otherwise, meets the requirements of the ASA B31.1 Code for Pressure Piping, the CSA B51 Code for Boiler, Pressure Vessel, and Pressure Piping, and all requirements of the Boilers and Pressure Vessels Act of the Province of Ontario.
- 3.1.11 Use only fittings, or other materials to be incorporated in the work, which are approved by TSSA's Boiler and Pressure Vessels Safety Program, for the class of work for which they are used.
- 3.1.12 Grooved joint piping systems shall be installed in accordance with the manufacturer's guidelines and recommendations. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified in the Contract Documents. Gaskets shall be supplied by coupling manufacturer. Grooved end shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove. A factory trained field representative shall provide on Site training to Subcontractor's field personnel in the installation of grooved piping products. Factory trained representative shall periodically review the Product installation. Subcontractor shall remove and replace any improperly installed Products.
- 3.1.13 Provide thrust restraints on mechanical pipe joints where required to accommodate axial thrust.
- 3.1.14 Provide a DN50 (2") drain valve and piping at the lowest point to permit draining.
- 3.2 TESTING
- 3.2.1 After all pipes have been placed in position, test the tightness of all joints and the soundness of all pipes.
- 3.2.2 Make all tests before piping is furred in.
- 3.2.3 Notify the Consultant at least 48 hours before commencing with test, and give the Consultant a written certificate confirming these tests.
- 3.2.4 Test all fire suppression lines hydrostatically at two (2) times the

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working pressure or as required by authorities having jurisdiction, for a period of not less than four (4) hours without any drop in pressure. Do testing before piping is buried or furred in and before pressure sensitive devices are installed in the pipework. Correct all defects disclosed by tests. Retest until all results are acceptable.

3.2.5 If any leaks are discovered by the above tests, remove and replace the faulty portions of the systems and repeat the test. Repeat this procedure until the system is accepted by the Consultant's representative on the Site. Do not caulk threaded joints.

3.3 FLUSHING AND CLEANING

3.3.1 General

3.3.1.1 Inspect the systems, and remove any heavy debris and excessive oil and dirt.

3.3.1.2 Flush all completed systems with clear water at the highest obtainable pressure and velocity.

3.3.1.3 During flushing and cleaning, maintain all isolating valves in the open position.

3.4 STREET SERVICES

3.4.1 Connect building fire main water line to street main where shown, and make all necessary arrangements with authorities and utilities involved. Pay for all permits and inspections and for all work to be done by the local authorities and utility companies.

3.4.2 Check and verify all invert elevations before proceeding with any of the work of this Section.

3.5 COMPLETION

3.5.1 Provide a declaration, signed by a responsible officer of the Company indicating that the following procedures and tests have been performed in accordance with the Drawings and Specifications. Provide two (2) copies of the signed declaration to the Consultant.

3.5.1.1 Water pressure test performed and leak free.

3.5.1.2 Plumbing inspections made and issue necessary certificates.

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3.5.2 Identify and colour code piping in accordance with Section 20 05
53 – Identification.

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1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 – General Mechanical Requirements, shall apply to and govern this Section.

1.2 SCOPE OF WORK

1.2.1 Provide all labour, materials, tools equipment, training, commissioning and certification required to complete the work as shown on the Drawings and specified in this Section, including:

1.2.1.1 Complete fire standpipe system, including valves, fire hose cabinets, fire department connections, fire hydrants, fire extinguishers, and electrical valve supervision.

1.2.2 Refer to Section 21 05 23 – Fire Protection Valves for valves.

1.2.3 Refer to Section 21 11 00 – Fire Suppression Piping for piping.

1.2.4 Refer to Section 21 11 16 – Fire Hydrants for hydrants.

1.2.5 Refer to Section 21 11 19 – Fire Department Connections for Siamese connections.

1.2.6 Refer to Section 21 30 00 – Fire Pumps for fire standpipe pumps.

1.2.7 Provide all electrical supervision devices for each shutoff valve in system. Refer to Section 21 05 23 – Fire Protection Valves.

1.2.8 All pipe sizes and layout of new systems shown on drawings are to assist tender coordination only. It is the responsibility of the Contractor to ensure adequate hose coverage, extinguisher coverage, pipe sizing, zoning and valving for the system as per NFPA 14 hazard occupancies, Owner's Insurer' standards, OBC, and authorities having jurisdiction. Install additional valves and resize piping as required at no additional cost to the owner. Re-routing of fire standpipe mains shall be approved in advance by the Consultant.

1.2.9 Identify all changes to the fire alarm system resulting from shop drawings. All cost related to changes initiated by the Sprinkler Designer shall be included in the Contract Price.

1.2.10 Obtain flow and pressure available from city main and obtain approval from IAO before commencing work. Verify flow and

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pressure data shown on contract documents with local authorities. Undertake flow test were required, at no additional cost to the owner. Conduct test in accordance with IAO Standards.

1.3 QUALITY ASSURANCE

1.3.1 Materials shall be listed by UL or ULC.

1.3.2 Comply with all codes, including the Ontario Building Code, local authorities, IAO and NFPA regulations.

1.4 SHOP DRAWINGS

1.4.1 Submit shop drawings for all fire standpipe equipment.

2 **PRODUCTS**

2.1 VALVES

2.1.1 Refer to Section 21 05 23 – Fire Protection Valves.

2.1.2 Dry-pipe valve shall be Simplex Grinnell Model 'E-2' with A-2 trim, compressed air connection, pressure gauges, alarm test bypass, air compressor and air maintenance devices.

2.2 FIRE HOSE CABINETS

2.2.1 Recessed fire hose cabinets shall be National Fire Equipment Model CK-2002, 762mm x 762mm x 203mm (30" x 30" x 8"). Cabinet shall be constructed of 1.19mm (18-gauge) baked white enamel corrosion protected steel tub with 2mm (14-gauge) grey baked enamel steel door and frame with hollow channel reinforcement. Front section to have 51mm (2") adjustment to wall surface and complete with 13mm (1/2") turn back frame. Door shall be fitted with full panel of 5mm (3/16") clear glass, full-length semi-concealed piano hinges, and flush stainless steel door latch. Provide plexi panel instead of glass for parking garage.

2.2.2 Surface mount fire hose cabinets shall be National Fire Equipment Model CS-800, 762mm x 762mm x 203mm (30" x 30" x 8"). Cabinet shall be constructed of 1.19mm (18-gauge) baked grey enamel corrosion protected steel tub with 2mm (14-gauge) grey baked enamel steel door and frame with hollow channel reinforcement. The frame section shall be site adjustable for left or right door swing. Door shall be fitted with full panel of 5mm (3/16") clear glass, full-length semi-concealed piano hinges, and flush stainless steel door latch. Provide plexi panel instead of glass for

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parking garage.

- 2.2.3 All equipment inside the fire hose cabinets shall be highly polished chrome plated finish.
- 2.2.4 Each cabinet shall contain the following equipment:
- 2.2.4.1 DN65 (2-1/2") dia. model A56 cast brass Fire Department valve with cap and chain.
- 2.2.4.2 DN40 (1-1/2") dia. model A51 cast brass angle valve with hydrolator.
- 2.2.4.3 30m (100 ft) x DN40 (1-1/2") dia. peerless 100% synthetic, hose, 3,450 kPa (500 psi) rated, complete with forgeline brass couplings.
- 2.2.4.4 Model 1575 moulded polycarbonate combination fog nozzle.
- 2.2.4.5 Model HR semi-automatic swing hose rack.
- 2.2.4.6 Model PWS-25-F – 9.5-litres (2.5 US gallons) stainless steel pressurized water extinguisher. (Except in parking garage, use PDC-10, dry chemical type, 60BC rating).
- 2.2.4.7 Three (3) hose wrenches.
- 2.2.5 Where the residual or static pressure at any DN40 (1-1/2") standpipe outlet exceeds 689 kPa (100 psi), provide an approved pressure-regulating valve, similar to Model UR25-15, to reduce the residual and static pressures with the required flow at the outlet to 689 kPa (100 psi).
- 2.2.5.1 In lieu of pressure regulating valve, approved pressure-restricting valve, similar to Model A156, may be used where the residual pressure is between 689 kPa (100 psi) and 1,206 kPa (175 psi).
- 2.2.6 Where the residual or static pressure at any DN65 (2-1/2") standpipe outlet exceeds 1,206 kPa (175 psi), provide an approved pressure-regulating valve, similar to Model A202, to reduce the residual and static pressures with the required flow at the outlet to 1,206 kPa (175 psi).
- 2.3 HOSES
- 2.3.1 Single 30m (100 ft) x DN40 (1-1/2") dia. peerless 100% synthetic, hose, 3,450 kPa (500 psi) rated, complete with forgeline brass couplings and Model 1575 moulded polycarbonate combination fog

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nozzle to be stored in or near CACF room.

2.4 FIRE EXTINGUISHERS

- 2.4.1 Provide Model ABC-10, 4.5 kg (10 lbs) multi purpose dry chemical fire extinguisher with 4A80BC rating in all finished areas where shown on plans and as required to meet coverage and maximum travel distance requirements per the Ontario Fire Code. Mount extinguisher in recessed cabinet NFE Model #CTE-300. Cabinet shall be constructed of 1.19mm (18-gauge) baked grey enamel corrosion protected steel tub with 2mm (14-gauge) grey baked enamel steel door and frame with hollow channel reinforcement. The frame section shall be site adjustable for left or right door swing. Door shall be fitted with full panel of 5mm ($\frac{3}{16}$ ") clear glass, full-length semi-concealed piano hinges, and flush stainless steel door latch.
- 2.4.2 Provide Model ABC-10-G, 4.5 kg (10 lbs) multi purpose dry chemical fire extinguisher with 4A60BC rating in the mechanical rooms, electrical room, diesel room, U.P.S., battery room, switchgear room, and transformer vault. Mount extinguisher near the door with an approved aluminum wall bracket.
- 2.4.3 Provide Model PDC-10, 4.5 kg (10 lbs) standard dry chemical type fire extinguisher, with a minimum rating of 60BC in the parking garage. Mount extinguisher in surface mounted cabinet equal to NFE Model #ECS-999, 267mm (10.5") W x 607mm (24") H x 159mm (6.25") D. Cabinets shall be complete with cylinder lock and break glass mechanism.
- 2.4.4 Provide Model F260 6 liters (1.6 US gallons) class 'K' extinguisher with 1BC rating complete with wall bracket for kitchen areas.

3 **EXECUTION**

3.1 FIRE HOSE/VALVE CABINETS

- 3.1.1 Height of cabinets shall be as directed and in accordance with local authorities.

3.2 STANDPIPE PROTECTION

- 3.2.1 For non-sprinklered buildings, protect all feed mains, standpipes, horizontal standpipes and branch lines located outside a rated shaft or exit staircase by wrapping the above piping with 3M Fire Barrier Plenum Wrap 5A+ to a fire resistance rating equal to the

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exit staircase.

3.2.2 For sprinklered buildings, protect all standpipes, horizontal standpipes and branch lines located outside a rated shaft or exit staircase by wrapping the above piping with 3M Fire Barrier Plenum Wrap 5A+ to a fire resistance rating equal to the exit staircase.

3.3 TESTING

3.3.1 Test fire standpipe system in accordance with NFPA-20.

3.4 WATER SUPPLY

3.4.1 Provide a low-pressure alarm switch, complete with hydraulic connection and Trerice No. 872 pressure snubber, in the water service main upstream of any pressure booster pump.

3.5 CONFORMANCE LETTER

3.5.1 Final NFPA certification letter shall be provided before mechanical compliance letter is issued. Certification letter shall contain contractor's contact information, the building permit number, certification statement in regard to NFPA compliance and be stamped by a licensed professional engineer.

END OF SECTION

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1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 - General Requirements, shall apply to and govern this Section.

1.1.2 All equipment and accessories shall be I.A.O., UL, ULC, or FM labelled and/or approved.

1.1.3 All systems shall be designed to NFPA-13 standards, all applicable codes and standards, authority having jurisdiction and the Owner's Insurance Underwriters approval.

1.2 SCOPE OF WORK

1.2.1 Provide all labour, materials, tools, equipment, training, commissioning and certification required to complete the work as shown on the drawings and specified herein, including:

1.2.1.1 Modifications to existing wet sprinkler systems.

1.2.2 Apply and pay for all permits.

1.2.3 Provide all electrical supervision devices for each shutoff valve in system. Refer to Section 21 05 23 – Fire Protection Valves.

1.2.4 Provide all required additional electrical work for this Section not specified in Sections 20 05 13 – Electric Motors, 20 05 14 – Electrical Wiring, and Division 26 – Electrical. Complete electrical work in accordance with Division 26 – Electrical.

1.2.5 Provide all additional working plans or load calculations as may be required by the bodies having jurisdiction. Include all costs pertaining to the review of these plans and calculations. All working plans and calculations shall be submitted to the Owner's insurer and local Fire Department for approval as required prior to construction commencement.

1.2.6 All pipe sizes, head location, head quantity, and layout of new systems shown on Drawings are to assist tender coordination only. It is the responsibility of the Contractor to ensure adequate head coverage, head quantities, pipe sizing, zoning, and valving for the system as per NFPA 13 hazard occupancies, Owner's Insurers' standards, all applicable codes and standards, and authorities having jurisdiction. Install additional heads, valves, and resize piping as required at no additional cost to the Owner. Size

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reduction of sprinkler main shall not be accepted unless approved by the Consultant. Re-routing of sprinkler main, or repositioning of heads in finished ceiling areas, shall be approved in advance by the Consultant.

- 1.2.7 Identify all changes to the fire alarm system resulting from sprinkler shop drawings. All cost related to changes initiated by the Sprinkler Designer shall be the responsibility of Division 21 – Fire Suppression.
- 1.2.8 Obtain flow and pressure available from city main and obtain approval from IAO before commencing work. Verify flow and pressure data shown on contract documents with local authorities. Undertake flow test were required, at no additional cost to the Owner. Conduct test in accordance with IAO Standards.
- 1.3 QUALITY ASSURANCE
- 1.3.1 The system installation shall be carried out by a sprinkler company who is a member in good standing of the Canadian Automatic Sprinkler Association.
- 1.3.2 To assure uniformity and compatibility of piping components in grooved piping systems, all grooved products utilized shall be from the same manufacturer. Grooving tools shall be supplied by the same manufacturer as the grooved components.
- 1.4 LAYOUT DRAWINGS
- 1.4.1 Sprinkler layout as shown on the Drawings is diagrammatic. Refer to latest Architectural Drawings for final layout of wall, partitions, ceilings, bulkheads, and occupancy areas.
- 1.4.2 Sprinkler contractor must check and verify all dimensions and conditions on the job, and ensure that the Work can be performed as indicated. Report all discrepancies to the Consultant before proceeding with the Work.
- 1.4.3 Prepare complete sprinkler layout drawings, arranging piping runs and sprinkler heads in proper relation to other equipment such as light fixtures, ducts, etc., to ensure clear ceiling heights indicated on Drawings. Coordinate location of sprinkler heads in suspended ceilings with the location of lighting, grilles, diffusers, and similar items. Maintain maximum headroom in areas with no ceilings.
- 1.4.4 Layout drawings shall also include all hydraulic calculations.

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- 1.4.5 Obtain approval of the sprinkler layout drawings by an Insurers' Advisory Organization, Factory Mutual, and the Consultant before any work is started.
- 1.4.6 Sprinkler layout drawings shall take into consideration, architectural, structural, mechanical and electrical layouts of the building and sprinkler mains and branches must be arranged to not interfere with any of the aforementioned.
- 1.4.7 Submit drawings, support details, and weights to structural engineer for review.
- 1.4.8 Sprinkler heads are to be installed symmetrically in ceiling tiles.
- 1.4.9 Layout drawings are to be sealed by a Registered Professional Engineer, registered in the Province of Ontario.
- 1.4.10 Submit drawings to the Consultant for review only after they have been approved by the local authorities and the Owner's Insurer.
- 1.5 **SUBMITTALS**
- 1.5.1 Submit shop drawings for the following:
 - 1.5.1.1 Sprinkler system layout, including hydraulic calculations
 - 1.5.1.2 Sprinkler heads
 - 1.5.1.3 Insulator switches
 - 1.5.1.4 Alarm valves - wet and dry
 - 1.5.1.5 Flow switches
 - 1.5.1.6 Low pressure switches
 - 1.5.1.7 Pre-action valves and trim
 - 1.5.1.8 Heat detectors
- 1.5.2 Layout drawings shall be approved by local Fire Department and Owner's Insurer prior submission to Consultant. All costs related to obtaining agency approval shall be borne by this Contractor.
- 1.5.3 Submit samples of all sprinkler heads to be used to the Consultant.
- 1.5.4 Forward to the Owner on completion of the contract the final

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unconditional acceptance certificates of the authorities.

- 1.5.5 Grooved joint couplings and fittings shall be shown on drawings and product submittals, and be specifically identified with the applicable style or series number.
- 1.5.6 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.
- 1.6 **DESIGN REQUIREMENTS**
- 1.6.1 Size piping on basis of hydraulic design.
- 1.6.2 Do all necessary hydraulic design, piping calculations, and submit to governing authorities for approval.
- 1.7 **HYDRAULIC CALCULATIONS**
- 1.7.1 Office Areas.
- 1.7.1.1 System shall be hydraulically designed.
- 1.7.1.2 Hazard classification – Light Hazard.
- 1.7.1.3 Rate of water application (density) 0.068 L/s/m² (0.1 gpm/ft²) over 139 m² (1,500 ft²).
- 1.7.1.4 Pipe sizes shall be based on 16.3 m² (175 ft²) per head.
- 1.7.1.5 The reflected ceiling layout as prepared by the Consultant shall not be altered or revised by this requirement. The number and location of heads shown shall remain as shown as a minimum.
- 1.7.2 Residential Suites, Corridors and Amenity Areas.
- 1.7.2.1 System shall be hydraulically designed.
- 1.7.2.2 Hazard classification – Light Hazard.
- 1.7.2.3 Rate of water application (density) 0.068 L/s/m² (0.05 gpm/ft²) over 139 m² (1,500 ft²), or 83.6 m² (900 ft²) using quick response sprinkler heads in low ceiling areas (less than 3.0m).
- 1.7.3 Service Spaces (Electrical Rooms, Telecom Rooms, Garbage

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Room, Loading Dock etc.) and Penthouse Mechanical Room.

- 1.7.3.1 System shall be hydraulically designed.
- 1.7.3.2 Hazard Classification – Ordinary Hazard Group 1.
- 1.7.3.3 Rate of water application (density) 0.102 L/s/m² (0.15 gpm/ft²) over 139 m² (1,500 ft²).
- 1.7.4 Parking Garage Dry System.
 - 1.7.4.1 System shall be hydraulically designed.
 - 1.7.4.2 Hazard Classification – Ordinary Hazard Group 1.
 - 1.7.4.3 Rate of water application (density) 0.102 L/s/m² (0.15 gpm/ft²) over 181.2 m² (1,950 ft²).
- 1.7.5 Retail Areas.
 - 1.7.5.1 System shall be hydraulically designed.
 - 1.7.5.2 Hazard Classification – Ordinary Hazard Group 2.
 - 1.7.5.3 Rate of water application (density) 0.136 L/s/m² (0.2 gpm/ft²) over 139 m² (1,500 ft²).
- 1.7.6 Diesel Tank Room and Diesel Generator Rooms.
 - 1.7.6.1 System shall be hydraulically designed.
 - 1.7.6.2 Hazard Classification – Extra Hazard.
 - 1.7.6.3 Rate of water application (density) 0.17 L/s/m² (0.25 gpm/ft²) over 23 m² (250 ft²).

2 **PRODUCTS**

2.1 VALVES

- 2.1.1 Refer to Section 21 05 23 – Fire Protection Valves.
- 2.1.2 Alarm valves shall be Tyco Model AV-1-300 Alarm Check Valve rated for 2,068 kPa (300 psi): Alarm check valves shall be specifically listed for use in wet pipe systems. Alarm check valves shall be of a ductile iron construction intended for use in either the vertical or horizontal position. When variable water supply pressures exist, alarm check valves shall be installed with a retard

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chamber. Alarm check valves shall be connected to a water motor-operated mechanical alarm or a pressure switch equal to Potter PS10A, for initiating electrical alarms, or both. Valves shall be complete with external bypass, test bypass, pressure gauges, and drain connections. Pipe relief and drain valves to hub drain.

2.1.3 Dry-pipe valves shall be Tyco Model DPV. Dry pipe valves shall be of a ductile iron construction installed in the vertical position. Dry pipe valves shall be rated for use at a maximum service pressure of 1,724 kPa (250 psi). Valves shall be mechanically latching and externally resettable. Dry pipe valves shall be of the differential type, having a differential of approximately 5.5:1. Valve to be complete with compressed air connection, alarm switches, accelerator, drain connection, pressure gauges, alarm test bypass, air compressor and air maintenance devices.

2.2 ELECTRIC SUPERVISION

2.2.1 Provide each O.S. & Y. gate valve with an electric monitor switch. Refer to Section 21 05 23 – Fire Protection Valves.

2.2.2 The sprinkler system shall be electrically supervised to indicate a trouble signal on the building fire alarm system annunciator for each of the following:

2.2.2.1 Movement of control valve handle.

2.2.2.2 Loss of excess water pressure required to prevent false alarms in a wet pipe system.

2.2.2.3 Loss of air pressure in a dry pipe system.

2.2.2.4 Loss of air pressure in a pressure tank.

2.2.2.5 Loss of electrical power or phase reversal in any automatically starting electrical fire pump.

2.2.2.6 Fire pump running.

2.2.2.7 Sprinkler zone flow alarm.

2.2.2.8 Failure of the electric tracing system.

2.2.2.9 Pre-action system first and second stage alarms.

2.2.2.10 CO₂ system activation.

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2.3 TEST AND DRAIN FITTINGS

2.3.1 For each system, provide Tyco Model F350 Sectional Test and Drain or Victaulic Style 720 TestMaster II combined test and drain fitting with orifice sized according to the installed sprinkler heads.

2.3.2 Pipe discharge to outside or the nearest floor drain. Outside drains shall be complete with 65mm (2-1/2") connections with cap and chain. Wall plate shall match the siamese connection.

2.4 SPRINKLER HEADS

2.4.1 Provide Tyco Model TY-FRB pendant automatic semi-recessed sprinklers complete with mounting plates all chrome plated in suspended ceilings.

2.4.2 Provide Tyco Model RFIII concealed clean line sprinkler heads in all drywall ceilings. Plate cover colour to be selected by Consultant.

2.4.3 Provide Tyco Model TY-FRB rough brass upright or pendant sprinkler heads in areas without suspended ceilings.

2.4.4 Sidewall sprinkler heads shall be Tyco Model TY-FRB, all chrome plated.

2.4.5 Sprinkler heads for kitchen walk-in coolers and freezers shall be Tyco Model DS-1 dry pendant quick response type.

2.4.6 Temperature ratings of sprinkler heads shall be suitable for the particular location, i.e. in general 75°C (167°F) heads shall be used, with higher temperature heads adjacent to unit heaters, etc.

2.4.7 Sprinklers shall be glass bulb type. Body shall be die-cast brass with hex-shaped wrench boss cast into the body to facilitate installation and reduce the risk of damage during installation.

2.4.8 Provide sprinkler guards for sprinkler heads in storage areas, mechanical rooms, and receiving area. Sprinkler guards shall be listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.

2.4.9 The sprinkler bulb protector must remain in place until the sprinkler is completely installed and before the system is placed in service. Remove bulb protectors carefully by hand after installation. Do not use any tools to remove bulb protectors.

2.5 PIPE AND FITTINGS

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- 2.5.1 Unburied piping shall be standard Schedule 40 black steel pipe, stretch reduced continuous weld up to and including 100mm (4") dia. and for 125mm dia. (5") and over, electric resistance weld. Where approved by the Authorities, lightwall piping may be used for piping of 50mm (2") dia. and over.
- 2.5.2 Fittings shall be standard screwed iron fittings.
- 2.5.3 Fittings shall be standard welding fittings if approved by authorities having jurisdiction.
- 2.5.4 Mechanical couplings such as Victaulic or Tyco/Grinnell may be used. Couplings shall be ULC listed and FM approved.
 - 2.5.4.1 Mechanical couplings shall consist of two ASTM A536 ductile iron housings, pressure-responsive synthetic rubber gasket (grade to suit the intended service) and plated steel bolts and nuts.
 - 2.5.4.2 Rigid Type Couplings: Housings shall be cast with offsetting, angle-pattern bolt pads to provide system rigidity and support and hanging in accordance with NFPA 13. Tongue and recess rigid type couplings shall only be permitted if the contractor uses a torque wrench for installation. Required torque shall be in accordance with the manufacturer's recommendations. Contractor shall remove and replace any improperly installed joints.
 - 2.5.4.3 32mm – 100mm (1-1/4" thru 4"): "Installation Ready" rigid type coupling designed for direct "stab" installation onto grooved end pipe without prior disassembly of the coupling equal to Victaulic FireLock® EZ Style 009.
 - 2.5.4.4 125mm (5") and larger: standard rigid joint, Victaulic FireLock® Style 005 or Style 07 Zero-Flex®.
 - 2.5.4.5 Flexible type couplings: use in seismic areas where required by NFPA 13. Victaulic Style 75 or 77.
 - 2.5.4.6 Grooved end fittings: ASTM A536 ductile iron, short radius, full flow (FireLock®), or standard ASTM A536 ductile iron, forged steel or ASTM A53 fabricated carbon steel fittings, factory grooved, designed to accept Victaulic couplings.
 - 2.5.4.7 Grooved joint flange adapters: ASTM A536 ductile iron casting, flat faced, for incorporating flanged components with ANSI Class 125, 150 and 300 bolt-hole patterns to a grooved system. Victaulic Style 741, 743 or 744.

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- 2.5.5 Piping for dry-pipe systems, including pre-action, shall be galvanized.
- 2.6 FLEXIBLE SPRINKLER PIPE FITTINGS
- 2.6.1 Flexible sprinkler pipe fittings shall be Victaulic VicFlex Series or approved equal.
- 2.6.2 Shall consist of a braided type 304 stainless steel flexible tube, zinc plated steel male threaded nipple for connection to branch-line piping, and a zinc plated steel reducer with a female thread for connection to the sprinkler head.
- 2.6.3 Coupling shall be single-bolt, consisting of two ductile iron housings, Grade E "EPDM" gasket, and a zinc electroplated steel bolt and nut conforming to ASTM A449.
- 2.6.4 The drop shall include a UL approved braided hose with a bend radius to 2" to allow for proper installation in confined spaces. The hose shall be listed for [(4) bends at 31" length] [(5) bends at 36" length] [(8) bends at 48" length] [(10) bends at 60" length] [(12) bends at 72" length].
- 2.6.5 Union joints shall be provided for ease of installation. The flexible drop shall attach to the ceiling grid using a one-piece open gate bracket. The bracket shall allow installation before the ceiling tile is in place. The braided drop system is UL listed for sprinkler services to 175 psi (1206 kPa) and FM Approved to 200 psi (1380 kPa).
- 2.6.6 For cold storage applications, bracket shall withstand differential movement, protect against condensation and stay intact.
- 2.6.7 All hoses shall be factory-pressure tested to 400 psi. (2760 kPa).
- 2.6.8 Sprinkler fittings shall have the following approvals:
- 2.6.8.1 1) FM-1637
- 2.6.8.2 2) UL 2443
- 2.7 PIPING "LOW PRESSURE" ALARM SENSOR
- 2.7.1 ULC listed, 115 Volt or 24 Volt (to suit fire alarm system) adjustable piping mounted pressure sensor with contacts arranged to actuate a fire alarm system trouble signal if piping pressure drops to a pressure below the switch setting.

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2.8 WATER FLOW ALARM SWITCHES

2.8.1 Potter Model VSR-F, ULC listed and FM approved, pipe mounting water flow alarm switch 50mm (2") to 200mm (8"), complete with:

2.8.1.1 A vane type sensor operating two single-pole, double-throw, snap action switches when sustained water flow exceeds 0.63 L/s (10 USgpm).

2.8.1.2 An integral, field adjustable retard device with automatic reset to delay switch operation to reduce the possibility of false alarms caused by a single or series of transient water flow surges.

2.8.1.3 A tamper-proof cover.

2.8.1.4 A U-bolt and piping saddle.

2.8.2 Where grooved end mechanical coupling joint piping is used, Victaulic Model WFD ULC listed and FM approved water flow alarm switch is also acceptable.

2.9 SPRINKLER ZONE ALARM, TEST AND DRAIN ASSEMBLIES

2.9.1 Tyco ULC listed and FM approved Model F350 Series factory assembled sprinkler zone alarm, pressure gauge, test and drain assemblies, each consisting of a water flow alarm, test and drain valves, a water flow sight glass, and interconnecting black steel piping and accessories, 50mm (2"), 65mm (2-1/2"), and 80mm (3") sizes.

2.9.2 Victaulic Style 747M zone control riser module assembly is also acceptable.

2.9.3 Install sprinkler zone alarm assembly in NFE Model #CV-200 lockable cabinet. Cabinet shall be constructed of 1.19mm (18-gauge) baked white enamel corrosion protected steel tub with 2mm (14-gauge) grey baked enamel steel door and frame with hollow channel reinforcement. Front section to have 51mm (2") adjustment to wall surface and complete with 13mm (1/2") turn back frame. Full metal door shall be fitted with full-length semi-concealed piano hinges, and flush stainless steel door latch.

2.9.4 Pipe module to drain.

2.10 PRESSURE GAUGES

2.10.1 Pressure gauges shall be ULC listed.

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- 2.10.2 Provide pressure gauges of the Bourdon type, minimum one percent accuracy through the entire range, complete with bronze Bourdon tube, brass socket, brass rotary movement, bronze bushings, tube and movement independently mounted from case, stainless steel case and ring, inherent shock protection. Furnish gauges having 114mm (4-½") dial, black graduations, black case, silver brazed joints, and adjustable black pointer.
- 2.10.3 Select gauges to suit fluid working pressure and, if possible, test pressure. If test pressure falls outside safe instrument range, attach a note to this effect on the installation instructions. Ensure that the normal working pressure occurs approximately at mid scale.
- 2.10.4 Install each gauge complete with 6mm (1/8") or 8mm (1/4") bar stock valve, rated 150°C (300°F) and 6,895 kPa (1,000 psi). Provide pressure snubber on all pump services. Install pressure gauges as noted.
- 2.10.5 Submit a schedule in shop drawing form showing service, location, range, make, and catalogue number for gauges.

3 EXECUTION

3.1 PIPE AND FITTINGS

- 3.1.1 Provide unions, couplings, or flanges at all connections to equipment or fixtures requiring servicing or replacement.
- 3.1.2 Provide Underwriter approved hangers, and support all piping from building structure. Under no circumstances shall piping be hung from ductwork or steel roof-deck. Provide secondary steel supports where piping under ducts cannot be supported directly from structure. Where pipes are hung from joists, they shall be hung from top cord.
- 3.1.3 Sprinkler mains and branch headers shall be routed to avoid electrical, battery, UPS, elevator machine, diesel generator, switch gear and telephone rooms, unless prior approval is obtained from Consultant.
- 3.1.4 Grooved joint piping systems shall be installed in accordance with the manufacturer's guidelines and recommendations. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be supplied by coupling manufacturer. Grooved end shall be clean and free from

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indentations, projections and roll marks in the area from pipe end to groove. A factory trained field representative shall provide on-site training to contractor's field personnel in the installation of grooved piping products. Factory trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

3.2 FLEXIBLE SPRINKLER PIPE FITTINGS

3.2.1 Contractor to refer to manufacturer's insulation manual and design guide to ensure proper installation of fittings.

3.2.2 Ceiling grids shall be able to withstand the force of a discharging flexible sprinkler fitting. Ceiling grid shall comply with ASTM C 635 and ASTM C 636.

3.3 EXCESS PRESSURE PUMPS

3.3.1 Support pumps rigidly by steel mounting plate attached to the flange above the alarm valve.

3.4 EXTRA STOCK OF SPRINKLER HEADS

3.4.1 Provide one (1) wall mounted steel cabinet with sprinkler wrench and six (6) heads of each type used in the installation. Cabinet shall have baked on enamel finish.

3.5 ELECTRICAL WORK

3.5.1 All wiring from the alarm valve, monitor switches and flow switches shall be done by Division 26 - Electrical.

3.5.2 All power wiring shall be by Division 26 - Electrical.

3.5.3 Provide all other field wiring required.

3.6 TESTING, ADJUSTING, FLUSHING, BOILING OUT AND CLEANING

3.6.1 After system is complete, flush and test entire system in accordance with NFPA-13.

3.6.2 Test all sprinkler lines hydrostatically at 2 times the working pressure or as required by the authorities but at not less than 1,380 kPa (200 psi), for a period of not less than four (4) hours without any drop in pressure. Do testing before piping is buried or furred in and before pressure sensitive devices are installed in the pipework.

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Correct all defects disclosed by tests. Retest until all results are acceptable.

3.6.3 If any leaks are discovered by the above tests, remove and replace the faulty portions of the systems and repeat the test. Repeat this procedure until the system is accepted by the consultant's representative on the site. Do not caulk threaded joints.

3.6.4 Check horizontal pipe with an accurate level for any alterations in pitch. Inspect laterals and cross arms, eliminate pockets.

3.6.5 Flush the system at full flow rate for ten (10) minutes, or until all foreign materials have been removed and the work is clear. Provide a standard certificate that flushing has been properly carried out and submit to Consultant.

3.7 DEMONSTRATION

3.7.1 Prior to final acceptance, the Contractor shall provide operational training in all aspects of the system to the Owner's key personnel. Training shall include emergency procedures, safety requirements, and demonstration of the system, including all interfaces with the Fire Alarm and Building Automation Systems.

3.8 CONFORMANCE LETTER

3.8.1 Final NFPA certification letter shall be provided before mechanical compliance letter is issued. Certification letter shall contain contractor's contact information, the building permit number, certification statement in regard to NFPA compliance and be stamped by a licensed professional engineer.

END OF SECTION



DIVISION 22 – PLUMBING
SPECIFICATIONS
FOR THE
CITY OF TORONTO - DAYCARE CENTRE (METRO HALL)
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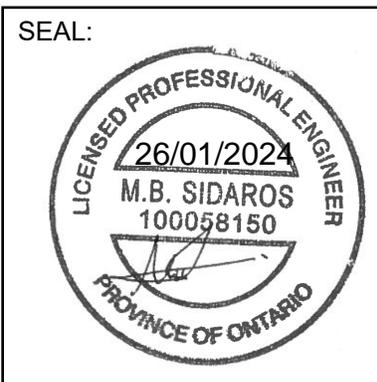
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Our Project No. 2021-0245

Issued for Approval
Design Development

January 26, 2024

DISCIPLINES MECHANICAL
ELECTRICAL
PLUMBING
LIGHTING DESIGN
COMMUNICATIONS & AV
SECURITY & RISK
COMMISSIONING
ENERGY SERVICES



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Appendix A	Plumbing Fixtures

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1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 - General Requirements, shall apply to and govern this Section.

1.2 SHOP DRAWINGS

1.2.1 Submit Shop Drawings for:

1.2.1.1 All plumbing valves.

2 **PRODUCTS**

2.1 GENERAL

2.1.1 All valves shall be of one manufacture unless stated otherwise and should have the manufacturer's name and pressure ratings clearly marked on body. Valves to conform to the current of ANSI, ASTM, ASME standards, and to the applicable MSS.

2.1.2 Bronze valves up to and including 1034kPa (150 psi) steam pressure to be manufactured to ASTM B62-93 standard. Bronze valves up to 1379kPa (200 psi) and 2068kPa (300 psi) steam pressure to be manufactured to ASTM B61-93 standard. Bronze valves used in water systems may be cast bronze to ASTM B584-87 alloy CDA-836.

2.1.3 Iron body valves shall be ductile iron manufactured to ASTM A536-84 Grade 65-45-12 or cast iron ASTM A126-95 Class B standard where ductile iron is not available.

2.1.4 All valves shall have a CRN registration number.

2.1.5 Valve Materials

2.1.5.1 Bronze: to ASTM B62 or B61 as applicable

2.1.5.2 Brass: to ASTM B283 C3770

2.1.5.3 Cast Iron: to ASTM A126, Class B

2.1.5.4 Forge Steel: to ASTM A105N

2.1.5.5 Cast Steel: to ASTM A216WCB

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- 2.1.6 Valve Markings
 - 2.1.6.1 All pressure ratings, manufacturers' trademark and size to conform as per MSS-SP-25.
- 2.1.7 End Connections
 - 2.1.7.1 Threaded ends: to ASME B1.20.1
 - 2.1.7.2 Solder ends: to ASME B16.18
 - 2.1.7.3 Flanged ends: to ASME B16.1 (Class 125)
 - 2.1.7.4 Face To Face dimensions: to ASME B16.10
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- 2.1.8 Testing & Design
 - 2.1.8.1 MSS-SP-80 - Bronze, Gate & Check Valves
 - 2.1.8.2 MSS-SP-110 - Ball Valves
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 - 2.1.8.4 MSS-SP-72 - American Valve
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 - 2.1.8.6 API 602 - Forge Steel Valves (Design)
 - 2.1.8.7 API 598 - Cast Steel Valves, Forge Steel Valves (Testing)
 - 2.1.8.8 API 609 - WKM High Performance BFV
 - 2.1.8.9 API 600 - Cast Steel Valves (Design)
- 2.2 VALVES FOR LOW PRESSURE SERVICE
 - 2.2.1 This section applies to valves used in domestic cold water, domestic hot water and natural gas systems up to 1,034 kPa (150 psi) system operating pressure.

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2.2.2 Gate Valves

2.2.2.1 50mm (2") dia. or less - shall be Class 125, all bronze, with solid wedge disc, non-rising stem, lead-free (NSF-61).

Threaded ends - Kitz 827
- Toyo 206A-LF
- Crane LF-438
- Apollo 102TLF

Soldered ends - Kitz 828
- Toyo 207A-LF
- Crane LF-1320
- Apollo 102SLF

2.2.3 Globe Valves

2.2.3.1 50mm (2") dia. or less - shall be Class 125, all bronze, with rising stem, fitted with PTFE disc, lead-free (NSF-61).

Threaded ends - Kitz 811
- Toyo 211A-LF
- Apollo 120TLF

Soldered ends - Kitz 812
- Toyo 212A-LF
- Apollo 120SLF

2.2.4 Butterfly Valves

2.2.4.1 65mm (2-1/2") dia. and over - shall be Class 125, ductile iron full lug body with aluminum bronze or stainless steel disk, stainless steel stems, EPDM resilient seat, lead-free (NSF-372), with a 1379kPa (200 psi) single flange shut off rating (dead end service) and 121°C (250°F) temperature rating.

2.2.4.2 Valves 65mm (2-1/2") dia. and up to 100mm (4") dia. shall have a 10-position lever. Valves 150mm (6") dia. and above shall have hand wheel gear activator.

Lug Style - Kitz 6122EL/G
- MAS D-Series LD4AELH/G
- Center Line 200XXBG064052/5
- Apollo LD141-XX-SE1-X

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Grooved ends - Victaulic Series 608N (for copper piping)
- Victaulic Series 861 Vic-300 (for SS piping)

2.2.5 Check Valves

2.2.5.1 50mm (2") dia. or less - shall be Class 125, brass or copper alloy body, brass disc, PTFE gasket, lead-free (NSF-61), Y pattern swing check.

Threaded ends - Kitz 822
- Toyo 236A-LF
- Apollo 163TLF

Soldered ends - Kitz 823
- Toyo 237A-LF
- Apollo 163SLF

2.2.5.2 65mm (2-½") dia. and over - shall be Class 150, stainless steel body and trim, PTFE or fluoroelastomer gaskets.

Flanged ends - Kitz 150UOAM

Grooved ends - Victaulic Series 816

2.2.5.3 Wafer Check Valves – stainless steel body, shaft, disc and spring.

Single Flap - Moygro W15A-666

Double Door - Mueller 72-HHH-H-H
- Powell 3070YMO

2.2.5.4 Silent Check Valves – carbon steel or stainless steel body, stainless steel trim, spring loaded center guided disc, stainless steel spring and shaft.

Flanged ends - Mueller 101MHT (wafer)
- Mueller 105MHT (globe style)

2.2.6 Ball Valves

2.2.6.1 100mm (4") dia. or less - shall be rated for 1034kPa (150 psi) steam, 4137kPa (600 psi) non-shock cold water or oil, with full or standard port brass or bronze body, lead-free (NSF-61) brass or stainless steel ball, PTFE seats and packing.

Threaded ends - Kitz 858
- Toyo 5044A-LF

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- Apollo 70LF-100 series
- MAS B-3LF

Soldered ends - Kitz 859
- Toyo 5049A-LF
- Apollo 70LF-200 series
- MAS B-4LF

Note: Ball valves may be used in lieu of gate or globe valves for pipe sizes of 100mm (4") dia. or less.

2.2.6.2 Gas ball valves:

2.2.6.2.1 50mm (2") dia. or less - shall be rated for 1034kPa (150 psi) steam, 4137kPa (600 psi) non-shock cold water or oil, with full or standard port brass or bronze body, brass chrome plated ball, Teflon seats and packing, lever handle, CSA approved (CGA 3.16).

Threaded - Toyo 5044A
- Kitz 58
- MAS B3

2.2.6.2.2 65mm (2-½") dia. and over - shall be Class 150, carbon steel body, stainless steel ball and stem, Teflon packing and gaskets, locking lever and/or gear.

Flanged - Kitz 150 SCTAM (1 piece)
- Kitz 150 SCTBZM (2 piece, full port)

2.2.7 Plug Valves

2.2.7.1 DN80 (3") dia. or less - shall be bronze eccentric plug valve, 1,379kPa (200 psi) non-shock cold water or oil, with memory stop and drip cap, grooved, flanged or screwed ends, as appropriate for piping system.

- DeZurik PEC Series

2.2.7.2 DN100 (4") dia. up to DN300 (12") dia. - shall be bronze eccentric plug valve, 1,379kPa (200 psi) non-shock cold water or oil, with handwheel gear, and grooved, flanged or screwed ends, as appropriate for piping system.

- DeZurik PEC Series

2.3 VALVES FOR MEDIUM TO HIGH PRESSURE SERVICE

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- 2.3.1 This section applies to valves used in domestic cold water and domestic hot water systems up to 3,440 kPa (500 psi) system operating pressure.
- 2.3.2 Gate Valves
- 2.3.2.1 50mm (2") dia. or less - shall be Class 300, stainless steel body and trim, OS&Y, PTFE packing and gasket.
Threaded ends - Kitz AK300UMM
- 2.3.2.2 65mm (2-½") dia. and over - shall be Class 300, stainless steel body and trim, OS&Y, PTFE packing and gasket.
Flanged ends - Kitz 300UMHAM
- 2.3.3 Globe Valves
- 2.3.3.1 50mm (2") dia. or less - shall be Class 300, stainless steel body and trim, OS&Y, PTFE packing and gasket.
Threaded ends - Kitz AK300UPM
- 2.3.3.2 65mm (2-½") dia. and over - shall be Class 300, stainless steel body and trim, OS&Y, PTFE packing and gasket.
Flanged ends - Kitz 300UPAM
- 2.3.4 Butterfly Valves (up to 1,724 kPa / 250 psi operating pressure)
- 2.3.4.1 65mm (2-½") dia. and over - shall be Class 150, cast brass or stainless steel body with aluminum bronze or stainless steel disk, stainless steel stems, Teflon seat, lead-free (NSF-372), with a 2,068 kPa (300 psi) single flange shut off rating (dead end service) and 121°C (250°F) temperature rating.
- 2.3.4.2 Valves 65mm (2-½") dia. and up to 100mm (4") dia. shall have a 10-position lever. Valves 150mm (6") dia. and above shall have hand wheel gear activator.
Grooved ends - Victaulic Series 608N (for copper piping)
- Victaulic Series 861 Vic-300 (for SS piping)
- 2.3.5 Check Valves
- 2.3.5.1 50mm (2") dia. or less - shall be Class 300, stainless steel body, PTFE or fluoroelastomer gasket, swing type check.

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- Threaded ends - Kitz AK300UOM
- Grooved ends - Victaulic Series 816
- 2.3.5.2 65mm (2-½") dia. and over - shall be Class 300, stainless steel body and bolted cover, PTFE gasket, swing type check.
- Flanged ends - Kitz 300UOAM
- 2.3.5.3 Wafer Check Valves – stainless steel body, shaft, disc and spring.
- Single Flap - Moygro W30A-666
- Double Door - Mueller 74-HHH-H-H
- Powell 3070YMO
- 2.3.5.4 Silent Check Valves – carbon steel or stainless steel body, stainless steel trim, spring loaded center guided disc, stainless steel spring and shaft.
- Flanged ends - Mueller 103MHT (wafer)
- Mueller 109MHT (globe style)
- 2.3.6 Ball Valves
- 2.3.6.1 100mm (4") dia. or less - shall be rated for 1034kPa (150 psi) steam, 4137kPa (600 psi) non-shock cold water or oil, with full or standard port brass or bronze body, lead-free (NSF-61) brass or stainless steel ball, PTFE seats and packing.
- Threaded ends - Kitz 858
- Toyo 5044A-LF
- Apollo 70LF-100 series
- MAS B-3LF
- Soldered ends - Kitz 859
- Toyo 5049A-LF
- Apollo 70LF-200 series
- MAS B-4LF
- Note: Ball valves may be used in lieu of gate or globe valves for pipe sizes of 100mm (4") dia. or less.

3 EXECUTION

3.1 GENERAL

- 3.1.1 Valves shall be the same size as the line in which installed.

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- 3.1.2 Valves shall be located in such a manner that the top works, operators, and bonnets may be easily removed.
- 3.1.3 Seats and seals used in potable water systems shall be ANSI classified in accordance with NSF-61.
- 3.1.4 Stems of valves shall be positioned for maximum ease in use, but in no event in a manner causing a hazard, nor with stem down unless specifically shown as such.
- 3.1.5 Provide valves where shown on the Drawings, or on schematic diagrams, or in details, or as specified in the Contract Documents.
- 3.1.6 Provide drain valves at all low points. Drain valves shall be ball or gate valves, complete with cap and chain.
- 3.2 GATE VALVES
 - 3.2.1 Provide gate valves:
 - 3.2.1.1 Where indicated on the Drawings and in the Specification.
 - 3.2.1.2 On all branch lines.
 - 3.2.1.3 As isolation of each floor for all services.
 - 3.2.1.4 At the base of all risers.
- 3.3 GLOBE OR ECCENTRIC PLUG VALVES
 - 3.3.1 Provide globe and/or eccentric plug valves:
 - 3.3.1.1 Where indicated on the Drawings and in the Specification.
 - 3.3.1.2 On all bypass systems.
 - 3.3.1.3 Where required for throttling control.
 - 3.3.2 For balancing of domestic hot water recirculation system, provide thermostatic flow regulators in lieu of throttling valves. Refer to Section 22 11 19 – Domestic Water Piping Specialties.
- 3.4 BUTTERFLY VALVES
 - 3.4.1 Provide butterfly valves:
 - 3.4.1.1 Where indicated on Drawings and in the Specification.

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3.4.2 For pipe sizes DN65 (2-1/2") and larger, butterfly valves may be used in lieu of gate valves.

3.5 CHECK VALVES

3.5.1 Provide check valves:

3.5.1.1 Where indicated on the Drawings and in the Specification.

3.5.1.2 On the discharge of all pumps.

3.5.1.3 On the discharge of multiple equipment.

3.6 BALL VALVES

3.6.1 Install ball valves in the following locations:

3.6.1.1 Where indicated on the Drawings and in the Specification.

3.6.1.2 At each single plumbing fixture.

3.6.1.3 At each single item of equipment.

3.6.2 For pipe sizes DN100 (4") and smaller, ball valves may be used in lieu of gate and globe valves.

END OF SECTION

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1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 – General Requirements, shall apply to and govern this Section.

1.2 SCOPE OF WORK

1.2.1 Provide an electrical pipe tracing system as indicated on the Drawings and specified in this Section.

1.2.2 Connect heat trace power supply from disconnect switches provided by Division 26 - Electrical. Refer to Division 26 – Electrical drawings for exact locations. Co-ordinate power requirements with Division 26 – Electrical. Refer to Section 20 05 14 – Electrical Wiring for wiring requirements.

1.2.3 Provide electric tracing for the following services:

1.2.3.1 All domestic water piping (cold, hot, hot recirculation), including humidification make-up, cooling tower make-up, and irrigation supply in unheated areas or outside the building.

1.2.3.2 All sanitary and storm drain lines in unheated areas except parking drain sanitary system.

1.2.3.3 Humidifier drain lines, exposed on roof.

1.2.3.4 Trench drains exposed to freezing.

1.2.3.5 Roof gutters.

1.3 SHOP DRAWINGS

1.3.1 Provide shop drawings for:

- heat trace cables
- power connection, splice and tee kits
- temperature sensors, moisture sensors, control panel, and contactor modules
- accessories including tape, straps, banding, labels

1.4 ELECTRICAL EQUIPMENT AND WORK

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1.4.1 Read together with Division 26 – Electrical and adhere to its requirements. Supply and install all electrical apparatus, which is required and is not covered by Division 26 – Electrical.

1.4.2 The entire design and installation shall comply with the Ontario Electrical Safety Code and all applicable regulations. Heating cable circuits shall be protected by a ground-fault device for equipment protection. This requirement is in accordance with section 427-22 of the NEC-1996. Ground-fault protection is included with the control system specified for all applications.

2 **PRODUCTS**

2.1 GENERAL

2.1.1 Furnish and install a complete cUL Listed, CSA Certified, or FM approved system of heating cables, components, and controls to provide freeze protection of piping as indicated in the Contract Documents.

2.2 PIPE FREEZE PROTECTION CABLES

2.2.1 The self-regulating heating cable shall consist of two (2) 16 AWG nickel-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature all along its length, allowing the heating cable to be cut to length in the field. The heating cable shall be covered by a radiation-crosslinked, modified polyolefin dielectric jacket. To provide a ground path and to enhance the heating cable's ruggedness, the heating cable shall have a braid of tinned copper and an outer jacket of modified polyolefin (-CR), as required per section 427-23 of the NEC-1996. For installation on plastic piping, the heating cable shall be applied using aluminum tape (AT-180). The heating cable shall be Tyco Thermal Controls, XL-Trace series, or approved equivalent.

2.2.2 In order to conserve energy and to prevent overheating, the heating cable shall have a self-regulating factor of at least 90 %. The self-regulation factor is defined as the percentage reduction, without thermostatic control, of the heating cable output going from 4.4°C (40°F) pipe temperature operation to 65.6°C (150°F) pipe temperature operation.

2.2.3 The heating cable shall operate on line voltage of 120 / 208 Volts without the use of transformers.

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2.2.4 The heating cable for metal-pipe freeze protection shall be sized according to the table below. The required heating cable output rating is in Watts per meter (foot) at 10°C (50°F). (Heating cable selection is based on 51mm (2 inch) fiberglass insulation on metal piping.)

Pipe size mm (inches)	Minimum Ambient Temperature	
	-17.8°C (0°F)	-28.9°C (-20°F)
100 (4") or less	16.4 (5) Watts	16.4 (5) Watts
150 (6")	16.4 (5) Watts	26.2 (8) Watts
200 (8")	16.4 (5) Watts	26.2 (8) Watts
250 (10") or more	16.4 (5) Watts	2 strips of 16.4 (5) Watts

2.2.5 Power connection, end seal, splice, and tee kit components shall be cUL Listed, CSA Certified, or FM Approved for use as part of the system to provide pipe freeze protection. Component enclosures shall be rated NEMA 4X to prevent water ingress and corrosion. Installation shall not require the installing Subcontractor to cut into the heating-cable core to expose the bus wires. All components that make an electrical connection shall be re-entenable for servicing. Installation of power-connection kits shall be under Division 22 - Plumbing.

2.2.6 No component shall use silicone to seal the electrical connections. An exception will be made in areas where a conduit transition is required.

2.3 TEMPERATURE AND MOISTURE SENSORS

2.3.1 Drainage piping shall have one sensor per "zone", mounted to the ceiling in unheated space and shall operate on Proportional Ambient Sensing Control. Trench Drain and Canopy Gutter De-icing cables shall be energized upon the detection of precipitation at low temperatures, and remain energized until runoff is clear.

2.3.2 Temperature sensors shall be 100-ohm platinum RTD (Resistance Temperature Devices), with 3m tails mechanically protected by a corrugated steel sheath and ½" gland fitting for connection to the

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junction box. Digit race RTD10CS or approved equivalent. Temperature sensors shall be connected to the control system terminals as indicated on heat-tracing schedules. Coordinate conduit and low-voltage signal wiring with Division 26 - Electrical. RTD wiring shall be shielded 3-conductor, 22AWG + drain, Belden type 8771 or approved equivalent.

- 2.3.3 Aerial Snow-Sensors shall detect precipitation occurring below 38°F (4°C) and close an internal contact to send a demand signal to the control system. Snow Sensors shall operate at 120V. Digit race LCD-7A or approved equivalent.
- 2.3.4 Gutter Moisture Sensors shall be mounted horizontally in the gutter as indicated on construction drawings, and shall detect the presence of moisture (i.e. runoff water) below 38°F (4°C) to send a demand signal to the control system. The intent of this device is to hold associated circuits on until all melt water is clear of the drainage system. Digit race type GIT-3A or approved equivalent. This Subcontractor is responsible for providing auxiliary relays to prevent line voltage reaching low-voltage control terminals.
- 2.4 CONTROL SYSTEM
 - 2.4.1 (Option 1) Manual Control
 - 2.4.1.1 The system shall be controlled by a switch, either directly or through an appropriate contactor.
 - 2.4.2 (Option 2) Thermostatic Control – Ambient Sensing
 - 2.4.2.1 The system shall be controlled by an ambient sensing thermostat (AMC-F5) set at 4.4°C (40°F) either directly or through an appropriate contactor.
 - 2.4.3 (Option 3) Thermostatic Control – Line Sensing
 - 2.4.3.1 The system shall be controlled by a line sensing thermostat (AMC-F5) set at 4.4°C (40°F) either directly or through an appropriate contactor.
 - 2.4.4 (Option 4) DDC Control System
 - 2.4.4.1 All sensors shall communicate with a DDC system, Digit race ACCS-30 or approved equivalent. This approach serves to minimize the number of sensing devices required for efficient system operation and also to eliminate field-location of control

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devices and thus reduce the risk of tampering.

- 2.4.4.2 The Heating Cable manufacturer shall provide a DDC system with pre-programmed parameters to concurrently control and monitor heating cable circuits fire-protection pipe freeze protection. All system programming shall be through a CSA-listed central User Interface Terminal, Tyco Thermal Controls type ACCS-UIT2 or approved equivalent.
 - 2.4.4.3 Heating Cable circuits and sensor signals (refer to Subsection 2.5 above) shall be connected to cUL-listed remote Power Control Modules, Tyco Thermal Controls type ACCS-PCM2-5 or approved equivalent. The Power Control Modules shall each house five two-pole contactors rated to 30A/277V, and five sensor inputs. Power Control Modules shall also include ground-fault sensing devices for each heating cable circuit, the status of which shall be monitored by the control system.
 - 2.4.4.4 Power Control Modules and User Interface Terminal shall be interconnected using RS-485 communication series. Coordinate communication conduit requirements with Division 26 - Electrical.
 - 2.4.4.5 The Control System shall be capable of communicating ground fault, temperature alarms, and status alarms through programmable alarm contacts. Coordinate with Division 26 - Electrical.
 - 2.4.4.6 The Control System shall be capable of communicating operating status, power consumption, and alarms to the Building Automation System in BACnet protocol.
 - 2.4.5 No heat tracing circuit shall extend more than 600mm (24") beyond a point where such junctions permit optional flow paths. In such cases, separately controlled tracers shall be used.
 - 2.4.6 Separately controlled heating circuits shall be provided on dead end legs and closed bypasses.
 - 2.4.7 Where the rating of the thermostat would be exceeded, it shall be used in conjunction with a relay or contactor.
- 3 **EXECUTION**
- 3.1 PIPE FREEZE PROTECTION
 - 3.1.1 Hydrostatically test all piping prior to installation of tracing cables.

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- 3.1.2 Heating Cable Installation shall comply with manufacturer's recommendations.
- 3.1.3 The cable shall be fastened to metallic piping at intervals no more than 300mm (12") using heat-resistant fiberglass tape, type GT-66 or approved equivalent. Metallic tie-wraps shall not be acceptable as they may puncture the heating cable jacket. When installing on polymer-based piping, aluminum heat-transfer tape shall be installed along the entire length of heating cable to improve performance.
- 3.1.4 Extra cable shall be used at points such as valves and flanges to compensate for increased heat loss.
- 3.1.5 All terminations shall be protected from the weather and from physical damage.
- 3.1.6 Any field alternations or deviations shall proceed only after authority via signed change order has been issued by the Consultant. All changes shall be accurately recorded by the Contractor and shall be turned over to the Consultant upon completion of the work.
- 3.1.7 Junction boxes, thermostats, and the like shall not be attached to the insulation, but shall be mounted on brackets fabricated of galvanized angle, channel or other material of sufficient strength to support equipment mounted on them.
- 3.1.8 Apply "Electric Traced" labels to the outside of the thermal insulation, on alternating sides at 3m intervals.
- 3.2 **SENSORS**
- 3.2.1 Install all sensing devices in accordance with manufacturer's recommendations. Refer to notes in Subsection 2.5 above.
- 3.2.2 Temperature sensors installed on piping (for Line-Sensing) shall be located opposite the heating cable so as to sense the coldest temperature on the segment of pipe.
- 3.2.3 Temperature sensors installed in air (for Ambient-Sensing) shall be strapped to the ceiling in a location such that the temperature is representative of the exposure temperature of any associated heat-tracing. Ambient temperature sensors shall not be installed adjacent to exhaust vents.

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3.2.4 Aerial Snow-Sensors shall be installed in a location such that they are exposed to precipitation from all directions and not subject to heating or exhaust vents. They shall be wired such that line voltage is not introduced to the signal run.

3.2.5 Gutter Snow-Sensors shall be installed between runs of heating cable with sensor grid pointed “upstream”, i.e. toward the flow of melt-water. They shall be wired such that line voltage is not introduced to the signal run.

3.3 CONTROL SYSTEM

3.3.1 Install all control components in accordance with manufacturer’s recommendations.

3.3.2 Sensor signal wiring shall be connected to the appropriate terminal within the appropriate power control module.

3.3.3 Control system components shall all be connected in series, using RS-485 twisted pair communication wiring. Coordinate necessary communication conduit runs with Division 26 – Electrical Subcontractor.

3.4 TESTING, COMMISSIONING AND REPORTING

3.4.1 All Self-Regulating Cables (for pipe tracing and gutter tracing) shall be tested for insulation resistance using a megohmmeter at 500, 1000, and 2500VDC and results shall exceed 1000MΩ to be acceptable. Self-Regulating cables shall also be tested for capacitance to verify continuous circuit lengths, with results recorded in nF and in approximate corresponding length. Refer to manufacturer’s installation guides for nF/ft conversion rates for each type of cable.

3.4.2 All Mineral-Insulated Cables (for trench drain de-icing) shall be tested for insulation resistance using a megohmmeter at 500VDC and results shall consistently exceed 100 MΩ to be acceptable. Cables shall also be tested for continuity, with results recorded in resistance (Ω) and approximate corresponding length.

3.4.3 Sensors and Control System shall be concurrently tested and commissioned with the assistance of the manufacturer. Temperature sensors may be tested by observing readings and comparing with actual temperature. Moisture sensors shall be tested by simulating activation criteria (low temperature and moisture) and observing contact engagement.

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3.4.4 The Division 22 - Plumbing Subcontractor is responsible for carrying testing, programming and commissioning costs as part of this Contract.

END OF SECTION

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3.2	Motor Starters

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1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 - General Requirements, shall apply to and govern this Section.

1.2 SCOPE OF WORK

1.2.1 Provide all labour, materials, tools equipment, training commissioning and certification required to complete the work as shown on the Drawings and specified in this Section, including:

1.2.1.1 All motor starters for mechanical equipment.

1.2.1.2 All motor control centres for mechanical equipment.

1.2.2 Division 26 – Electrical shall provide all Motor Control Centres (MCC's) and loose motor starters.

1.2.3 Provide Division 26 – Electrical with a complete motor list, including nominal power, voltage, phase, application, starter type and control interlocks.

1.3 SUBMITTALS

1.3.1 Provide shop drawings for:

1.3.1.1 All motor starters.

1.3.1.2 All motor control centres.

1.4 ELECTRICAL EQUIPMENT AND WORK

1.4.1 Read together with Division 26 – Electrical and adhere to its requirements. Supply and install all electrical apparatus, which is required and is not covered by Division 26 – Electrical.

2 **PRODUCTS**

2.1 MOTOR CONTROL CENTRES

2.1.1 Provide motor control centres where indicated, specified and shown on schedules containing motor starters, control, interlocks and pilot lights.

2.1.2 Control centres shall consist of standard vertical section of

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2,286mm (90") and width and depth as required to house the equipment contained, all joined together to form a rigid free standing, completely dead front EEMAC 2 drip tight enclosed assembly. Arrange all units for front access only.

- 2.1.3 Wire all control units for EEMAC Class II, Type "B" construction with all interwiring between starters and assemblies, terminal boards for each starter and all control wiring and load power connections to terminal boards.
- 2.1.4 All horizontal and vertical bus shall be tin-plated copper. Vertical bus rating not less than 300 amperes or larger where required to accommodate the loads served plus 25% spare capacity. Horizontal bus rating as indicated but in no case less than the ampacity of the feeder to the motor control centre. Provide a horizontal tin-plated copper ground 6mm x 32mm (1/4" x 1-1/4") for the full length of the motor control centre. Provide 3 phase, 3-wire, or 3 phase, 4-wire mains with main circuit breaker as shown on the Drawings. Coordinate feeder supply with Division 16 – Electrical and provide all cable lugs and/or bus duct terminations.
- 2.1.5 Unless otherwise indicated in the Contract Documents motor starters shall:
 - 2.1.5.1 Be of the combination type containing motor starter and fusible disconnect switch. All components and wiring shall be readily accessible and shall be connected to the vertical bus with self-aligning plug-on connectors having free-floating spring action. A minimum of one padlock hasp per starter shall be provided on the panel fastener to allow padlocking in either connect or disconnect position.
 - 2.1.5.2 Contain fuse clips for Class J, Form I, High Rupturing Capacity (HRC) fuses.
 - 2.1.5.3 Be provided with an operating handle interlocked with door so that the handle must be in the "OFF" position before the door can be opened. A semi-secret release shall be provided allowing bypassing of the interlock.
 - 2.1.5.4 Be provided with dual horsepower rated disconnect switches, quick-make, quick-break type.
 - 2.1.5.5 Be full voltage magnetic type complete with three external manual reset thermal overload relays and low voltage protection. Identify each unit with an engraved lamacoid (white core) nameplate.

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Adhere to Section 15075 – Mechanical Identification colour scheme for tags. Provide a Siemens 3UN8 or 3UN6 trip unit or Klockner-Moeller equivalents in motor starters for all motors provided with thermistor type protection embedded in the stator windings. Provide 3UN8 units for 3-wire momentary contact control circuits and 3UN6 units for 2-wire maintained contact control circuits.

- 2.1.5.6 Have an integral control transformer complete with fusible protection for operation of all line voltage controls.
- 2.1.5.7 Have all covers equipped with start/stop pushbuttons and/or selector switches and push to test pilot lights as indicated on the wiring diagrams.
- 2.1.5.8 Have manual reset thermal overload relays in each of the three phases to suit the service factor and acceleration time of the motor served.
- 2.1.6 Provide a “Failsafe Industries” catalogue #M-600 or approved equal insulation resistance monitor in motor starters for fire pumps and fan motors used solely for smoke control. Provide a long life lamp in the starter cover to flash under alarm condition. Identify lamp with a lamacoid plate reading “LOW INSULATION RESISTANCE”. Provide dry contacts for remote annunciation at the Building Automation Control System.
- 2.1.7 Unless otherwise shown on the Motor Control Centre and Starter Schedules, each motor control centre shall have not less than the following spaces:
 - 2.1.7.1 One section one size 1.
 - 2.1.7.2 Two sections two size 1.
 - 2.1.7.3 Three sections two size 1
one size 2
 - 2.1.7.4 Four sections two size 1
two size 2.
- 2.1.8 Short circuit interrupting capacity for all starters shall be minimum of _____ kA for all MCC's, or higher to meet co-ordination study. Support all bus work to suit rating.

2.2 MOTOR STARTERS

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- 2.2.1 Provide where indicated, shown the Motor Starter Schedules and as specified in this Section separate motor starters not forming part of a motor control centre for all mechanical equipment (except those equipped with packaged starters).
- 2.2.2 Motor starters shall be supplied by the manufacturer of the motor control centres specified, and shall meet the requirements therein complete with disconnect switch, fuses, control transformer, and all auxiliary devices.
- 2.2.3 Provide combination type with non-fused disconnect switch for individual motor starters equal to CGE CR 208, where overcurrent protection has been provided at motor control centre or distribution source.
- 2.2.4 Provide combination type with fusible disconnect switches equal to CGE CR 208 for grouped motor starters supplied from a common feeder or splitter. Include all interconnection power wiring.
- 2.2.5 Manual starters for single phase fractional horsepower motors unless otherwise indicated shall be equal to CGE CR 1061 with pilot light in cover. In finished areas, provide flush mounted units with stainless steel covers and pilot lights.
- 2.2.6 Where starters are grouped, provide a common backboard, interlocking and control wiring indicated on the Motor Control Schedules and engraved nameplates indicating source of control supply if separate from the starter.
- 2.2.7 Short circuit interrupting capacity for all starters shall be minimum of _____ kA for all starters, or higher to meet co-ordination study. Support all bus work to suit rating.

3 **EXECUTION**

3.1 MOTOR CONTROL CENTRES

- 3.1.1 Mount motor control centres on 100mm (4") high concrete bases.
- 3.1.2 Provide watertight connections for all services entering the top of the motor control centres.
- 3.1.3 Check all overload relays or heaters to ensure they are in accordance with the recommendations of the starter manufacturer by size and motor run-up time.
- 3.1.4 After installation, verify sequence of all control devices.

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3.1.5 Provide lamacoid plastic plates identifying motor control centres. Adhere to Section 20 05 53 – Identification colour scheme for tags. Provide phase identification. Provide warning label for motors under remote control.

3.2 MOTOR STARTERS

3.2.1 Provide lamacoid plastic plates identifying all starters. Provide warning label for motors under remote control. Adhere to Section 20 05 53 – Identification colour scheme for tags.

END OF SECTION

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3.1	Cleanouts and Cleanout Access Covers

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Section No.: **22 05 76**
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1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 - General Requirements, shall apply to and govern this Section.

1.2 SHOP DRAWINGS

1.2.1 Submit shop drawings for the following equipment:

1.2.1.1 Cleanouts

2 **PRODUCTS**

2.1 CLEANOUTS AND CLEANOUT ACCESS COVERS

2.1.1 Provide cleanouts where shown on Contract Drawings on all drainage and waste systems, and as required by the Local Plumbing Code, including the following:

2.1.1.1 Where there is a change of direction of 45 degrees or more.

2.1.1.2 Not more than 15m (50'-0") apart on straight runs for DN100 (4") and less; 30m (100'-0") for DN150 (6") and greater.

2.1.1.3 On sanitary drain stacks serving kitchen sinks, at every second floor.

2.1.1.4 At the base of every stack and rainwater leader.

2.1.1.5 Where drains leave the building.

2.1.1.6 On footing drains where shown on the Drawings.

2.1.2 Bring cleanouts below floor up to finished floor with a 'Y' and 1/8th bend. Locate all cleanouts for easy access and in areas of least traffic, as directed by Consultant.

2.1.3 Make cleanouts full size of drain up to and including 100mm (4") drains. For drains larger than 100mm (4"), use 100mm (4") cleanouts.

2.1.4 Cleanouts in floor – cast iron body, removable positive gasket seal closure, 150mm (6") adjustable round cover. J.R.Smith Series 4000; Zurn ZN1400 Series; Mifab C1100-R Series, Watts CO-200 Series.

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- 2.1.4.1 Finished areas with nickel bronze top. J.R.Smith 4020; Zurn ZN1400-NH; Mifab C1100-R-1, Watts CO-200-R-1.
- 2.1.4.2 Tiled areas with nickel bronze top. J.R.Smith 4140; Zurn ZN1400-NH-X; Mifab C1100-T-1, Watts CO-200-T-1.
- 2.1.4.3 Terrazzo areas with nickel bronze top. J.R.Smith 4180; Zurn ZN1400-NH-Z; Mifab C1100-UR-1, Watts CO-200-U-1.
- 2.1.4.4 Concrete areas with extra heavy cast iron top. J.R.Smith 4220; Zurn Z1400-NH; Mifab C1100-XR-4, Watts CO-200-RX-4.
- 2.1.5 Cleanouts in walls.
 - 2.1.5.1 Face-of-wall access cover for openings in tile, masonry and plaster walls with round C.P. bronze frame and secured cover. J.R.Smith 4720, Watts CO-300 Series.
 - 2.1.5.2 Flush-with-wall access cover for plaster and wet wall constructions with round C.P. bronze frame and secured cover. J.R.Smith 4725; Zurn Z1463; Mifab C1440-R6, Watts CO-300 Series.
 - 2.1.5.3 Access doors in tile, masonry and plaster walls, and in acoustic tile: refer to Section 15050 – Basic Materials and Methods.
 - 2.1.5.4 Urinal cleanout – wall access cleanout with bronze plug, S.S. bolt and wingnut, and 100mm (4") polished S.S. secured cover. J.R.Smith SQ4-1819; Zurn Z1666-1; Mifab C1440-RD-3, Watts WUCO.
- 2.1.6 Cleanouts at the base of each stack and rainwater leader – cast iron cleanout tee and countersunk iron plug with gasket seal, less cover. J.R.Smith 4510; Zurn Z1445-HBXSP; Mifab C1460, Watts CO-460.
- 2.1.7 Cleanouts for concealed cast iron stacks – cast iron cleanout tee and countersunk iron plug with gasket seal, S.S. round cover and screw. J.R.Smith 4530; Zurn Z1446-HBXSP; Mifab C1460-RD-3, Watts CO-460-RD.
- 2.1.8 Cleanouts for exposed and concealed copper stacks to be by pipe manufacturer.

3 **EXECUTION**

3.1 CLEANOUTS AND CLEANOUT ACCESS COVERS

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- 3.1.1 Cleanouts on drains outside building shall be brought up to grade with a DN100 (4") 'Y' and 1/8th bend in medium weight soil pipe with solid brass recess plug-in top. Provide necessary support for soil pipe and set cleanout flush with grade in a 300mm by 300mm by 150mm (12" x 12" x 6") concrete pad.
- 3.1.2 In all areas with seamless flooring and plastic terrazzo finishes provide special flanges. These flanges shall be 100mm (4") larger in diameter than the drain or cleanout top of sleeve diameter, and located approximately 5mm ($\frac{3}{16}$ ") below the top flanges to be of the same material as the drain or cleanout finish.
- 3.1.3 Provide special flanges for cleanouts as described above.

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1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 - General Requirements, shall apply to and govern this Section.

1.2 SCOPE OF WORK

1.2.1 Provide all labour, materials, tools, equipment, training, commissioning and certification required to complete the work as shown on the Drawings and specified in this Section, including:

1.2.1.1 Domestic cold water piping, including connections to all fixtures and equipment, capped connections, and connections to municipal water supply.

1.2.1.2 Domestic hot water piping, including connections to all fixtures and equipment and capped connections.

1.2.1.3 PEX tubing for potable water distribution system.

1.3 REGULATORY REQUIREMENTS

1.3.1 Standards listed by reference, including revisions by issuing authority, form part of this Specification Section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title, or other designation established by issuing authority. Standards subsequently referenced in this Section are referred to by issuing authority abbreviation and standard designation.

1.3.2 In addition to specific requirements for pipe fittings as further specified in this document and where applicable, the equipment shall comply with the Boiler and Pressure Vessels Act (the "Act") and CSA Standard B51.

1.3.3 In compliance with the Act and relevant Codes, all fittings shall be registered by the manufacturer, and shall be identified by the appropriate Canadian registration number.

1.3.4 Where fittings are provided without the appropriate Canadian registration number, the Contractor shall obtain a copy of the manufacturer's Statutory Declaration as provided to the authorities having jurisdiction.

1.3.5 All welding and fabrication shall be to the requirements of the

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ANSI/ASME B31.9 code for pressure piping and CSA standard B51 code for the Construction and Inspection of Boilers and Pressure Vessels.

- 1.3.6 All copper piping shall be certified to ASTM Standard B42 for Seamless Copper Pipe or ASTM Standard B88 for Seamless Copper Water Tube.
- 1.3.7 All stainless steel piping shall be certified to ASNI/AWWA C220-98.
- 1.3.7.1 ASTM F876 Standard Specification for Cross-Linked Polyethylene (PEX) Tubing.
- 1.3.7.2 ASTM F877 Standard Specification for Cross-Linked Polyethylene (PEX) Plastic Hot and Cold Water Distribution Systems.
- 1.3.7.3 ASTM F1960 Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for use with Cross-Linked Polyethylene (PEX) Tubing.
- 1.3.7.4 CAN/CSA B137.5 Cross-Linked Polyethylene (PEX) Tubing Systems for Pressure Applications.
- 1.3.7.5 CAN/ULC-S101-M89 Standard Methods of Fire Endurance Tests of Building Construction and Materials.
- 1.3.7.6 CAN/ULC-S115-M95 Standard Method of Fire Tests of Firestop Systems.
- 1.3.7.7 CAN/ULC-S102.2-M88 Standard for Surface Burning Characteristics of Flooring, Floor Covering and Miscellaneous Materials and Assemblies.
- 1.3.8 Plastic Pipes Institute (PPI):
 - 1.3.8.1 PPI Technical Report TR-4/00.
 - 1.3.9 Wirsbo, AQUAPEX *Installation Handbook*, current edition.
- 1.4 **SUBMITTALS**
 - 1.4.1 Provide shop drawings for all specified Products, including:
 - 1.4.1.1 Piping material and fittings.
 - 1.4.1.2 Joining material (flux, solder, filler metal, coupling)

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- 1.4.1.3 Submit verification of Standard Grade hydrostatic pressure ratings from Plastic Pipe Institute in accordance with TR-4/00. The following three (3) standard grade ratings are required: 93°C (200°F) at 551 kPa (80 psi); 82°C (180°F) at 689 kPa (100 psi) and 23°C (73.4°F) at 1,102 kPa (160 psi).
- 1.4.1.4 Submit Product Submittal sheets for tubing, manifolds, stand-up brackets, connection system, and fittings.
- 1.4.2 Submit appropriate ULC or Warnock Hersey and CSA listings as proof of compliance with provincial building and plumbing codes.
 - 1.4.2.1 Submit listings that indicate that the PEX tubing system has been listed to CAN/ULC-S101 when the PEX tubing is incorporated in and traverses a CAN/ULC-S101 floor/ceiling assembly. The listing must be appropriate to assemblies on site.
 - 1.4.2.2 Submit listings that indicate that the PEX tubing firestop system has been listed to CAN/ULC-S115 when the PEX tubing penetrates a fire separation. The listing must be appropriate to assemblies on site.
 - 1.4.2.3 Submit listings that indicate that the PEX tubing system has been listed to CAN/ULC-S102.2 for maximum 25 flame spread and maximum 50 smoke developed.
 - 1.4.2.4 Submit listings that indicate that the PEX tubing system has been listed to CAN/CSA-B137.5.
- 1.4.3 Submit the following:
 - 1.4.3.1 Copy of manufacturer's letter indicating that the installer has been recognized by the manufacturer as a "Trained Installer" trained in the use of its PEX tubing potable water distribution system.
 - 1.4.3.2 Manufacturer's installation instructions.
 - 1.4.3.3 Installer shall provide in writing to the Owner that the PEX tubing and components furnished under this specification conforms to the material and mechanical requirements specified herein.
- 1.4.4 Include the following in the closeout documentation:
 - 1.4.4.1 Warranty documents specified in the Contract Documents.
 - 1.4.4.2 Manufacturer's field reports specified in this Section.

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1.4.4.3 Project record documents for installed materials in accordance with Section 20 00 00 - General Requirements.

1.4.5 Division 22 - Plumbing Subcontractor to prepare and submit an alternative compliance application under the OBC if stainless steel piping is used for domestic water service.

1.5 QUALITY ASSURANCE

1.5.1 Qualifications:

1.5.1.1 Installer experienced in performing work of this Section who has specialized in installation of work similar to that required for this project.

1.5.1.2 Installation must be by skilled tradesmen holding a trade qualification license or apprentices under the supervision of a licensed tradesperson.

1.5.2 Pre-installation Meetings:

1.5.2.1 Conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

1.6 DELIVERY, STORAGE AND HANDLING

1.6.1 Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

1.6.2 Deliver materials to job site in manufacturer's original, unopened, undamaged containers with identification labels intact.

1.6.3 Store materials protected from exposure to harmful weather and job site conditions.

1.6.4 Store PEX tubing in cartons or under cover to avoid dirt or foreign material from being introduced into the tubing.

1.6.5 Do not expose PEX tubing to direct sunlight for more than 30 days. If construction delays are encountered, installer is responsible for providing cover to portions of tubing exposed to direct sunlight.

1.7 WARRANTY

1.7.1 Refer to the Articles of Agreement, General Conditions and Section 20 00 00 - General Requirements for project warranty provisions.

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- 1.7.2 PEX manufacturer's warranty shall conform to the following:
 - 1.7.2.1 PEX tubing and fittings shall carry a twenty-five (25) year non-prorated warranty against failure due to defect in material or workmanship.
 - 1.7.2.2 All tubing manufacturer's valves and stops shall carry a one (1) year non-prorated warranty against failure due to defect in material or workmanship.
 - 1.7.2.3 The assembly of manufacturer's tubing and fittings shall carry a twenty-five (25) year non-prorated warranty on maintaining a leak-proof seal.
 - 1.7.2.4 Warranty shall provide for repair or replacement of any tube, fittings, or connection, which are proven to be defective and pay for consequential damages.
 - 1.7.2.5 Warranty shall be transferable to subsequent owners.
 - 1.7.2.6 Effective Warranty: Current manufacturer's warranty at time of installation.
 - 1.7.2.7 Warranty shall commence on Date of Substantial Completion.

2 **PRODUCTS**

2.1 PIPES AND FITTINGS

- 2.1.1 For 860 kPa (125 psi) or less operating pressure use 860 kPa (125 psi) rated fittings. For 860 kPa to 1,730 kPa (125 psi to 250 psi) operating pressure use 1,730 kPa (250 psi) rated fittings.
- 2.1.2 Buried water lines:
 - 2.1.2.1 Piping shall be IPEX "Blue Brute" PVC, 100mm – 300mm (4" – 12"), to Standards AWWA C900, CAN/CSA B137.3, ULC Cex448, UNI-B-3-80.
 - 2.1.2.2 Fittings for 100, 150 and 200mm (4", 6" & 8") PVC pipe shall be injection moulded, colour coded blue with push-on gasketed joints conforming to AWWA C907 (latest revision), be ULC listed, FM approved and be certified by the Canadian Standards Association to CAN/CSA B 137.2. Injection moulded fittings shall be produced from 4000 psi HDB compound.
 - 2.1.2.3 Gaskets shall be made of SBR. Gaskets must be removable from

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the pipe gasket race, in order to aid cleaning the bell and spigot should it be necessary prior to assembly.

- 2.1.2.4 Service connections to PVC mains shall be effected by using PVC moulded tapped couplings 100mm, 150mm & 200mm (4", 6" & 8") conform to AWWA C907 and be certified by the Canadian Standards Association to CAN/CSA B137.2.
- 2.1.2.5 Service saddles shall be stainless steel 304 and be a minimum 18-gauge (1.3mm) construction and shall have AWWA taper (CC) outlet thread. Service saddles shall be used for taps on pipe sizes larger than 200mm (8"), where tapped couplings cannot be used.
- 2.1.2.6 Mechanical joint restraints shall conform to ASTM F1674 and manufacturer's specifications. Restraining collars shall be attached to the fitting bell behind the gasket face. Tie-rods shall run from the collar behind the bell to a suitable collar on the connecting pipe. Tie-rods to be Denso wrapped.
- 2.1.2.7 Concrete thrust blocks shall conform to Ontario Provincial Standards Specification (OPSS) 1350 with nominal minimum 28-day compression strength of 20 MPa (2,900 psi). Thrust blocks as per UNI-B-3-92 and shall be constructed as per Ontario Provincial Standards Drawing (OPSD) 1103.01 and OPSD 1103.02.
- 2.1.2.8 Tracer wire shall be 12-gauge Thermoplastic Water Resistant insulated wire, Nylon jacketed (TWN) multi-strand copper and shall be installed along all PVC watermains at the 12 o'clock position and as close to the pipe as possible. The tracer wire shall be brought to the surface at all fire hydrants, looped twice around the hydrant barrel 100mm (4") below finished grade and fastened by means of a washer to a breakaway flange bolt.
- 2.1.3 Domestic cold water, hot water, and hot water recirculation piping shall be type 'L' hard copper with wrought copper or cast brass fittings and 95/5 solder joints or brazed joints using phosphorus based filler metal, up to 1,380 kPa (200 psi) operating pressure.
- 2.1.3.1 Alternatively, for domestic cold water and hot water piping, 100mm (4") dia. and larger, stainless steel piping, Schedule 10 (up to 250 psi) / Schedule 40 (for operating pressure above 250 psi), conforming to AWWA Standard C220 with roll-grooved joints can be used.
- 2.1.4 Mechanical couplings (e.g. Victaulic) shall be permitted for domestic cold water, hot water and hot water recirculation systems,

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provided:

- 2.1.4.1 The couplings are located in accessible locations unless otherwise approved by the engineer.
- 2.1.4.2 All couplings are by one manufacturer, suitable for pressure and temperature of respective system.
- 2.1.4.3 Rigid (Victaulic Style 107H Quick-Vic) couplings with offsetting angle bolt pads are used in mechanical rooms for Schedule 40 piping.
- 2.1.4.3.1 Flexible (Victaulic Style 177) couplings may be used in equipment drops in lieu of flexible-connectors and where vibration attenuation and stress relief are required.
- 2.1.4.4 Couplings for stainless steel roll-grooved plumbing piping to be manufactured from ductile iron conforming to ASTM-A536 and be complete with a Grade 'E' EPDM gasket, suitable for water service to 110°C (230°F) Couplings to be UL classified in accordance with ANSI/NSF-61 for potable water service.
- 2.1.4.5 Couplings for copper grooved piping in size 50mm (2") and above to be designed to copper-tube dimensions with offsetting angle bolt pads to provide a rigid joint, (Victaulic Style 607) complete with EPDM flush-seal gasket suitable for temperatures from -34° (-30°F) to 110°C (230°F). Couplings to be UL classified in accordance with ANSI/NSF-61 for potable water service.
- 2.1.4.6 Fittings for copper piping shall be full flow copper fittings per ASTM B-75, or B-152, conform to ANSI B16.18 (cast copper alloy) or ANSI B16.22 (wrought copper), manufactured to copper-tube dimensions.
- 2.1.4.7 Couplings for stainless steel roll-grooved piping shall be with EPDM gaskets conforming to ANSI/NSF-61.
- 2.2 **PEX POTABLE WATER DISTRIBUTION SYSTEM**
- 2.2.1 Plumbing tubing system to be Wirsbo AQUAPEX Professional Plumbing System as manufactured by Uponor Canada Inc.
- 2.2.2 Tube shall be cross-linked polyethylene (PEX) manufactured by PEX-A or peroxide method.
- 2.2.2.1 PEX tubing shall be manufactured in accordance with ASTM F876, ASTM F877 and CAN/CSA-B137.5. The tube shall be listed to

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ASTM by an independent third party agency.

- 2.2.2.2 PEX tubing shall have Standard Grade hydrostatic design and pressure ratings of 93°C (200°F) at 551 kPa (80 psi); 82°C (180°F) at 689 kPa (100 psi) and 23°C (73.4°F) at 1,102 kPa (160 psi). Temperature and pressure ratings shall be issued by the Plastic Pipe Institute (PPI), a division of the Society of the Plastic Industry (SPI).
- 2.2.2.3 Minimum bend radius for cold bending of the PEX tubing shall not be less than six (6) times the outside diameter. Bends with a radius less than stated shall require the use of a bend support as supplied by tube manufacturer.
- 2.2.2.4 PEX tube dimension shall be 12mm (½”) up to and including 40mm (1-½”) nominal inside diameter in accordance with ASTM F876 and ASTM F877 and as indicated on the Contract Drawings.
- 2.2.3 Manifolds to be either:
 - 2.2.3.1 Wirsbo Quick & Easy AQUACENTER
 - 2.2.3.2 Wirsbo Quick & Easy PLS Manifold
 - 2.2.3.3 Wirsbo Quick & Easy Type “L” Copper Manifold
- 2.2.4 Fittings shall be Wirsbo Quick & Easy, manufactured of polysulfone or brass. Fittings shall be PEX-A cold expansion type fitting.
 - 2.2.4.1 Fittings shall be supplied by the PEX tubing manufacturer.
 - 2.2.4.2 PEX-A cold expansion type fitting shall be an assembly consisting of insert and PEX-A cold expansion ring.
- 2.2.5 Ice maker and washing machine outlet boxes shall be supplied by the PEX tubing manufacturer.
- 2.2.6 Fixture shut-offs shall be supplied by the PEX tubing manufacturer.
- 2.2.7 Wall penetration brackets, drop ear bend support type, designed for wall membrane penetrations shall be supplied by PEX tubing manufacturer.
- 2.2.8 Concrete tube support brackets “Stand-Up” to hold PEX tubing in place in structural concrete slabs shall be of rigid PVC construction and be designed for that purpose.

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3 EXECUTION

3.1 GENERAL

- 3.1.1 Comply with manufacturer's product data, including Product technical bulletins, installation instructions, and Product carton instructions for installation.
- 3.1.2 Ream all piping and keep plugged to prevent entry of dirt. Use pipes, which conform to CSA and ASTM standards.
- 3.1.3 Install piping in a professional manner and in accordance with the practices of the trade.
- 3.1.4 Consider the piping shown on the Drawings as diagrammatic, for clearness in indicating the general runs and connections and that the piping may, or may not, in all parts be shown in the true position. This does not relieve the responsibility for the proper erection of the systems of piping in every respect suitable for the work intended.
- 3.1.5 Ensure that fabrication, welded or otherwise, meets the requirements of the ASA B31.9 Code for Pressure Piping, the CSA B51 Code for Boiler, Pressure Vessel, and Pressure Piping, and all requirements of the Boilers and Pressure Vessels Act of the Province of Ontario.
- 3.1.6 Use only fittings, or other materials to be incorporated in the work, which are approved by TSSA's Boiler and Pressure Vessels Safety Program, for the class of work for which they are used.
- 3.1.7 Thoroughly clean the inside of fittings and outside of pipe with steel wool and coat with flux, before soldering or brazing any copper pipe work joint. Remove the working parts of valves before soldering or brazing commences, and replace after soldering or brazing is complete.
- 3.1.8 Provide swing joints in runouts to units, off horizontal mains.
- 3.1.9 In Victaulic grooved piping systems, install swing joints consisting of flexible couplings, pipe nipples and elbows that provide simultaneous movement in all directions. Refer to Victaulic design submittal #26.12.
- 3.1.10 Use di-electric connections for cathodic protection wherever pipes of dissimilar material are connected together. When connecting

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grooved end steel to copper piping, use Victaulic dielectric waterway, Style 647-GG.

- 3.1.11 All traps and fittings shall be of same material or equal in quality and thickness to the pipe to which they are connected.
- 3.1.12 Provide unions or flanges at all connections to equipment or fixtures requiring servicing or replacement.
 - 3.1.12.1 Unions or flanges for servicing are not required in installations using Victaulic couplings. (The couplings shall serve as disconnect points.)
- 3.1.13 In copper pipes, provide wrought copper unions with soldered joints for pipe up to and including 50mm (2"), and 1,035 kPa (150 psi) cast brass flanges for pipes 65mm (2-1/2") or larger.
- 3.1.14 Install all grooved end components as per manufacturers latest recommendation. All grooved products shall be of one manufacturer. The 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.
- 3.1.15 Provide thrust restraints on mechanical pipe joints where required to accommodate axial thrust. Scope of bracing shall include but not be limited to all joints at the base of all vertical storm drains, including cleanouts, and all joints in horizontal piping at the lowest level which drains by gravity to the street services.
- 3.2 **EXAMINATION**
 - 3.2.1 Verify conditions, which have been previously installed under other sections, are acceptable for PEX tubing system installation in accordance with manufacturer's instructions.
- 3.3 **EQUIPMENT CONNECTIONS**
 - 3.3.1 Install piping connection to equipment, to prevent any strain on pipe and equipment and to facilitate removal equipment without disconnecting more than the minimum of pipework or shutting down any other piece of equipment.
 - 3.3.2 Install equipment and apparatus requiring servicing and/or replacing with unions or flanges.
 - 3.3.3 Install valves, and automatic valve assemblies prefabricated and in

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uniform arrangement.

3.3.4 Install piping, automatic control valves, thermostat wells, orifice plates, etc., and any other appurtenances, supplied under the work of other Specification Sections or by the Owner for insertion in piping and equipment.

3.3.5 Provide di-electric fittings between dissimilar metals where corrosion may occur.

3.4 CONNECTIONS FOR OTHER TRADES

3.4.1 Provide valved hot and/or cold water to all equipment supplied by others, requiring same and connect.

3.4.2 Provide quick fill valved connections for chilled water, hot water, and condenser water systems.

3.4.3 Provide valve bypass arrangement for water differential pressure transmitters. Coordinate exact quantity and location with the Division 25 - Integrated Automation Subcontractor.

3.5 PEX INSTALLATION

3.5.1 Install PEX tubing in accordance with tubing manufacturer's recommendations and as indicated on Contract Drawings.

3.5.2 Manifolds shall be isolated with potable water ball valves.

3.5.3 PEX tubing shall not be exposed to direct sunlight for more than 30 days.

3.5.4 Insulation must cover the PEX tubing when exposed to a direct UV light source such as fluorescent light bulbs.

3.5.5 Ensure that no glues, solvents, sealants, or chemicals come in contact with the tubing without prior permission from the tube manufacturer.

3.5.6 PEX tubing passing through structural concrete slabs shall be sleeved with utility grade polyethylene tubing one (1) pipe diameter larger than the PEX tubing.

3.5.7 PEX tubing passing through metal studs shall be use grommets or sleeves at the penetration.

3.5.8 Protect PEX tubing with sleeves where abrasion may occur.

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- 3.5.9 Use strike protectors where PEX tubing has the potential for being struck with a screw or nail.
- 3.5.10 Manufacturer's bend supports shall be used where bends are less than six (6) times outside pipe diameter.
- 3.5.11 Manufacturer's concrete tube support bracket shall be used in structural concrete applications at all fixture and manifold locations.
- 3.5.12 Manufacturer's wall penetration brackets shall be used at all wall membrane penetrations.
- 3.5.13 Pressure test PEX potable water distribution system with air or potable water in accordance with applicable codes or, in the absence of applicable codes, to a pressure of 173 kPa (25 psi) above normal working pressure of the system. The pressure test shall last a minimum of 30 minutes. As the piping expands, restore pressure first at 10 minutes into the test, and again at 20 minutes. The test pressure must not fall more than 34kPa (5 psi) after 30 minutes. No leakage should be detected.
- 3.5.14 Comply with safety precautions when pressure testing, including use of compressed air, where applicable. Water shall not be used to pressurize the system if ambient air temperature has the possibility of dropping below 0°C (32°F).
- 3.6 **TESTING**
- 3.6.1 After all pipes have been placed in position and all branches installed, but before fixtures have been set or connected, test the tightness of all joints and the soundness of all pipes.
- 3.6.2 Make all tests before piping is furred in.
- 3.6.3 Notify the Consultant at least 48 hours before commencing with test, and give the Consultant a written certificate confirming these tests.
- 3.6.4 Test all water lines hydrostatically at 1-1/2 times the working pressure but at not less than 1,380 kPa (200 psi), for a period of not less than four (4) hours without any drop in pressure. Do testing before piping is buried or furred in and before pressure sensitive devices are installed in the pipework. Correct all defects disclosed by tests. Retest until all results are acceptable.
- 3.6.5 If any leaks are discovered by the above tests, remove and replace

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the faulty portions of the systems and repeat the test. Repeat this procedure until the system is accepted by the Consultant's representative on the Site. Do not caulk threaded joints.

3.6.6 Check horizontal pipe with an accurate level for any alterations in pitch. Inspect laterals, cross arms, and eliminate pockets. Correct any cases of water hammer.

3.7 FIELD QUALITY CONTROL

3.7.1 Provide PEX manufacturer's field service consisting of produce use recommendations and periodic site visit for inspection of product installation in accordance with manufacturer's instructions.

3.7.2 Manufacturer shall visit the site on a monthly basis during the installation of the PEX piping system. Each visit shall be documented with a report issued to the Consultant.

3.8 FLUSHING AND CLEANING

3.8.1 Inspect the systems, and remove any heavy debris and excessive oil and dirt.

3.8.2 Flush all completed systems with clear water at the highest obtainable pressure and velocity.

3.8.3 During flushing and cleaning, maintain all isolating and control valves in the open position.

3.8.4 Sterilize domestic hot and cold water piping. Provide chemical and bacteriological test data to prove that sterilization has been carried out.

3.8.5 Flush, chlorinate and reflush all outside water mains in accordance with AWWA C651-05 Specifications.

3.9 STREET SERVICES

3.9.1 Connect building cold water services, fire water, main storm and sanitary sewers to street mains where shown, and make all necessary arrangements with authorities and utilities involved. Pay for all permits and inspections and for all work to be done by the local authorities and utility companies.

3.9.2 Check and verify all invert elevations before proceeding with any of the work of this Section.

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3.10 COMPLETION

3.10.1 Provide a declaration, signed by a responsible officer of the Division 22 – Plumbing Subcontractor indicating that the following procedures and tests have been performed in accordance with the Drawings and Specifications. Provide two (2) copies of the signed declaration to the Consultant.

3.10.1.1 Water pressure test performed and leak free.

3.10.1.2 Plumbing inspections made and issue necessary certificates.

END OF SECTION

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1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 - General Requirements, shall apply to and govern this Section.

1.2 SHOP DRAWINGS

1.2.1 Submit shop drawings for the following equipment:

1.2.1.1 Hose bibs

1.2.1.2 Water meter

1.2.1.3 Thermostatic mixing valves

1.2.1.4 Backflow preventers

1.2.1.5 Pressure reducing valves

1.2.1.6 Shock absorbers

1.2.1.7 Domestic hot water storage tanks

2 **PRODUCTS**

2.1 SHOCK ABSORBERS

2.1.1 Shock absorbers shall be P.P.P. Inc 'SS' Series.

2.2 HOSE BIBS

2.2.1 Outside wall hydrants ('N.F.W.H.') shall be non-freeze flush type with stainless steel box, polished nickel bronze hinged locking cover and key and integral vacuum breaker. J.R.Smith 5509-QTNB; Zurn Z-1300-SS; Mifab MHY-20-3; Watts HY-725-SS.

2.2.2 Non-freeze wall hydrants ('N.F.W.H.') shall be ¼ turn non-drip, ceramic cartridge, 19mm (¾") non-freeze wall type with bronze face, adjustable wall-flange operating key, and self-draining integral vacuum breaker. Length to suit wall thickness. J.R.Smith 5609-QT; Zurn Z-1310; Mifab MHY-16; Watts HY-420.

2.2.3 Inside hose bibs (H.B.) shall be with rough chrome plated, heavy duty, angled body, 12mm (½") with 19mm (¾") hose end vacuum breaker. Acorn 'Neptune' 8121CR.

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2.2.4 Inside combination cold and hot water hose bibs 'HB-2' in mechanical rooms and garbage rooms shall be DN15 (1/2") with DN20 (3/4") hose end vacuum breaker.

2.3 WATER METER

2.3.1 Water meter shall be 'Neptune' Trident, style 3 disc meter with standard register.

2.3.2 Provide 3-valve by-pass around meter and drain valve.

2.3.3 Provide remote reading totalizer complete with wiring and plastic conduit.

2.4 BACKFLOW PREVENTERS

2.4.1 Provide backflow preventers in accordance with CAN/CSA-B64.10-11.

2.4.2 Acceptable Products for non-potable applications are as follows:

2.4.2.1 B64.4 Reduced Pressure Principle Type (RP) – Conbraco Series 40-200, Watts 009/909, Wilkins 975XL/975, Febco 825YA/YD, Hersey Grinnell FRP-2, Ames 4000.

2.4.2.2 B64.5 Double Check Valve Type (DCVA) – Conbraco Series 40-100, Watts 007/757, Wilkins 950XL/950, Febco 805/850, Hersey Grinnell FDC/HDC, Ames 2000/3000.

2.4.3 Acceptable Products for potable applications are as follows:

2.4.3.1 B64.4 Reduced Pressure Principle Type (RP) – Apollo Valves Series 40-200, Watts 009/909, Wilkins 375XL, Febco 825YA/YD, Ames 4000B (or 4000SS).

2.4.3.2 B64.5 Double Check Valve Type (DCVA) – Conbraco Series 40-100, Watts 007/757, Wilkins 950XL/950, Febco 805/850, Ames 2000/3000.

2.4.4 Use screwed connections to DN50 (2") size, flanged connections for larger sized valves, bronze or cast iron body, bronze trim, and stainless steel pilot trim.

2.4.5 Backflow preventers shall have a minimum working pressure of 1,724 kPa (250 psi).

2.5 HOT WATER MIXING VALVES

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- 2.5.1 Provide master thermostatic valves conforming to requirements of CSA B.125 to control valve discharge water temperature to 49°C (120°F). Select valves to provide the required maximum flow rate at a maximum pressure drop of 69 kPa (10 psi).
- 2.5.2 Thermostatic Valves shall be listed to ASSE 1017 – Temperature Actuated Mixing Valves For Hot Water Distribution Systems. Valves should also have Uniform Plumbing Code Canadian (cUPC) listing.
- 2.5.3 Valve body to cast bronze to ASTM B 584. Bronze internal components to ASTM B 139.
- 2.5.4 Valve shall have Manufacturer's name, as well as ASSE 1017 and cUPC logos, clearly displayed for conformance to standard.
- 2.5.5 Provide factory assembled and tested large TYPE TM thermostatic water mixing valve, small TYPE TM valve, DURA-trol® solid bi-metal thermostat (directly linked to valve porting to control the intake of hot and cold water and compensate for supply temperature or pressure fluctuations) with Seven Year Limited Warranty, color coded dials (HOT-COLD with directional indicators), locking temperature regulator handles, adjustable limit stops set for 49°C (120°F), integral hot and cold supply check stops.
- 2.5.6 Provide outlet ball valve shutoffs, color-coded dial thermometer, and inlet piping manifold.
- 2.5.7 Factory preassembled and hydrostatically tested to ASSE 1017 requirements, rough bronze finished system shall provide full time standby service should one mixing valve require maintenance.
- 2.5.8 Valves shall be piped strictly in accordance to Manufacturer's required piping method and be factory assembled and shipped to site for installation.
- 2.6 THERMOSTATIC FLOW REGULATOR
- 2.6.1 Flow regulator shall be Circuit Solver as manufactured by Therm-Omega-Tech, Inc., or equivalent, NSF-61 certified for use in all domestic water systems.
- 2.6.2 Circuit Solver shall regulate the flow of recirculated domestic hot water based on water temperature entering the regulator regardless of system operating pressure.

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- 2.6.3 Even when fully closed the Circuit Solver shall bypass a small amount hot water to maintain dynamic control of the recirculating loop.
- 2.6.4 Circuit Solver shall be factory adjustable as required by project conditions.
- 2.6.5 Circuit Solver shall be available in sizes ranging from DN15 (½ inch) NPT to DN50 (2") NPT, with standard tapered female pipe thread connection, rated to 1,378 kPa (200 psi) maximum operating pressure and to 148.9°C (300°F) maximum working temperature.
- 2.6.6 Body and all internal components shall be constructed of stainless steel with major components constructed of type 303 stainless steel.
- 2.6.7 Thermal actuator shall be spring loaded and self cleaning, delivering closing thrust sufficient to keep orifice opening free of scale deposits.

3 EXECUTION

3.1 UNIONS, FLANGES, DI-ELECTRIC COUPLINGS

- 3.1.1 Provide unions or flanges at all connections to equipment of fixtures requiring servicing or replacing.
- 3.1.2 In copper pipes, provide wrought copper unions with soldered joints for pipes up to and including DN50 (2") sizes and 1,034 kPa (150 psi) cast brass flanges for pipes DN100 (4") or larger.
- 3.1.3 Install approved dielectric isolation in following specified systems:
 - 3.1.3.1 Domestic cold water systems
 - 3.1.3.2 Make-up water systems
 - 3.1.3.3 Expansion pipes where make-up is connecting to the expansion tank
 - 3.1.3.4 In all other locations where specifically noted or shown on the Drawings
- 3.1.4 Install approved dielectric isolation at the transition between noble materials such as copper, brass bronze, high alloy castings, or stainless steel and low alloy ferrous materials such as black iron,

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galvanized iron, or cast iron. These dielectric isolators must be installed in such a way that they are not shorted out by accidental contacts to process equipment, building steel, instrumentation tubing, or electrical neutrals. Ensure that dielectric unions are constructed of materials that are compatible galvanically with the systems to which they are connected, e.g. a dielectric union for installation between copper and iron must be constructed with a body of iron and a tailpiece of copper or brass.

3.2 SHOCK ABSORBERS

3.2.1 Provide shock absorbers on both hot and cold water systems. Install in an upright position at all quick closing valves, solenoids, groups of plumbing fixtures and isolated fixtures. Locate and size as required and in accordance with the Plumbing and Drainage Institute Standard No. WH201 P.D.I. and as per manufacturer's instruction.

3.3 BACKFLOW PREVENTERS

3.3.1 Provide backflow preventers for all potential cross connections, including domestic water connections to all heating, cooling and refrigeration equipment, to irrigation system, where shown on drawings, and as required by the Ontario Plumbing Code and local authority having jurisdiction. As a minimum standard, installation shall be in conformance with CAN/CSA-B64.10-11.

3.3.2 Provide bronze body, spring loaded, soft seated, silent check valve upstream of backflow preventers. Up to and including DN50 (2"): Watts Series 600, Conbraco 61-500, Wilkins Model 40. DN65 (2-½") and above: Apco Series 300, Mueller.

3.3.3 Installation of silent check valve upstream of double check valves servicing main domestic water line is not required.

3.4 KITCHEN, AND OTHER OWNER'S EQUIPMENT

3.4.1 Provide complete roughing-in and final connections for kitchen, laboratory, and other Owner's equipment as shown on the drawings and as further delineated by the kitchen, laboratory, and other Owner's equipment drawings provided by the Owner and/or by other Specialist Consultants. This Subcontractor shall prepare complete 1:50 scale drawing with all services shown as required for approval by the Consultant.

3.4.2 No roughing-in shall be started and no final connections made to

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equipment until complete roughing-in and connection drawings have been provided by the Owner.

- 3.4.3 Provide valved and capped connections to equipment supplied by others.
- 3.4.4 When the equipment has been installed, do all final connections to equipment.
- 3.4.5 Provide vacuum breaker on each domestic water connection serving each laboratory fixture. Conbraco Series 38-502, Watts 9D/N-LF9, Wilkins 750A/760, Febco 815, Hersey Grinnell BCP.
- 3.5 THERMOSTATIC FLOW REGULATOR
- 3.5.1 Install thermostatic flow regulator in each domestic hot water recirculation riser/branch beyond the last hot water device in that branch. Provide suitable line size isolation valves and access panel as required in non-accessible ceilings and walls.

END OF SECTION

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1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 - General Requirements, shall apply to and govern this Section.

1.2 SCOPE OF WORK

1.2.1 Provide all labour, materials, tools, equipment, training, commissioning and certification required to complete the work as shown on the Drawings and specified in this Section, including:

1.2.1.1 Sanitary system, including drains, and vents.

1.2.1.2 Floor drains and fittings.

1.3 REGULATORY REQUIREMENTS

1.3.1 In addition to specific requirements for pipe fittings as further specified in this document and where applicable, the equipment shall comply with the Boiler and Pressure Vessels Act (the "Act") and CSA Standard B51.

1.3.2 In compliance with the Act and relevant Codes, all fittings shall be registered by the manufacturer, and shall be identified by the appropriate Canadian registration number.

1.3.3 Where fittings are provided without the appropriate Canadian registration number, the Contractor shall obtain a copy of the manufacturer's Statutory Declaration as provided to the authorities having jurisdiction.

1.3.4 All welding and fabrication shall be to the requirements of the ANSI/ASME B31.9 code for pressure piping and CSA standard B51 code for the Construction and Inspection of Boilers and Pressure Vessels.

1.3.5 All copper piping shall be certified to ASTM Standard B88 for Seamless Copper Water Tube.

1.4 REFERENCES

1.4.1 ASTM D1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

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1.4.2 CAN/CSA B181.2 – PVC Drain, Waste and Vent Pipe and Pipe Fittings.

1.4.3 CAN/CSA B182.1 – Plastic Drain and Sewer Pipe and Pipe Fittings.

1.4.4 CAN/CSA B602 – Mechanical Couplings for Drain, Waste, and Vent Pipe and Sewer Pipe.

1.4.5 CAN/ULC-S102.2 Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies.

1.4.6 CAN/ULC-S115 – Standard Method of Fire Tests of Firestop Systems

1.4.7 National Plumbing Code of Canada (NPC)

1.4.8 Ontario Building Code (OBC)

1.5 QUALITY ASSURANCE

1.5.1 Source Limitations: Obtain plastic piping and fittings from a single manufacturer.

2 **PRODUCTS**

2.1 PIPES AND FITTINGS

2.1.1 Buried sanitary drains:

2.1.1.1 Piping shall be IPEX “PVC BDS Solvent Weld” DR-35 100mm - 150mm (4” - 6”) CAN/CSA B182.1, or IPEX “Ring-Tite” PVC DR-35 100mm - 375mm (4” – 15”) CAN/CSA B182.2, to ASTM Standard D3034.

2.1.1.2 Fittings for 100, 125, 150, 200, 300, and 375-mm (4”, 5”, 6”, 8”, 10”, 12”, & 15”) PVC DR 35 pipe shall be injection-moulded or fabricated fittings, certified by the Canadian Standards Association to CAN/CSA B182.1 and B182.2. Pipe and fittings to be constructed by the same manufacturer to ensure compatibility.

2.1.1.3 Gaskets shall be factory installed and made of elastomer, EPDM. Nitrile gaskets shall be used, as determined by the Consultant, where contaminated soils or special chemical or temperature resistance is encountered or required.

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- 2.1.1.4 PVC injection-moulded or fabricated tees shall be used for all service connections on new sewer main construction, including sewer mains for new subdivisions prior to assumption.
- 2.1.1.5 The pipe shall be jointed in accordance with the manufacturer's specifications.
- 2.1.1.6 Tracer wire shall be installed with all PVC pipe.
- 2.1.2 Sanitary piping cast into raft footings shall be ABS DWV.
- 2.1.3 Unburied sanitary drains, 75mm (3") dia. and under shall be copper drainage tube (DWV), cast brass fittings and 50/50 solder joints. Drains 100mm (4") dia. and over shall be standard weight cast iron pipe and fittings with mechanical joints.
 - 2.1.3.1 Alternatively, PVC-DWV pipe and fittings may be used in accordance with the following:
 - 2.1.3.1.1 For above-ground DWV applications, IPEX System 15 DWV certified to CAN/CSA B181.2 and having a Flame Spread Rating not more than 25.
 - 2.1.3.1.2 For above-ground DWV applications within air plenums (including entry and exit from plenum), and in High Buildings, IPEX System XFR DWV certified to CAN/CSA B181.2 and having a Flame Spread Rating not more than 25 and Smoke Developed Classification not more than 50.
 - 2.1.3.2 PVC pipe joints shall be solvent weld as follows:
 - 2.1.3.2.1 IPEX System 15/System XFR One-Step PVC Cement certified to CSA B181.2.
 - 2.1.3.2.2 IPEX System 15/System XFR Two-Step PVC Cement certified to CSA B181.2.
 - 2.1.3.2.3 IPEX System 15/System XFR PVC Primer certified to CSA B181.2.
 - 2.1.3.2.4 Sizes 1-1/2 inch to 6 inch: One-Step PVC Cement.
 - 2.1.3.2.5 Sizes 8 inch and above: Two-Step PVC Cement with PVC Primer.
 - 2.1.3.3 Sanitary drain lines serving waterless urinals and pool main drains up to 150mm (6") diameter shall be IPEX System 15 DWV certified to CAN/CSA B181.2 and having a Flame Spread Rating not more than 25. If drain lines are located within air plenums (including

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entry and exit from plenum), or in High Buildings, piping shall be IPEX System XFR DWV certified to CAN/CSA B181.2 and having a Flame Spread Rating not more than 25 and Smoke Developed Classification not more than 50. Run PVC piping in full length up to the connection to buried service unless otherwise indicated on plans.

- 2.1.4 Pumped sanitary drains shall be Schedule 40 galvanized steel pipe; stretch reduced continuous weld, ASTM A53, with screwed fittings.
 - 2.1.4.1 In lieu of the above specified piping, DWV piping with cast brass fittings and 50/50 solder joints may be used.
 - 2.1.4.2 In lieu of the above specified piping, IPEX "Xirtec CPVC" S40 for use in an air plenum or High Building, or IPEX "Xirtec PVC" S40 otherwise, may be used.
 - 2.1.4.3 Mechanical couplings (e.g. Victaulic) shall be permitted for pumped sanitary drain system, provided:
 - 2.1.4.3.1 The couplings are located in accessible locations.
 - 2.1.4.3.2 All couplings are by one manufacturer, suitable for pressure and temperature of respective system.
 - 2.1.4.3.3 Rigid (zero-flex or equivalent) couplings with angle bolt pads are used in mechanical rooms.
 - 2.1.4.3.4 Couplings for Schedule 40 piping to be manufactured from ductile iron conforming to ASTM-A536 and be complete with a Grade 'E' EPDM gasket, suitable for water service to 110°C (230°F).
 - 2.1.4.3.5 Couplings for copper grooved piping in size 50mm (2") and above to be designed with angle bolt pads to provide a rigid joint, complete with EPDM flush-seal gasket suitable for temperatures from -34° (-30°F) to 110°C (230°F).
 - 2.1.4.3.6 Fittings for Schedule 40 piping shall be manufactured from ductile iron conforming to ASTM-A536 or segmentally welded steel, with grooves designed to accept grooved end couplings.
- 2.1.5 Vents 50mm (2") dia. and less shall be type DWV copper, 65mm (2-1/2") and over galvanized.
 - 2.1.5.1 In lieu of the above specified piping, IPEX System XFR for use in in air plenums and High Buildings, and IPEX System 15 otherwise,

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may be used.

- 2.1.6 Fitting restraints for cast iron piping shall be HoldRite #117 series or approved equal. Field-devised methods and materials shall not be used to accomplish this application solution.

3 EXECUTION

3.1 GENERAL

- 3.1.1 Install in accordance with requirements of the Ontario Building Code or the local plumbing Authority Having Jurisdiction.
- 3.1.2 Ream all piping and keep plugged to prevent entry of dirt. Use pipes, which conform to CSA and ASTM standards.
- 3.1.3 Connect vent lines into the soil stack above highest fixture or extend separately through roof to a height of 600mm (24") above roofline and 3.6m (12 ft) away from any opening into building and flash properly.
- 3.1.4 Do not use double hubs, straight crosses, double T's or double TY's on any soil or waste pipe.
- 3.1.5 Install piping in a workmanlike manner and in accordance with current plumbing industry practices.
- 3.1.6 Consider the piping shown on the Drawings as diagrammatic, for clearness in indicating the general runs and connections and that the piping may, or may not, in all parts be shown in the true position. This does not relieve the responsibility for the proper erection of the systems of piping in every respect suitable for the work intended.
- 3.1.7 Cleanouts and other service items must be accessible.
- 3.1.8 Penetrations through structure shall be such that structural loads are not transferred to pipes.
- 3.1.9 On screwed piping, make up joints, metal to metal with red or white lead and oil applied to the thread. No hemp wick or packing will be permitted in making up screwed joints.
- 3.1.10 Thoroughly clean the inside of fittings and outside of pipe with steel wool and coat with flux, before soldering any copper pipe work joint. Remove the working parts of valves before soldering commences, and replace after soldering is complete.

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- 3.1.11 Use di-electric connections for cathodic protection wherever pipes of dissimilar material are connected together. When connecting grooved end steel to copper piping, use Victaulic dielectric waterway, Style 647-GG.
- 3.1.12 All traps and fittings shall be of same material or equal in quality and thickness to the pipe to which they are connected.
- 3.1.13 Provide unions or flanges at all connections to equipment or fixtures requiring servicing or replacement.
- 3.1.14 In copper pipes, provide wrought copper unions with soldered joints for pipe up to and including 50mm (2"), and 1,035 kPa (150 psi) cast brass flanges for pipes 65mm (2-1/2") or larger.
- 3.1.15 Install all grooved end components as per manufacturers latest recommendation. All grooved products shall be of one manufacturer.
- 3.1.16 Provide fitting restraints on mechanical pipe joints where required to accommodate axial thrust. Fitting restraints shall include but not be limited to all fittings over 75mm (3") in size, at the base of all vertical sanitary drains serving more than 10 storeys, including cleanouts, and all joints in horizontal piping at the lowest level which drains by gravity to the street services.
- 3.1.17 Provide fire-stop systems for all piping, at all penetrations through fire-rated separations tested and listed in accordance with CAN/ULC-S115.
- 3.2 **PVC PIPE DRAIN INSTALLATION**
- 3.2.1 In addition to the foregoing instructions (where applicable):
 - 3.2.1.1 Plastic piping installed in a building classified as a "High Building" or installed within a ceiling space used as an air plenum shall have a Flame Spread Rating less not more than 25 and Smoke Developed Classification not more than 50.
 - 3.2.1.2 Installation by a qualified installer.
 - 3.2.1.3 This Subcontractor to meet with PVC pipe manufacturer prior to construction to review the procedures concerning all aspects of installation described herein (solvent welding, supports, expansion/contraction and testing). The Contractor shall provide the Engineer with a written record of the meeting.

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- 3.2.1.4 Pipe must be cut squarely. Burrs and other loose materials shall be removed by chamfering of the pipe-end.. When required, PVC purple primer, Xirtec 07, shall first be generously applied to the pipe-end and inside the fitting hub. Next, CSA certified PVC solvent cement shall be applied to the pipe-end and inside the fitting hub while these areas are still moist. The pipe-end shall next be inserted to the full depth of the fitting hub and given a one-quarter turn. The pipe-end shall then be held in position until the solvent cement cures to the point of initial set. Pipe and fitting solvent weld joints shall be allowed to fully cure prior to pressure testing (follow the pipe manufacturers' recommended cure times).
- 3.2.1.5 For pumped discharge piping, ensure piping is braced to structure to avoid excessive movement.
- 3.2.1.6 This Subcontractor to accommodate all effects of thermal expansion and contraction movement by the use of line offsets or mechanical joint rubber couplings at sufficient intervals. As a general guideline, for piping installed in a controlled climate, straight pipe runs of less than 30m (100 ft) shall not require any expansion/contraction measures; for piping exposed to external weather elements, only runs of 15m (50 ft) or less shall not require expansion/contraction accommodation.
- 3.2.1.7 CSA certified mechanical joint couplings shall be installed at every second floor of the building. Rigidly support the stack pipe on alternating floors to minimize potential movement.
- 3.2.1.8 Provide fire-stop systems for all piping, at all penetrations through fire-rated separations tested and listed in accordance with CAN/ULC-S115.
- 3.3 TESTING
- 3.3.1 After all pipes have been placed in position and all branches installed, but before fixtures have been set or connected, test the tightness of all joints and the soundness of all pipes.
- 3.3.2 Make all tests before piping is furred in.
- 3.3.3 Notify the Consultant at least 48 hours before commencing with test, and give the Consultant a written certificate confirming these tests.
- 3.3.4 Sanitary, Waste, and Vent Piping: Securely close all openings in pipe ends throughout the work by means of approved plugs and fill

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the entire piping system, including stacks, branches to fixtures and all horizontal runs with water, up to highest opening and let this water stand at this level for not less than two (2) hours. Perform another test after the fixtures are set, connected, and connections are made to all equipment. Test by running water into all pipes, fixtures, traps, and apparatus in order to detect any imperfect material or workmanship. Where it is impossible to test the whole system at one time, divide into parts. Perform a smoke or ball test or any other test required by authorities having jurisdiction.

- 3.3.5 Test all pumped drain lines hydrostatically at 1-1/2 times the working pressure but at not less than 1,380 kPa (200 psi), for a period of not less than four (4) hours without any drop in pressure. Do testing before piping is buried or furred in and before pressure sensitive devices are installed in the pipework. Correct all defects disclosed by tests. Retest until all results are acceptable.
- 3.3.6 If any leaks are discovered by the above tests, remove and replace the faulty portions of the systems and repeat the test. Repeat this procedure until the system is accepted by the Consultant's representative on the site. Do not caulk threaded joints.
- 3.3.7 Check horizontal pipe with an accurate level for any alterations in pitch. Inspect laterals, cross arms, and eliminate pockets.
- 3.3.8 For PVC piping:
 - 3.3.8.1 Testing to be conducted after all solvent weld joints have cured.
 - 3.3.8.2 Perform hydrostatic pressure test prior to the piping system being commissioned.
 - 3.3.8.3 Pressure test underground piping systems before backfilling in accordance with requirements of the Ontario Building Code or the local plumbing Authority Having Jurisdiction.
 - 3.3.8.4 Pressure test above-ground piping systems in accordance with requirements of the Ontario Building Code or the local plumbing Authority Having Jurisdiction.
 - 3.3.8.5 As per manufacturer's instructions.
 - 3.3.8.6 The system should be slowly filled with water and all air bled from the highest and farthest points in the installation.
 - 3.3.8.7 Once the system has reached the desired test pressure, it should

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remain at this pressure for one hour.

- 3.3.8.8 During this time, visually inspect all joints for leaks.
- 3.3.8.9 If any leaks are discovered, remove and replace the faulty portion(s) of the system and allow to cure fully before re-testing.
- 3.3.8.10 Follow proper safety precautions and use protective equipment during testing.
- 3.3.8.11 Prepare test and inspection reports.

3.4 DRAIN PIPES IN RAFT FOOTINGS

- 3.4.1 Firmly restrain piping by tying off to adjacent rebars for entire horizontal length.
- 3.4.2 After leak test, leave water in pipe during concrete pour.
- 3.4.3 Notify Consultant at least 48 hours before pour.

3.5 FLUSHING AND CLEANING

- 3.5.1 General
 - 3.5.1.1 Inspect the systems, and remove any heavy debris and excessive oil and dirt.
 - 3.5.1.2 Flush all completed systems with clear water at the highest obtainable pressure and velocity.

3.6 STREET SERVICES

- 3.6.1 Connect building main and sanitary sewer to street main where shown, and make all necessary arrangements with authorities and utilities involved. Pay for all permits and inspections and for all work to be done by the local authorities and utility companies.
- 3.6.2 Check and verify all invert elevations before proceeding with any of this Work.

3.7 COMPLETION

- 3.7.1 Provide a declaration, signed by a responsible officer of the Division 22 – Plumbing Subcontractor indicating that the following procedures and tests have been performed in accordance with the Drawings and Specifications. Provide two (2) copies of the signed

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declaration to the Consultant.

3.7.1.1 Pressure test performed and leak free.

3.7.1.2 Plumbing inspections made and issue necessary certificates.

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1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 - General Requirements, shall apply to and govern this Section.

1.2 SHOP DRAWINGS

1.2.1 Submit shop drawings for the following equipment:

1.2.1.1 Floor drains

1.2.1.2 Trap primers

1.2.1.3 Grease interceptors

1.2.1.4 Catch basins

2 **PRODUCTS**

2.1 FLOOR DRAINS

2.1.1 Finished Areas – ‘FD-1’

2.1.1.1 Cast iron body floor drain, reversible flashing clamp with weep holes, adjustable top and 125mm (5”) diameter, nickel bronze, 6mm (1/4”) thick secured strainer, full 100mm (4”) throat opening. J.R.Smith 2005A; Zurn ZN415-B; Mifab F1100C-1, Watts FD-100-C-A5-1. For quarry or mosaic tiled areas provide 125mm x 125mm (5” x 5”) square nickel bronze strainer. J.R.Smith 2005B; Zurn ZN415-Y; Mifab F1100C-S, Watts FD-100-C-L5-1.

2.2 HUB DRAINS

2.2.1 Unfinished Areas – ‘HD-1’

2.2.1.1 Cast iron body drain, reversible flashing clamp with weep holes and cast iron hub adaptor. J.R.Smith 2005-2645; Zurn Z415-1030; Mifab F1100C-DD-50, Watts FD-100-C-DD-50.

2.2.2 Finished Areas – ‘HD-2’

2.2.2.1 Cast iron body drain, reversible flashing clamp with weep holes and nickel bronze hub adaptor. J.R.Smith 2005-2645NB; Zurn ZN415-1030; Mifab F1100C-DD-1, Watts FD-100-C-DD-1.

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2.3 FUNNEL FLOOR DRAINS

2.3.1 Unfinished Areas – ‘FFD-1’

2.3.1.1 Cast iron body combination funnel and floor drain, reversible flashing clamp with weep holes, adjustable top, 200mm (8") diameter, heavy duty, cast iron grate 13mm (1/2") thick strainer with 89mm x 229mm (3-1/2" x 9") cast iron funnel. J.R.Smith 2320-3591-CI; Zurn Z556 with Z414-1; Mifab F1320C-G-50, Watts FD-320-G-50.

2.3.2 Finished Areas – ‘FFD-2’

2.3.2.1 Cast iron body combination funnel and floor drain, reversible flashing clamp with weep holes, adjustable top, 125mm (5") diameter, nickel bronze, 6mm (1/4") thick secured strainer with 100mm (4") diameter nickel bronze funnel. J.R.Smith 2005A-3580NB; Zurn ZN415-B with ZN414; Mifab F1100C-F4-1, Watts FD-100-C-EF-1.

2.4 TRAP PRIMERS

2.4.1 One to Four Drain

2.4.1.1 Provide P.P.P MP-500 complete with adjustable timer trap seal primer. Tap size to be 15mm (1/2") with integral stainless steel screen. Electrical components shall include circuit breaker, test switch, timer solenoid valve (UL listed) and 120V/1Ph/60Hz connection.

2.4.2 More than Four Drain

2.4.2.1 Provide P.P.P. PT complete with adjustable timer trap seal primer. Primer shall be activated by a 20mm (3/4") normally closed solenoid valve. Manifold shall be prefabricated type "L" copper tubing. Electrical components shall include circuit breaker, switch, timer, solenoid valve (UL Listed). Electronic assembly tested and certified to UL73. Electrical connection shall be 120V/1Ph/60Hz. Cabinet shall be 356mm x 406mm x 86mm made from 16 GA steel and galvanized. Access door shall be prime coated steel complete with screw driver latch.

2.5 GREASE INTERCEPTOR

2.5.1 Provide a grease interceptor of the capacity as indicated on the Drawings.

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- 2.5.2 The grease interceptor shall be epoxy coated steel construction with removable baffles, gasketed aluminum cover, flow-control device, and deep seal trap with cleanout.
- 2.5.3 Provide the following accessories:
- 2.5.3.1 - Floor extension to suit invert of pipe.
 - 2.5.3.2 - Enzyme opening.
 - 2.5.3.3 - 'LR' for low profile installation.
 - 2.5.3.4 - 'S' for suspension with waterproofing flange and adequately
 - 2.5.3.5 - supported from structure.
- 2.5.4 If installed in fill provide stainless steel interceptor.
- 2.5.5 Provide electronic monitoring device with control panel, step down transformer and all control wiring (monitoring device required for all projects located in Scarborough).

3 EXECUTION

3.1 TRAPS

- 3.1.1 Provide every fixture and floor drain with traps in accordance with local regulations. Provide each trap with its own brass plug and ferrule cleanout.
- 3.1.2 For traps located in ceilings, provide access doors.
- 3.1.3 For drains in apparatus casings or air plenums, provide deep seal trap. For drains in outside air plenums, provide running trap located as far as possible from drains.
- 3.1.4 All traps for floor and hub drains shall be protected with trap primers. For electronic trap primers, run line voltage wiring to the nearest electrical panel with spare circuit.
- 3.1.5 Division 22 contractor must coordinate with electrical trade for circuit locations during scope drawing stage, otherwise Division 22 trade will be responsible for all costs associated with circuit wiring.
- 3.1.6 Trap seal primers must be installed above finished floor. Piping must have a minimum of 300mm (12") from bottom of outlet before 90 degree elbow can be used. Furthest distance from primer to

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floor drain is 6m. Trap primer make up line must have a continuous slope to the floor drain.

3.1.7 If required by authorities having jurisdiction, provide building traps complete with cleanout and fresh air inlet with special grilles to meet the Consultant's approval.

3.2 DRAINS

3.2.1 In all areas with seamless flooring and plastic terrazzo finishes provide special flanges. These flanges shall be 100mm (4") larger in diameter than the drain top or sleeve diameter, and located approximately 5mm ($\frac{3}{16}$ ") below the top flanges to be of the same material as the drain finish.

3.2.2 Provide special flanges for the following items as described above:

3.2.2.1 Floor drains

3.2.2.2 Hub drains

3.2.2.3 Combination drains

3.2.2.4 Area drains

3.3 UNIONS, FLANGES, DI-ELECTRIC COUPLINGS

3.3.1 Provide unions or flanges at all connections to equipment of fixtures requiring servicing or replacing.

3.3.2 In copper pipes, provide wrought copper unions with soldered joints for pipes up to and including DN50 (2") sizes and 1,034 kPa (150 psi) cast brass flanges for pipes DN100 (4") or larger.

3.3.3 Install approved dielectric isolation in following specified systems:

3.3.3.1 In all locations where specifically noted or shown

3.3.4 Install approved dielectric isolation at the transition between noble materials such as copper, brass bronze, high alloy castings, or stainless steel and low alloy ferrous materials such as black iron, galvanized iron, or cast iron. These dielectric isolators must be installed in such a way that they are not shorted out by accidental contacts to process equipment, building steel, instrumentation tubing, or electrical neutrals. Ensure that dielectric unions are constructed of materials that are compatible galvanically with the systems to which they are connected, e.g. a dielectric union for

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installation between copper and iron must be constructed with a body of iron and a tailpiece of copper or brass.

3.4 KITCHEN AND OTHER OWNER'S EQUIPMENT

- 3.4.1 Provide complete roughing-in and final connections for kitchen, laboratory, and other Owner's equipment as shown on the Drawings and as further delineated by the kitchen, laboratory, and other Owner's equipment drawings provided by the Owner. Contractor shall prepare complete 1:50 scale drawing with all services shown as required for approval by the Consultant.
- 3.4.2 No roughing-in shall be started and no final connections made to equipment until complete roughing-in and connection drawings have been provided by the Owner.
- 3.4.3 Provide a complete venting system as part of the roughing-in. Venting shall be acceptable to the local plumbing inspector.
- 3.4.4 Provide capped connections to equipment supplied by others.
- 3.4.5 When the equipment has been installed, do all final connections to equipment.

END OF SECTION

Project Name: CITY OF TORONTO - DAYCARE CENTRE (METRO HALL)
Project No.: 2021-0245
Section Name: **Plumbing Fixtures**
Section No.: **22 40 00**
Date: January 26, 2024

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3.3	Fixtures

Project Name: CITY OF TORONTO - DAYCARE CENTRE (METRO HALL)
Project No.: 2021-0245
Section Name: **Plumbing Fixtures**
Section No.: **22 40 00**
Date: January 26, 2024

1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 - General Requirements, shall apply to and govern this Section.

1.2 SHOP DRAWINGS

1.2.1 Submit shop drawings for the following equipment:

1.2.1.1 Plumbing fixtures and brass.

1.2.1.2 Fixture carriers and other appurtenances.

2 **PRODUCTS**

2.1 FIXTURES

2.1.1 Refer to Appendix A for plumbing fixtures.

3 **EXECUTION**

3.1 TRAPS

3.1.1 Provide every fixture with traps in accordance with local regulations. Provide each trap with its own brass plug and ferrule cleanout.

3.1.2 For traps located in ceilings, provide access doors.

3.2 UNIONS, FLANGES

3.2.1 Provide unions or flanges at all connections to fixtures requiring servicing or replacing.

3.2.2 In copper pipes, provide wrought copper unions with soldered joints for pipes up to and including DN50 (2") sizes and 1,034 kPa (150 psi) cast brass flanges for pipes DN100 (4") or larger.

3.3 FIXTURES

3.3.1 Supply and install all hangers, supports, brackets, reinforcement, steel back-up plates, etc. for the proper installation of fixtures and supply fittings.

3.3.2 Install all components in strict accordance with manufacturer's

Project Name: CITY OF TORONTO - DAYCARE CENTRE (METRO HALL)
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recommendations.

- 3.3.3 Where plumbing fixtures contact wall, and/or floors, seal joints with Dow Corning #781, building sealant, make watertight and bead smooth in a neat professional manner.
- 3.3.4 Exposed trim, supplies, traps, fittings, etc. shall be brass, heavily chrome plated unless noted otherwise.
- 3.3.5 Provide a trap for each fixture.
- 3.3.6 Vent fixtures in accordance with Section 22 13 16 – Sanitary Waste and Vent Piping.
- 3.3.7 Install chrome plated angle on straightaway type screwdriver compression stops, as required, on all hot and cold water service connections to all fixtures.
- 3.3.8 Install escutcheon plates where all service connections to fixtures pass through walls or floors. Plates shall be cast brass, heavy chrome plated. Same internal diameter as external diameter of pipe.

END OF SECTION

PRODUCT SPECIFICATION INFORMATION

PROJECT NAME

211018 - Metro Hall // Plumbing Fixtures

PROJECT LOCATION

**Toronto, Ontario
Canada**

DATE

2024/06/25

PREPARED BY

Head Office

American Standard

WC-1

Toilet - Wall-hung

AFWALL® MILLENNIUM™ FloWise®

To be specified

Centoco - Seat



☒ **500STSCFE-001** FAST-N-LOCK, For elongated bowl, Open front, Heavy-duty, For commercial applications, Polypropylene, Toilet seat, Less seat cover, Plastic commercial check hinges, and Stainless steel hinge pin, Specified in White finish,

FAST-N-LOCK mounting system takes the guess work out when tightening the hardware. The specially designed fasteners in click" when the appropriate torque is reached. The bolt and nut material shall be stainless steel,

Dimensions: 25 mm (1") high, 473 mm (18-5/8") long, 371 mm (14-5/8") wide

American Standard- Toilet

☒ **3351101.020**



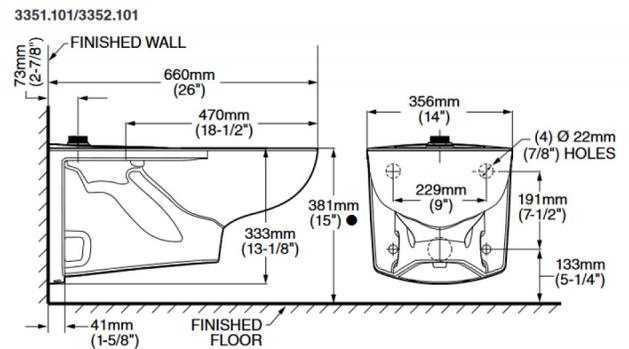
Toilet, Wall-hung with wall outlet, Toilet operates in the range of 4.2 to 6.0 LPF (1.1 - 1.6 GPF), White finish Vitreous china, EverClean® antimicrobial surface, Elongated bowl, Concealed trapway design, Direct-fed siphon jet flush action, 38 mm (1-1/2") top spud, Flush valve by others, Fully-glazed 54 mm (2-1/8") trapway, Static load rating of 454 kg (1000 lb), this product is not recommended for bariatric use, Condensation channel, Toilet seat not included, Consisting of:
 Overall Dimensions: 356 mm (14") wide, 660 mm (26") from finished wall, Water Surface: 254 x 305 mm (10" x 12") water surface area
 Map Score: >=1000 MaP® flush score (when use with proper flush valve)
 Compliances: ASME A112.19.2 compliant, CSA B45.1 compliant.

Sloan - Flush Valve



☒ **SL-ROYAL 111-1.28-ESS** ROYAL® Automatic no-touch Exposed Water closet flushometer, 38 mm (1-1/2") spud coupling For top spud toilet, Hardwired, constructed from Semi-red brass, Polished chrome finish, High Efficiency 4.8 LPF (1.28 GPF), Chloramine resistant PERMEX® synthetic rubber diaphragm, OPTIMA® EL-1500 self-adaptive infrared sensor, Sensor located on die cast sensor plate with no visible fasteners (for 2-gang electrical box), Courtesy Flush® electrical override button, Flush tube for 292 mm (11-1/2") rough-in, Adjustable tailpiece, 25 mm (1") I.P.S. screwdriver Bak-Chek® angle control stop with free spinning vandal-resistant stop cap, Dual-filtered fixed bypass, Sweat solder adapter kit with cover tube, High back pressure vacuum breaker, 25 mm (1") supply pipe, Cast wall flange with set screw, Non-hold-open, no external volume adjustment, fixed volume accuracy is controlled by CID™ technology, 24 VAC input/output, With indicator light, Requires transformers 0345154 or 0345999, Pressure Range: 103 - 552 kPa (15 - 80 PSI) operating water pressure
 Compliances: cUPC compliant.

Refer to the product specification sheet for complete information



Note:

Spec Reference: 123702
Product Reference: 222296; 7039973; 7308524; 7030565; 7041732; 7303925

Sloan - Faucet and Flush Valve Power Kit



☒ **SL-EL-154** For flush valve

Watts - Carrier



☒ **ISCA-101-L/R-M11** Industry Standard single Horizontal adjustable Closet Carrier, Adjustable for standard and wheelchair height, 102 mm (4") no hub waste, 51 mm (2") no hub vent connections, patented compression seal faceplate assembly, epoxy coated cast iron, with incremental measurements embossed onto legs to easily adjust height of carrier to most commonly used fixture requirements, epoxy coated cast iron foot support, neoprene bowl gasket, epoxy coated cast iron, integral test cap, chrome cap nuts, Plated hardware, Adjustable ABS nipple, Tiling frame,

Codes and Compliances: Carrier complies with requirements of ASME A112.6.1M up to a 500 lb (227 kg) static load.

Champion - Coupling



☒ **MI-XHUB** Connects to Type 300 stainless steel shield painted red for easy identification, Neoprene gasket,

Compliances and certifications:

Note:

Spec Reference: 123702
Product Reference: 222296; 7039973; 7308524;
7030565; 7041732; 7303925

American Standard

WC-2 Manual

Toilet - Floor mounted with floor outlet

BABY DEVORO™ FloWise®

To be specified

Centoco - Seat



☒ **AM2300STSCC-001** For baby seat, Open front, Heavy-duty, For commercial applications, Polypropylene, Toilet seat, Less seat cover, Self-sustaining plastic commercial check hinges, and Stainless steel hinge pin, Specified in White finish, and Antimicrobial additive inhibits the growth of stain and odor causing bacteria, Includes stainless steel hardware,

Dimensions: 25 mm (1") high, 387 mm (15-1/4") long, 362 mm (14-1/4") wide

Sloan - Flush Valve



☒ **ROYAL 111-YO-1.28** ROYAL® Manual Exposed Water closet flushometer, 38 mm (1-1/2") spud coupling For top spud toilet, constructed from Semi-red brass, Polished chrome finish, High Efficiency 4.8 LPF (1.28 GPF), Chloramine resistant PERMEX® synthetic rubber diaphragm, Metal oscillating handle with triple seal handle packing, Flush tube for 292 mm (11-1/2") rough-in, Adjustable tailpiece, 25 mm (1") I.P.S. screwdriver Bak-Chek® angle control stop with free spinning vandal-resistant stop cap, Dual-filtered fixed bypass, Sweat solder adapter kit with cover tube, High back pressure vacuum breaker, Inlet located right of valve, 25 mm (1") supply pipe, Cast wall flange with set screw, Non-hold-open, no external volume adjustment, fixed volume accuracy is controlled by CID™ technology, Angle back check stop seat bumper for seats without covers, Pressure Range: 103 - 552 kPa (15 - 80 PSI) operating water pressure Complies: Requires less than 5 pounds of force to activate (push button), cUPC compliant.

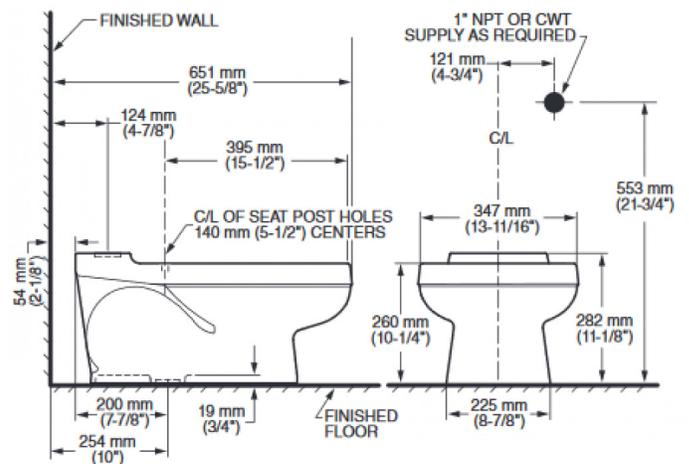
American Standard- Toilet

☒ **2282001.020**



Toilet, Floor mounted with floor outlet, Toilet operates in the range of 4.8 to 6.0 LPF (1.28 - 1.6 GPF), White finish Vitreous china, Junior bowl, 260 mm (10-1/4") rim height for toddlers, Minimum 254 mm (10") rough-in from wall to the center of waste outlet, Siphon jet flush action, 38 mm (1-1/2") top spud, Flush valve by others, Fully-glazed trapway, Toilet seat not included, Two (2) colour-matched bolt caps with retainers (481310-100), Consisting of:
Overall Dimensions: 348 mm (13-11/16") wide, 651 mm (25-5/8") from finished wall, 283 mm (11-1/8") high
Water Surface:
Map Score: 800 g MaP® flush score
Compliances: ASME A112.19.2 compliant, CSA B45.1 compliant.

Refer to the product specification sheet for complete information



Note:

Spec Reference: 123702

Product Reference: 222294; 7132857; 7307938

FRANKE**S-1 (Adult Handwash)***Type 304 Stainless steel***Single compartment,
Counter mounted,
Undermount
Kitchen sink***To be specified***Chicago Faucets - Faucet**

☒ **430-ABCP** Counter mounted, Manual, Single handle, Sink faucet, Polished chrome finish, Single hole centerset, Lead Free ANSI/NSF 61 compliant, ECAST® brass construction, Ceramic cartridge with volume control, 5.7 LPM (1.5 GPM) maximum flowrate, Pressure compensating Econo-Flo™ non-aerated laminar spray outlet, Tubular cast brass spout, 229 mm (9") spout reach, 146 mm (5-3/4") high, 108 mm (4-1/4") lever handle, 13 mm (1/2") NPSM supply inlet, Includes hot limit safety stop.

Lawler - Mixing Valve

☒ **570-86820** Point of Use and Master controlled fixtures, Thermostatic master water mixing control valve, Lead free brass body construction, Nickel plated finish, Lead free brass body construction, 1.9 - 30 LPM (0.5 - 8 GPM) range for flowrate , To adjust the mixed outlet temperature of the valve, remove the cap to gain access to the adjusting spindle. The spindle should be rotated-clockwise to reduce the temperature, counter-clockwise to increase the temperature until the desired set point is reached, 11 LPM (3 GPM) tempered flowrate @ 5 PSI pressure drop, The temperature is adjusted with the help of Spindle, 4-7/8" (124 mm) Height, The temperature is adjusted with the help of Spindle, 3/8" MNPT (9.5 mm) inlet, 3/8" MNPT (9.5 mm) inlet, 95-115 °F outlet water temperature range, 3/8" MNPT (9.5 mm) outlet, 3/8" MNPT (9.5 mm) outlet, internal checks, Thermostatic master water mixing control valve, Nickel plated finish, Point of Use and Master controlled fixtures, ASSE 1070 approved Certified to CSA B125.3 for ASSE 1070 applications, 95-115 °F outlet water temperature range, Offers choice of temperature settings from 95° through 115 °F., 125 PSI max hydrostatic pressure, 125 PSI max hydrostatic pressure, ±20% pressure variation, ±20% pressure variation, 11 LPM (3 GPM) tempered flowrate @ 5 PSI pressure drop, To adjust the mixed outlet temperature of the valve, remove the cap to gain access to the adjusting spindle. The spindle should be rotated-clockwise to reduce the temperature, counter-clockwise to increase the temperature until the desired set point is reached, 40-80 °F, 10 °F, 180 °F max, 7 GPM flowrate @ 45 PSI, Offers choice of temperature settings from 95° through 115 °F., ±5 °F, Protects against scalding and chilling

Franke Commercial- Sink

☒ **UCS6808P-1**

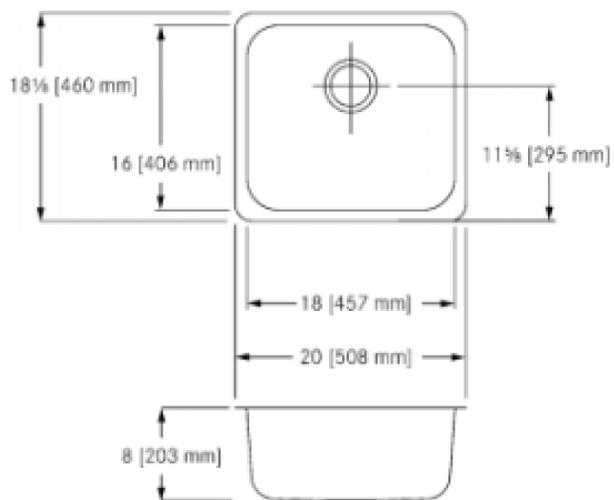
Without faucet ledge, 18 gauge Type 304 Stainless steel Polished to #4 satin finish, Center back waste location, 38 mm (1-1/2") (DN38) brass tailpiece, 89 mm (3-1/2") crumb cup strainer, waste fitting included, Undercoated to reduce condensation and resonance,

Codes and Compliances: ASME A112.19.3 compliant, CSA B45.4 compliant,

Bowl Dimension: Left bowl is 457mm (18") long and right bowl is 305mm (12") long, 406 mm (16") wide, 203 mm (8") deep,

Overall Dimension: 508 mm (20") long, 460 mm (18-1/8") wide, 203 mm (8") high.

Refer to the product specification sheet for complete information



Note:

Spec Reference: 123702
Product Reference: 7018175; 7018429;
 7018383; 7047032; 7017077



S-1 (Adult Handwash)

Type 304 Stainless steel

Single compartment,
Counter mounted,
Undermount
Kitchen sink

McGuire - Supply



☒ **LFCK165LK** Lead Free, with Chrome-plated finish, Pipe to compression connection, 3/8" I.P.S x 3/8" O.D connection, Shallow wall flange, Loose key handle, Full turn brass stem, 305 mm (12") chrome-plated risers, Purple EPDM peroxide cured washers,

Codes and compliances: NSF/ANSI 61 & 372, UPC

McGuire - P-Trap



☒ **8912CB** Heavy cast brass, Adjustable p-trap, 292 mm (11-1/2") length, With cleanout plug, Steel box flange, Neoprene gasket, Seamless tubular brass bend, Slipnuts

Note:

Spec Reference: 123702
Product Reference: 7018175; 7018429;
7018383; 7047032; 7017077



S-2

Type 304 Stainless steel

Double compartment,
Counter mounted,
Undermount
Kitchen sink

To be specified

Chicago Faucets - Faucet



☒ **434-ABBN** Counter mounted, Manual, Single handle, Sink faucet, Brushed nickel finish, Single hole centerset, Lead Free ANSI/NSF 61 compliant, ECAST® brass construction, With supply, Ceramic cartridge with volume control, 5.7 LPM (1.5 GPM) maximum flowrate, Gooseneck spout, Pull down, 210 mm (8-1/4") spout reach, 432 mm (17") high, Lever handle, 13 mm (1/2") NPSM supply inlet for 10 mm (3/8") or 13 mm (1/2") flexible riser, Includes hot limit safety stop.

Franke Commercial- Sink

☒ **UCD6408P-1**



Without faucet ledge, 18 gauge Type 304 Stainless steel Polished to #4 satin finish, Center back waste location, 38 mm (1-1/2") (DN38) brass tailpiece, 89 mm (3-1/2") crumb cup strainer, waste fitting included, Undercoated to reduce condensation and resonance,

Codes and Compliances: ASME A112.19.3 compliant, CSA B45.4 compliant,

Bowl Dimension: Left bowl is 356 mm (14") long and right bowl is 356 mm (14") long, Left bowl is 406 mm (16") wide and right bowl is 406 mm (16") wide, Left bowl is 203 mm (8") deep and right bowl is 203 mm (8") deep,

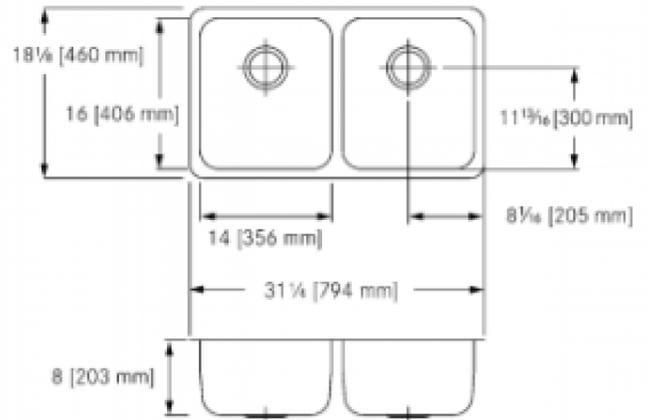
Overall Dimension: 794 mm (31-1/4") long, 460 mm (18-1/8") wide, 203 mm (8") high.

Refer to the product specification sheet for complete information

Lawler - Mixing Valve



☒ **570-86820** Point of Use and Master controlled fixtures, Thermostatic master water mixing control valve, Lead free brass body construction, Nickel plated finish, Lead free brass body construction, 1.9 - 30 LPM (0.5 - 8 GPM) range for flowrate , To adjust the mixed outlet temperature of the valve, remove the cap to gain access to the adjusting spindle. The spindle should be rotated-clockwise to reduce the temperature, counter-clockwise to increase the temperature until the desired set point is reached, 11 LPM (3 GPM) tempered flowrate @ 5 PSI pressure drop, The temperature is adjusted with the help of Spindle, 4-7/8" (124 mm) Height, The temperature is adjusted with the help of Spindle, 3/8" MNPT (9.5 mm) inlet, 3/8" MNPT (9.5 mm) inlet, 95-115 °F outlet water temperature range, 3/8" MNPT (9.5 mm) outlet, 3/8" MNPT (9.5 mm) outlet, internal checks, Thermostatic master water mixing control valve, Nickel plated finish, Point of Use and Master controlled fixtures, ASSE 1070 approved Certified to CSA B125.3 for ASSE 1070 applications, 95-115 °F outlet water temperature range, Offers choice of temperature settings from 95° through 115 °F., 125 PSI max hydrostatic pressure, 125 PSI max hydrostatic pressure, ±20% pressure variation, ±20% pressure variation, 11 LPM (3 GPM) tempered flowrate @ 5 PSI pressure drop, To adjust the mixed outlet temperature of the valve, remove the cap to gain access to the adjusting spindle. The spindle should be rotated-clockwise to reduce the temperature, counter-clockwise to increase the temperature until the desired set point is reached, 40-80 °F, 10 °F, 180 °F max, 7 GPM flowrate @ 45 PSI, Offers choice of temperature settings from 95° through 115 °F., ±5 °F, Protects against scalding and chilling



Note:

Spec Reference: 123702
Product Reference: 7018168; 13820278;
7018383; 7017080; 7017077



S-2

Double compartment,
Counter mounted,
Undermount
Kitchen sink

Type 304 Stainless steel

McGuire - Supply



☒ **LFBV170** Lead Free, with Chrome-plated finish, Convertible loose key handle.

McGuire - P-Trap



☒ **8912CB** Heavy cast brass, Adjustable p-trap, 292 mm (11-1/2") length, With cleanout plug, Steel box flange, Neoprene gasket, Seamless tubular brass bend, Slipnuts

Note:

Spec Reference: 123702
Product Reference: 7018168; 13820278;
7018383; 7017080; 7017077



S-3

Type 304 Stainless steel

Triple compartment,
Counter mounted, Drop-in
Commercial sinks

To be specified

McGuire - P-Trap



☒ **8912CB** Heavy cast brass, Adjustable p-trap, 292 mm (11-1/2") length, With cleanout plug, Steel box flange, Neoprene gasket, Seamless tubular brass bend, Slipnuts

Franke Commercial- Sink

☒ LBT6410PCB-1-1



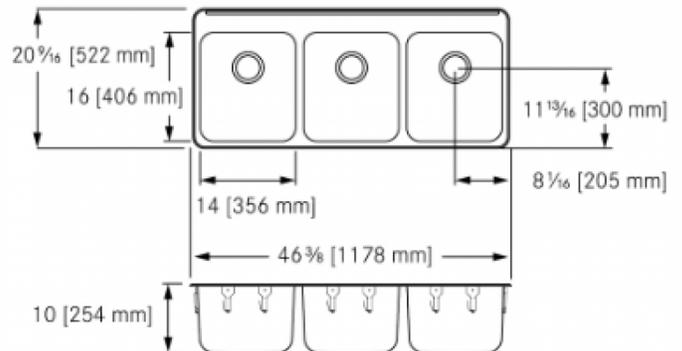
Single hole centerset, With faucet ledge, 18 gauge Type 304 Stainless steel Polished to #4 satin finish, Factory installed EZ TORQUE™ fasteners, Factory applied rim seal, Center back waste location, 38 mm (1-1/2") (DN38) brass tailpiece, 89 mm (3-1/2") crumb cup strainer, waste fitting included, Undercoated to reduce condensation and resonance,

Codes and Compliances: ASME A112.19.3 compliant, CSA B45.4 compliant,

Bowl Dimension: Left bowl is 356 mm (14") long, middle bowl is 356 mm (14") long and right bowl is 356 mm (14") long, Left bowl is 406 mm (16") wide, middle bowl is 406 mm (16") wide and right bowl is 406 mm (16") wide, Left bowl is 254 mm (10") deep, middle bowl is 254 mm (10") deep and right bowl is 254 mm (10") deep,

Overall Dimension: 1178 mm (46-3/8") long, 522 mm (20-9/16") wide, 254 mm (10") high.

Refer to the product specification sheet for complete information



Note:

Spec Reference: 123702
Product Reference: 7032621; 7017077

To be specified

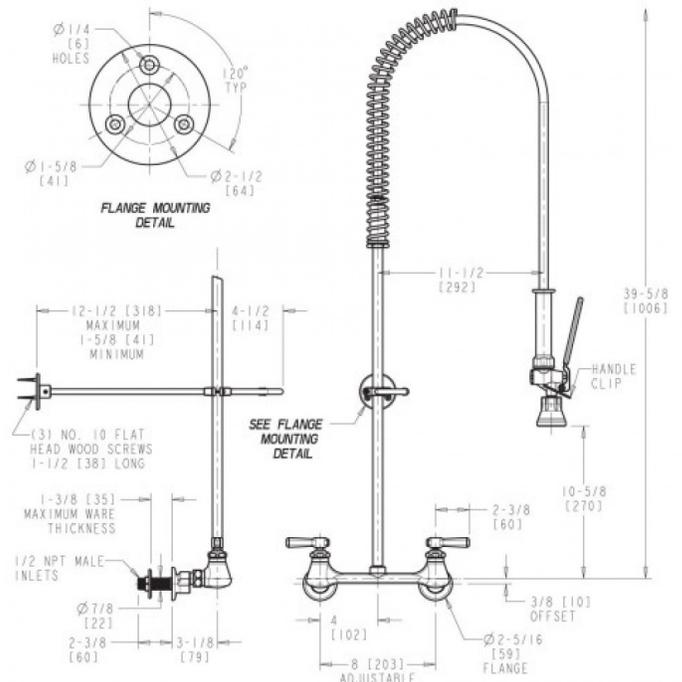
Chicago Faucets- Faucet

☒ **510-GWSLXKCAB**



Wall-hung, Manual, Two handles, Pre-rinse fitting, Chrome plated finish, 184 - 222 mm (7-1/4" - 8-3/4") adjustable centerset, Lead Free ANSI/NSF 61 and ANSI/NSF 372 compliant, ECAST® brass construction, 1/4 turn ceramic cartridge with integrated check valve, 3.8 LPM (1.0 GPM) flow rate @60psi pre-rinse spray valve, Spray outlet, Pre-rinse spout, Pull down, 292 mm (11-1/2") spout reach, 1006 mm (39-5/8") high, Pre-rinse spout and valve consisting of 584 mm (23") riser with spring guide, 1118 mm (44") flexible stainless steel hose with insulated handle, pipe strap and hook assembly, Vandal-resistant 60 mm (2-3/8") lever handle with indexed buttons, 13 mm (1/2") NPT female thread inlet.

Refer to the product specification sheet for complete information



Note:

Spec Reference: 123702
Product Reference: 13831535



S-4

Grade 18-8 Type 304 Stainless steel

Single compartment,
Counter mounted,
Undermount
Kitchen sink

To be specified

Chicago Faucets - Faucet



☒ **434-ABBN** Counter mounted, Manual, Single handle, Sink faucet, Brushed nickel finish, Single hole centerset, Lead Free ANSI/NSF 61 compliant, ECAST® brass construction, With supply, Ceramic cartridge with volume control, 5.7 LPM (1.5 GPM) maximum flowrate, Gooseneck spout, Pull down, 210 mm (8-1/4") spout reach, 432 mm (17") high, Lever handle, 13 mm (1/2") NPSM supply inlet for 10 mm (3/8") or 13 mm (1/2") flexible riser, Includes hot limit safety stop.

Kindred- Sink

☒ **QSU A1925-8**



Without faucet ledge, Grade 18-8 20 gauge Type 304 Stainless steel Polished to satin finish, Silk finish, Installation kit are included, Center back waste location, 89 mm (3-1/2") basket strainer waste fittings included, Sink is fully undercoated,

Bowl Dimension: Left bowl is 584mm (23") long and right bowl is 381mm (15") long, Left bowl is 432 mm (17") wide and right bowl is 432 mm (17") wide, 203 mm (8") deep,

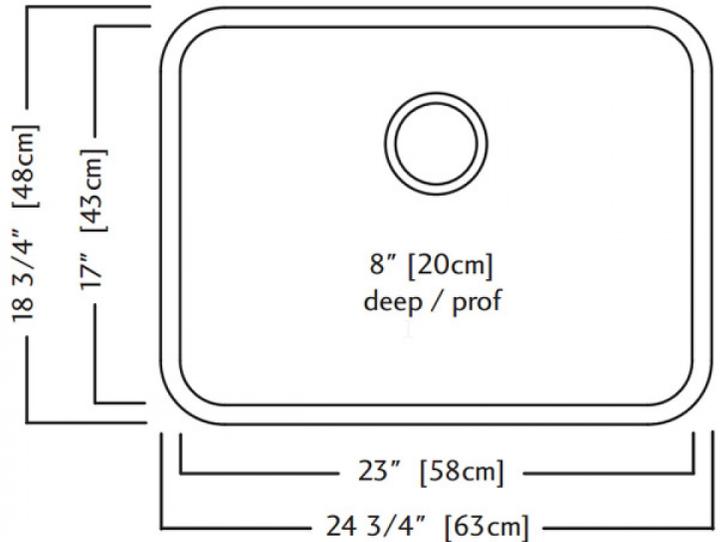
Overall Dimension: 629 mm (24-3/4") long, 476 mm (18-3/4") wide, 203 mm (8") high.

Lawler - Mixing Valve



☒ **570-86820** Point of Use and Master controlled fixtures, Thermostatic master water mixing control valve, Lead free brass body construction, Nickel plated finish, Lead free brass body construction, 1.9 - 30 LPM (0.5 - 8 GPM) range for flowrate , To adjust the mixed outlet temperature of the valve, remove the cap to gain access to the adjusting spindle. The spindle should be rotated-clockwise to reduce the temperature, counter-clockwise to increase the temperature until the desired set point is reached, 11 LPM (3 GPM) tempered flowrate @ 5 PSI pressure drop, The temperature is adjusted with the help of Spindle, 4-7/8" (124 mm) Height, The temperature is adjusted with the help of Spindle, 3/8" MNPT (9.5 mm) inlet, 3/8" MNPT (9.5 mm) inlet, 95-115 °F outlet water temperature range, 3/8" MNPT (9.5 mm) outlet, 3/8" MNPT (9.5 mm) outlet, internal checks, Thermostatic master water mixing control valve, Nickel plated finish, Point of Use and Master controlled fixtures, ASSE 1070 approved Certified to CSA B125.3 for ASSE 1070 applications, 95-115 °F outlet water temperature range, Offers choice of temperature settings from 95° through 115 °F., 125 PSI max hydrostatic pressure, 125 PSI max hydrostatic pressure, ±20% pressure variation, ±20% pressure variation, 11 LPM (3 GPM) tempered flowrate @ 5 PSI pressure drop, To adjust the mixed outlet temperature of the valve, remove the cap to gain access to the adjusting spindle. The spindle should be rotated-clockwise to reduce the temperature, counter-clockwise to increase the temperature until the desired set point is reached, 40-80 °F, 10 °F, 180 °F max, 7 GPM flowrate @ 45 PSI, Offers choice of temperature settings from 95° through 115 °F., ±5 °F, Protects against scalding and chilling

Refer to the product specification sheet for complete information



Note:

Spec Reference: 123702
Product Reference: 15110099; 13820278;
7018383; 7047032; 7017077



S-4

Single compartment,
Counter mounted,
Undermount
Kitchen sink

Grade 18-8 Type 304 Stainless steel

McGuire - Supply



☒ **LFCK165LK** Lead Free, with Chrome-plated finish, Pipe to compression connection, 3/8" I.P.S x 3/8" O.D connection, Shallow wall flange, Loose key handle, Full turn brass stem, 305 mm (12") chrome-plated risers, Purple EPDM peroxide cured washers,

Codes and compliances: NSF/ANSI 61 & 372, UPC

McGuire - P-Trap



☒ **8912CB** Heavy cast brass, Adjustable p-trap, 292 mm (11-1/2") length, With cleanout plug, Steel box flange, Neoprene gasket, Seamless tubular brass bend, Slipnuts

Note:

Spec Reference: 123702
Product Reference: 15110099; 13820278;
7018383; 7047032; 7017077



S-5 (Kids Handwash)

Type 304 Stainless steel

Single compartment,
Counter mounted,
Undermount
Kitchen sink

To be specified

Sloan - Faucet



☒ **EAF-700-HLT-CP-1.0GPM-LAM-IR-IQ-FCT** OPTIMA®, Counter mounted, Automatic no-touch, Hardwired (specify transformer separately), Sink/lavatory faucet, Polished chrome finish, Single hole centerset, Brass spout, Flexible high pressure hose, 3.8 LPM (1.0 GPM) maximum flowrate, Laminar flow outlet, Gooseneck spout, 147 mm (5-7/8") spout reach, 355 mm (13-31/32") high, Double infrared sensors with automatic setting feature and microprocessor, Bi-stable magnetic solenoid valve, Above deck control access, Mixing valve ordered separately, Sloan transformer recommended, 12/24 hour hygienic rinse line purge function (field settable).

Franke Commercial- Sink

☒ **UCS6808P-1**



Without faucet ledge, 18 gauge Type 304 Stainless steel Polished to #4 satin finish, Center back waste location, 38 mm (1-1/2") (DN38) brass tailpiece, 89 mm (3-1/2") crumb cup strainer, waste fitting included, Undercoated to reduce condensation and resonance,

Codes and Compliances: ASME A112.19.3 compliant, CSA B45.4 compliant,

Bowl Dimension: Left bowl is 457mm (18") long and right bowl is 305mm (12") long, 406 mm (16") wide, 203 mm (8") deep,

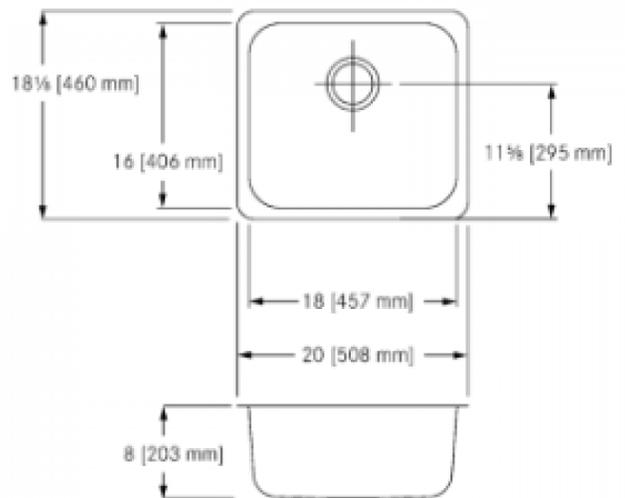
Overall Dimension: 508 mm (20") long, 460 mm (18-1/8") wide, 203 mm (8") high.

Lawler - Mixing Valve



☒ **570-86820** Point of Use and Master controlled fixtures, Thermostatic master water mixing control valve, Lead free brass body construction, Nickel plated finish, Lead free brass body construction, 1.9 - 30 LPM (0.5 - 8 GPM) range for flowrate , To adjust the mixed outlet temperature of the valve, remove the cap to gain access to the adjusting spindle. The spindle should be rotated-clockwise to reduce the temperature, counter-clockwise to increase the temperature until the desired set point is reached, 11 LPM (3 GPM) tempered flowrate @ 5 PSI pressure drop, The temperature is adjusted with the help of Spindle, 4-7/8" (124 mm) Height, The temperature is adjusted with the help of Spindle, 3/8" MNPT (9.5 mm) inlet, 3/8" MNPT (9.5 mm) inlet, 95-115 °F outlet water temperature range, 3/8" MNPT (9.5 mm) outlet, 3/8" MNPT (9.5 mm) outlet, internal checks, Thermostatic master water mixing control valve, Nickel plated finish, Point of Use and Master controlled fixtures, ASSE 1070 approved Certified to CSA B125.3 for ASSE 1070 applications, 95-115 °F outlet water temperature range, Offers choice of temperature settings from 95° through 115 °F., 125 PSI max hydrostatic pressure, 125 PSI max hydrostatic pressure, ±20% pressure variation, ±20% pressure variation, 11 LPM (3 GPM) tempered flowrate @ 5 PSI pressure drop, To adjust the mixed outlet temperature of the valve, remove the cap to gain access to the adjusting spindle. The spindle should be rotated-clockwise to reduce the temperature, counter-clockwise to increase the temperature until the desired set point is reached, 40-80 °F, 10 °F, 180 °F max, 7 GPM flowrate @ 45 PSI, Offers choice of temperature settings from 95° through 115 °F., ±5 °F, Protects against scalding and chilling

Refer to the product specification sheet for complete information



Note:

Spec Reference: 123702
Product Reference: 7018175; 19596481;
7018383; 7047032; 7017077; 7030567



S-5 (Kids Handwash)

Type 304 Stainless steel

Single compartment,
Counter mounted,
Undermount
Kitchen sink

McGuire - Supply



☒ **LFCK165LK** Lead Free, with Chrome-plated finish, Pipe to compression connection, 3/8" I.P.S x 3/8" O.D connection, Shallow wall flange, Loose key handle, Full turn brass stem, 305 mm (12") chrome-plated risers, Purple EPDM peroxide cured washers,

Codes and compliances: NSF/ANSI 61 & 372, UPC

McGuire - P-Trap



☒ **8912CB** Heavy cast brass, Adjustable p-trap, 292 mm (11-1/2") length, With cleanout plug, Steel box flange, Neoprene gasket, Seamless tubular brass bend, Slipnuts

Sloan - Faucet and Flush Valve Power Kit



☒ **SL-ETF-416** For faucet

Note:

Spec Reference: 123702
Product Reference: 7018175; 19596481;
7018383; 7047032; 7017077; 7030567

American Standard

LAV-1 (Revised)

Undermount Lavatory
Vitreous china

OVALYN

To be specified

Sloan - Faucet



☒ **SF-2400-PLG-CP-0.35GPM-MLM-IR-FCT** SLOAN®, Counter mounted, Automatic no-touch, Plug-in, Lavatory faucet, Polished chrome finish, Single hole centerset, Brass construction, 610 mm (24") flexible hose, 1.3 LPM (0.35 GPM) maximum flowrate, Multi-laminar spray outlet, 0.25 GPC (0.95 LPC) factory default, Integrated pedestal spout, 114 mm (4-1/2") spout reach, 152 mm (6") high, Infrared sensor with adjustable range, Filtered solenoid valve with serviceable strainer filter, Four (4) AA-size battery back-up power source, Mixing valve ordered separately, Sloan transformer recommended.

Sloan - Faucet and Flush Valve Power Kit



☒ **SL-ETF-416** For faucet

American Standard- Basin

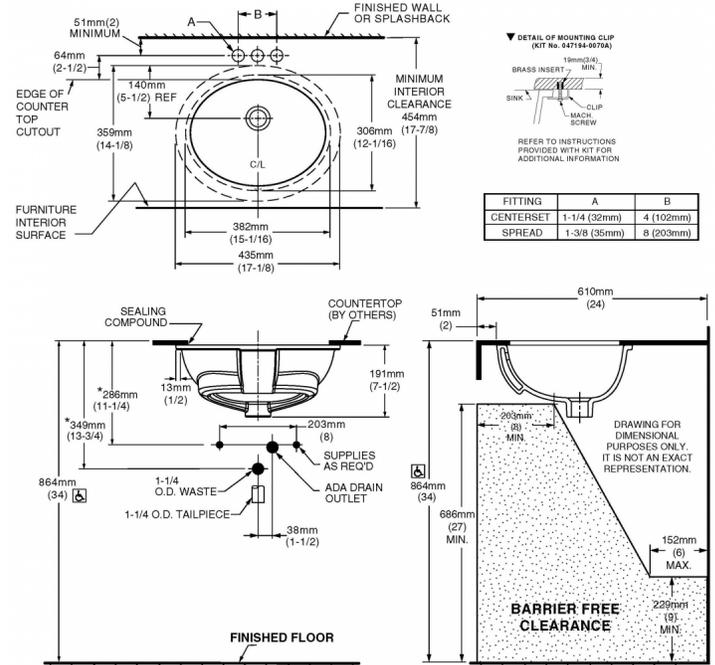
☒ **0495300.020**



Undermount Lavatory, Vitreous china, White finish, Front overflow, Glazed underside, Mounting kit supplied (047194-0070A),

Overall Dimensions: 435 mm (17-1/8") long, 359 mm (14-1/8") wide, 191 mm (7-1/2") high
Bowl Dimensions: 383 mm (15-1/16") long, 306 mm (12-1/16") wide, 140 mm (5-1/2") deep
Weight:

Refer to the product specification sheet for complete information



Note:

Spec Reference: 123702
Product Reference: 7010604; 7314470;
7030567; 7018383; 7028883

*American
Standard*

LAV-1 (Revised)

Undermount Lavatory
Vitreous china

OVALYN

Lawler - Mixing Valve



☒ **570-86820** Point of Use and Master controlled fixtures, Thermostatic master water mixing control valve, Lead free brass body construction, Nickel plated finish, Lead free brass body construction, 1.9 - 30 LPM (0.5 - 8 GPM) range for flowrate , To adjust the mixed outlet temperature of the valve, remove the cap to gain access to the adjusting spindle. The spindle should be rotated-clockwise to reduce the temperature, counter-clockwise to increase the temperature until the desired set point is reached, 11 LPM (3 GPM) tempered flowrate @ 5 PSI pressure drop, The temperature is adjusted with the help of Spindle, 4-7/8" (124 mm) Height, The temperature is adjusted with the help of Spindle, 3/8" MNPT (9.5 mm) inlet, 3/8" MNPT (9.5 mm) inlet, 95-115 °F outlet water temperature range, 3/8" MNPT (9.5 mm) outlet, 3/8" MNPT (9.5 mm) outlet, internal checks, Thermostatic master water mixing control valve, Nickel plated finish, Point of Use and Master controlled fixtures, ASSE 1070 approved Certified to CSA B125.3 for ASSE 1070 applications, 95-115 °F outlet water temperature range, Offers choice of temperature settings from 95° through 115 °F., 125 PSI max hydrostatic pressure, 125 PSI max hydrostatic pressure, ±20% pressure variation, ±20% pressure variation, 11 LPM (3 GPM) tempered flowrate @ 5 PSI pressure drop, To adjust the mixed outlet temperature of the valve, remove the cap to gain access to the adjusting spindle. The spindle should be rotated-clockwise to reduce the temperature, counter-clockwise to increase the temperature until the desired set point is reached, 40-80 °F, 10 °F, 180 °F max, 7 GPM flowrate @ 45 PSI, Offers choice of temperature settings from 95° through 115 °F., ±5 °F, Protects against scalding and chilling

American Standard - Fixture Drain



☒ **2411.015.002** Grid drain, For sinks, Brass construction, Chrome finish, 6-3/8" (162 mm) height, With overflow, 32 mm (1-1/4") tailpiece

Note:

Spec Reference: 123702
Product Reference: 7010604; 7314470;
7030567; 7018383; 7028883

American Standard

LAV-3

Wall-hung Lavatory
Vitreous china

MURRO

To be specified

Sloan - Faucet



☒ **EBF-650-BAT-TEE-BN-0.35GPM-MLM-IR-FCT** OPTIMA®, Counter mounted, Automatic no-touch, Optional hardwired power (battery as a back-up), 24 VAC power harness connector supplied, Lavatory faucet, Brushed nickel finish (may require a minimum order quantity - contact supplier), 102 mm (4") centerset, Brass spout, 1.3 LPM (0.35 GPM) maximum flowrate, Multi-laminar spray outlet, Fixed spout, 116 mm (4-9/16") spout reach, 92 mm (3-5/8") high, Self-adapting infrared sensor, Dual inlet filter assembly with 9.5 mm (3/8") compression brass cap for tempered water included, Wireless bluetooth status view, setting adjustment and diagnostic via Sloan Connect App?®, Integral water supply shut off.

Sloan - Faucet and Flush Valve Power Kit



☒ **SL-EL-154** For flush valve

American Standard- Basin

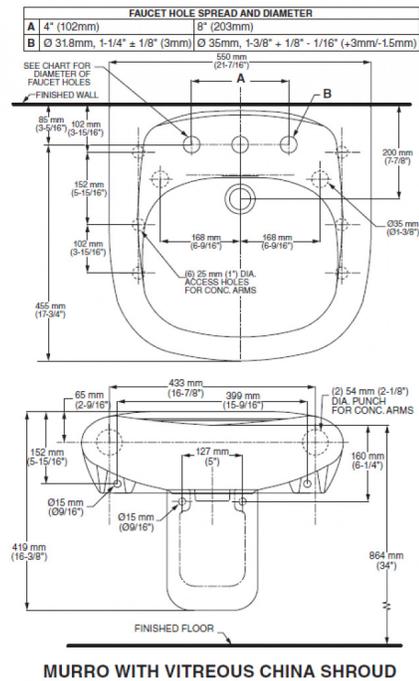
☒ **0954004EC.020 0097000.020**



Wall-hung Lavatory, Vitreous china, EverClean® antimicrobial surface, White finish, 102 mm (4") centerset. Rear overflow, Faucet ledge with recessed self-draining deck, For concealed arm or wall support, Acrylic shroud, conceals control box and thermostatic mixing valve (0097000), Soap dispenser, When installed with a below deck electronics faucet which has the control box, the accessories will not fit under the shroud and will need to be installed outside the shroud,

Overall Dimensions: 545 mm (21-7/16") long, 540 mm (21-1/4") wide, 152 mm (6") high
Bowl Dimensions: 343 mm (13-1/2") long, 394mm (15-1/2") wide, 127 mm (5") deep
Weight:

Refer to the product specification sheet for complete information



Note:

Spec Reference: 123702
Product Reference: 15581148; 19383243;
7030565; 7018383; 7028883; 7016922; 7017073;
17168699

*American
Standard*

LAV-3

Wall-hung Lavatory
Vitreous china

MURRO

Lawler - Mixing Valve



☒ **570-86820** Point of Use and Master controlled fixtures, Thermostatic master water mixing control valve, Lead free brass body construction, Nickel plated finish, Lead free brass body construction, 1.9 - 30 LPM (0.5 - 8 GPM) range for flowrate , To adjust the mixed outlet temperature of the valve, remove the cap to gain access to the adjusting spindle. The spindle should be rotated-clockwise to reduce the temperature, counter-clockwise to increase the temperature until the desired set point is reached, 11 LPM (3 GPM) tempered flowrate @ 5 PSI pressure drop, The temperature is adjusted with the help of Spindle, 4-7/8" (124 mm) Height, The temperature is adjusted with the help of Spindle, 3/8" MNPT (9.5 mm) inlet, 3/8" MNPT (9.5 mm) inlet, 95-115 °F outlet water temperature range, 3/8" MNPT (9.5 mm) outlet, 3/8" MNPT (9.5 mm) outlet, internal checks, Thermostatic master water mixing control valve, Nickel plated finish, Point of Use and Master controlled fixtures, ASSE 1070 approved Certified to CSA B125.3 for ASSE 1070 applications, 95-115 °F outlet water temperature range, Offers choice of temperature settings from 95° through 115 °F., 125 PSI max hydrostatic pressure, 125 PSI max hydrostatic pressure, ±20% pressure variation, ±20% pressure variation, 11 LPM (3 GPM) tempered flowrate @ 5 PSI pressure drop, To adjust the mixed outlet temperature of the valve, remove the cap to gain access to the adjusting spindle. The spindle should be rotated-clockwise to reduce the temperature, counter-clockwise to increase the temperature until the desired set point is reached, 40-80 °F, 10 °F, 180 °F max, 7 GPM flowrate @ 45 PSI, Offers choice of temperature settings from 95° through 115 °F., ±5 °F, Protects against scalding and chilling

American Standard - Fixture Drain



☒ **2411.015.002** Grid drain, For sinks, Brass construction, Chrome finish, 6-3/8" (162 mm) height, With overflow, 32 mm (1-1/4") tailpiece

Note:

Spec Reference: 123702
Product Reference: 15581148; 19383243;
7030565; 7018383; 7028883; 7016922; 7017073;
17168699

*American
Standard*

LAV-3

Wall-hung Lavatory
Vitreous china

MURRO

McGuire - Supply



☒ **LFBV2165** Lead Free, with Chrome-plated finish, Two 13 mm (1/2") I.P.S. x 10 mm (3/8") Ø brass ball valve connection, Two steel shallow flanges, Convertible loose key handle, 304 mm (12") copper flexible risers.

McGuire - P-Trap



☒ **8902CB** Cast brass body material, Chrome-plated finish, Professional line box flange, 292 mm (11-1/2") length, With cleanout plug, Steel box flange, Neoprene gasket, Slipnuts, 17 gauge seamless tubular wall bend

Watts - Carrier



☒ **WCA-411** WCA-411/WCA-411-WC, Single floor-mounted lavatory carrier with concealed arms, For concealed arm carrier, adjustable arms, epoxy coated cast iron, integral welded feet, upper tie rod, Heavy gauge steel offset uprights, basin locking device, Plated hardware, levelling screws.

Note:

Spec Reference: 123702
Product Reference: 15581148; 19383243;
7030565; 7018383; 7028883; 7016922; 7017073;
17168699



LB-1

Laundry Box

Metal Laundry Box (8-1/4" W x 6" H x 3-1/2" D)

To be specified

Material

- Plastic
- Metal construction

Connection Type

- 1/2" FEMALE SWEAT x 3/4" HOSE
- 1/2" PEX FITTING x 3/4" HOSE
- 1/2" ProPEX FITTING

Fire Rating

- No Fire Rating
- With Fire Rating

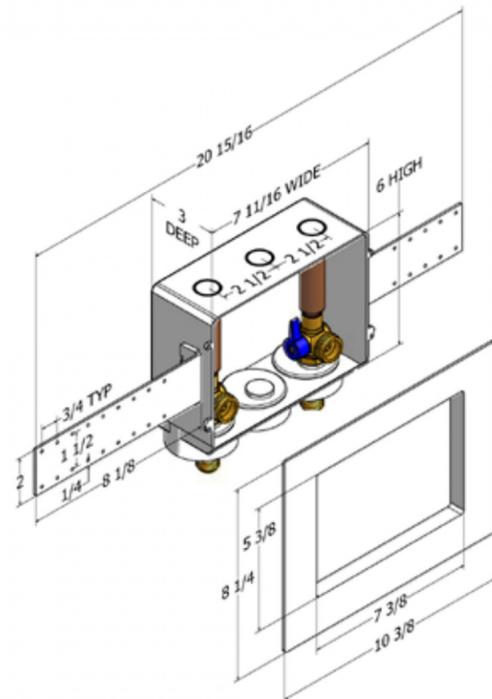
PPP- Laundry Box

MM-500 MLB



Metal construction. Solenoid operated equipment can create destructive water hammer, by adding the Ice maker box assembly you are protecting your equipment as well as insuring against premature replacement

Refer to the product specification sheet for complete information



Note:

Spec Reference: 123702
Product Reference: 7304101



MS-1

Type 316 Stainless steel

Single compartment, Floor mounted, Mop service sinks

To be specified

American Standard - Faucet



☒ **8354112.002** Wall-hung, Manual, Two handles, Mop sink faucet, Polished chrome finish, 152 - 254 mm (6" - 10") adjustable centerset, Brass construction, Integral check valve, Ceramic disc cartridge, no flow restrictor, 37.8 LPM (10 GPM) @20 PSI, Threaded hose end, Cast brass spout with bucket hook, 248 mm (9-3/4") spout reach, Top brace, Vandal-resistant lever handles, 13 mm (1/2") female inlet.

Lawler - Mixing Valve



☒ **TMM-1070-87500** The point of use mechanical mixing valve with thermostatic limit stop, MECHANICAL MIXING VALVE, Lead free brass body construction, Lead free brass body construction, The temperature adjusting dial is located on the cold inlet. Turning the dial clockwise will lower the outlet temperature, turning the dial counter-clockwise will raise it. The valve cannot be adjusted above its shut-off temperature of 120F, 1.8 LPM (0.5 GPM) tempered flowrate @ 5 PSI pressure drop, Compression Fitting, 84 mm (3-5/16") high, Compression Fitting, 3/8" MNPT (9.5 mm) inlet, 3/8" MNPT (9.5 mm) inlet, 3/8" MNPT (9.5 mm) outlet, 3/8" MNPT (9.5 mm) outlet, integral rubber duck-bill backflow checks, MECHANICAL MIXING VALVE, The point of use mechanical mixing valve with thermostatic limit stop, ASSE 1070 approved ASSE lead free Certified for ASSE 1070 applications, High temperature limit stop, Automatically shuts down flow of water when temperature reaches 120 °F, 125 PSI max supply pressure, 5 PSI Minimum Operating pressure, 5 PSI Minimum Operating pressure, 125 PSI max supply pressure, 1.8 LPM (0.5 GPM) tempered flowrate @ 5 PSI pressure drop, The temperature adjusting dial is located on the cold inlet. Turning the dial clockwise will lower the outlet temperature, turning the dial counter-clockwise will raise it. The valve cannot be adjusted above its shut-off temperature of 120F, 140 °F max, 8 LPM (2.1 GPM) flowrate @ 45 PSI, Automatically shuts down flow of water when temperature reaches 120 °F, 118 °F ±3 °F, Protects against scalding and chilling

Franke Commercial- Sink

☒ **FSS222210-316-1**



Without faucet ledge, 16 gauge Type 316 Stainless steel Polished to #4 satin finish, With 305 mm (12") high backsplash and integral corner splashguard, Radius coved bowl corners, Includes one piece wall hangers, Center waste location, 51 mm (2") I.P.S. grid drain, Undercoated to reduce condensation and resonance,

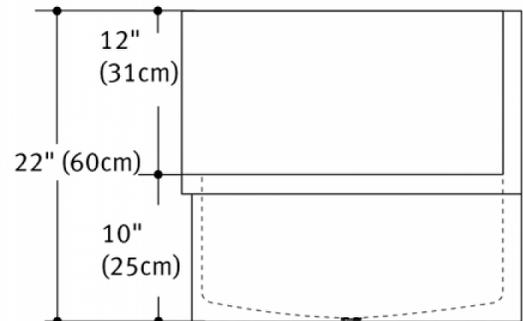
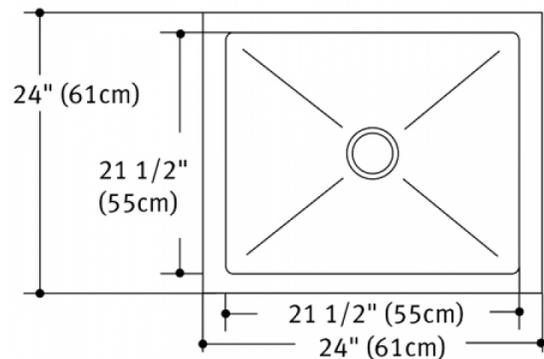
Codes and Compliances: ASME A112.19.3 compliant, CSA B45.4 compliant,

Bowl Dimension: 546 mm (21-1/2") long, 546 mm (21-1/2") wide, 254 mm (10") deep,

Overall Dimension: 610 mm (24") long, 610 mm (24") wide, 559 mm (22") high,

Notes: The sink can be installed in either left or right corners.

Refer to the product specification sheet for complete information



Note:

Spec Reference: 123702

Product Reference: 7018165; 38558; 7018151



EW-1

**Emergency Equipment
AutoFlow eyewash with
wall mounting**

*Eyewash, Wall Mounted, AutoFlow™
90° Swing-Down*

To be specified

Dust Cover

GS Dust Cover. Addn. for Each Stn. Steel Dust Cover for GS-Plus™ Spray Head in Place of Plastic

Spray Head Configuration

- G1848LH-L
- G1848LH
- G1848LH-R
- G1848L
- G1848
- G1848R

Bowl Material

- Green Plastic Bowl. Addn. for Green ABS Plastic Bowl in Place of Orange
- Yellow Plastic Bowl. Addn. for Yellow ABS Plastic Bowl in Place of Orange

Mixing Valve

Thermostatic mixing valve blends hot and cold water

Trap

Trap. Addn. for Tailpiece and 1 1/2" IPS Cast Brass Trap

Bowl Cover

Bowl Cover. Addn. for Stn. Steel Dust Cover that Covers Entire Stn. Steel Bowl

Hose

Auxiliary Hose Spray

Control

Hand and Foot Control

Tailpiece

1-1/2" Diameter Brass Tailpiece

Guardian- Emergency Equipment

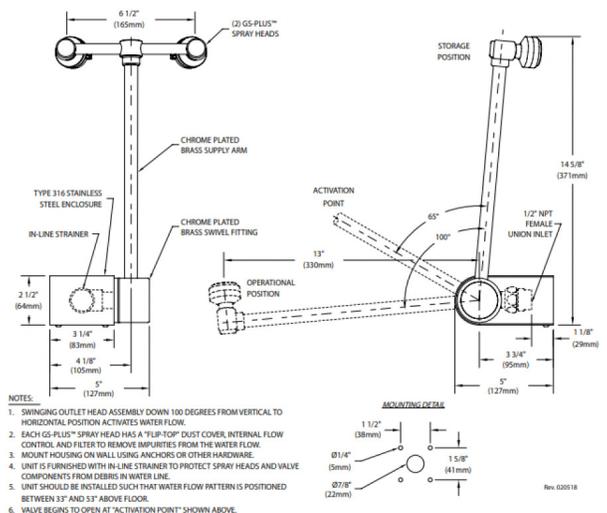
G1848-G3600LF-HFC



Wall-hung, Thermostatic mixing valve blends hot and cold water, Polished chrome finish finish, G1848, Two GS-Plus spray heads with flip top dust cover each, 13 mm (1/2") Ø I.P.S. brass plug-type valve with O-ring seals, 13 mm (1/2") Ø NPT female inlet supply inlet, In-line strainer, Hand and Foot Control, Hand and Foot Control,

Codes and Compliances:, ANSI compliant.

Refer to the product specification sheet for complete information



Note:

Spec Reference: 123702
Product Reference: 19124643



HB-1

Type 304 Stainless steel

Single compartment, Wall-hung,
Wall trough sink

To be specified

Chicago Faucets - Faucet



☒ **897-RCF** Wall-hung, Manual, Two handles, Mop sink faucet, Rough chrome plated finish, 194 - 213 mm (7-5/8" to 8-3/8") adjustable centerset, Round wall escutcheons, Brass construction, Adjustable supply arms, 1/4 turn ceramic cartridge, No flow restrictor, Threaded hose end, Spout with pail hook, 146 mm (5-3/4") spout reach, 273 mm (10-3/4") high, Top brace, 60 mm (2-3/8") lever handle with indexed buttons, Atmospheric vacuum breaker is not intended for continuous pressure applications.

Franke Commercial- Sink

☒ **WTS2025-1-2**



203 mm (8") centerset, 14 gauge Type 304 Stainless steel Polished to #4 satin finish, With 152 mm (6") high backsplash, Radius coved bowl corners and rolled radius rim, Center waste location, 38 mm (1-1/2") (DN38) brass tailpiece, 89 mm (3-1/2") crumb cup strainer,

Codes and Compliances: ASME A112.19.3 compliant, CSA B45.4 compliant,

Bowl Dimension: 559 mm (22") long, 419 mm (16-1/2") wide, 267 mm (10-1/2") deep,

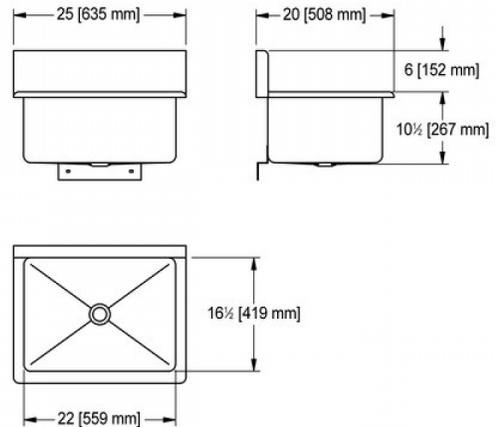
Overall Dimension: 635 mm (25") long, 508 mm (20") wide, 419 mm (16-1/2") high.

Lawler - Mixing Valve



☒ **570-86820** Point of Use and Master controlled fixtures, Thermostatic master water mixing control valve, Lead free brass body construction, Nickel plated finish, Lead free brass body construction, 1.9 - 30 LPM (0.5 - 8 GPM) range for flowrate , To adjust the mixed outlet temperature of the valve, remove the cap to gain access to the adjusting spindle. The spindle should be rotated-clockwise to reduce the temperature, counter-clockwise to increase the temperature until the desired set point is reached, 11 LPM (3 GPM) tempered flowrate @ 5 PSI pressure drop, The temperature is adjusted with the help of Spindle, 4-7/8" (124 mm) Height, The temperature is adjusted with the help of Spindle, 3/8" MNPT (9.5 mm) inlet, 3/8" MNPT (9.5 mm) inlet, 95-115 °F outlet water temperature range, 3/8" MNPT (9.5 mm) outlet, 3/8" MNPT (9.5 mm) outlet, internal checks, Thermostatic master water mixing control valve, Nickel plated finish, Point of Use and Master controlled fixtures, ASSE 1070 approved Certified to CSA B125.3 for ASSE 1070 applications, 95-115 °F outlet water temperature range, Offers choice of temperature settings from 95° through 115 °F., 125 PSI max hydrostatic pressure, 125 PSI max hydrostatic pressure, ±20% pressure variation, ±20% pressure variation, 11 LPM (3 GPM) tempered flowrate @ 5 PSI pressure drop, To adjust the mixed outlet temperature of the valve, remove the cap to gain access to the adjusting spindle. The spindle should be rotated-clockwise to reduce the temperature, counter-clockwise to increase the temperature until the desired set point is reached, 40-80 °F, 10 °F, 180 °F max, 7 GPM flowrate @ 45 PSI, Offers choice of temperature settings from 95° through 115 °F., ±5 °F, Protects against scalding and chilling

Refer to the product specification sheet for complete information



Note:

Spec Reference: 123702
Product Reference: 7032789; 7018472;
7018383; 7017077

FRANKE

HB-1

**Single compartment, Wall-
hung,**
Wall trough sink

Type 304 Stainless steel

McGuire - P-Trap



☒ **8912CB** Heavy cast brass, Adjustable p-trap, 292 mm (11-1/2") length, With cleanout plug, Steel box flange, Neoprene gasket, Seamless tubular brass bend, Slipnuts

Note:

Spec Reference: 123702
Product Reference: 7032789; 7018472;
7018383; 7017077



DIVISION 23 – HVAC
SPECIFICATIONS
FOR THE
CITY OF TORONTO - DAYCARE CENTRE (METRO HALL)
55 JOHN STREET
TORONTO, ONTARIO

Prepared by:

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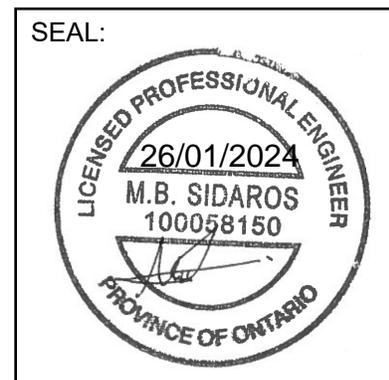
DISCIPLINES MECHANICAL
ELECTRICAL
PLUMBING
LIGHTING DESIGN
COMMUNICATIONS & AV
SECURITY & RISK
COMMISSIONING
ENERGY SERVICES

Our Project No. 2021-0245

Issued for Approval
Design Development

January 26, 2024

SEAL:



Project Name: CITY OF TORONTO - DAYCARE CENTRE (METRO HALL)
Project No.: 2021-0245
Section Name: **Table of Contents**
Section No.: **Division 23 - HVAC**
Date: January 26, 2024

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Section 23 05 36	Motor Starters and MCCs
Section 23 21 13	Hydronic Piping
Section 23 30 13	Ductwork and Accessories
Section 23 33 19	Duct Silencers
Section 23 34 00	Fans
Section 23 36 00	Air Terminal Units
Section 23 37 13	Diffusers, Registers and Grilles
Section 23 37 19	Louvers

Project Name: CITY OF TORONTO - DAYCARE CENTRE (METRO HALL)
Project No.: 2021-0245
Section Name: **Hydronic Valves**
Section No.: **23 05 23**
Date: January 26, 2024

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Project Name: CITY OF TORONTO - DAYCARE CENTRE (METRO HALL)
Project No.: 2021-0245
Section Name: **Hydronic Valves**
Section No.: **23 05 23**
Date: January 26, 2024

1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 - General Requirements, shall apply to and govern this Section.

1.2 SCOPE OF WORK

1.2.1 Provide valves for all hydronic piping systems, with the exception of control valves. Control valves shall be supplied under the work of the Division 25 – Integrated Automation Subcontractor, installed under this Section, and connected as part of the work of the Division 25 – Integrated Automation Subcontractor.

1.3 SHOP DRAWINGS

1.3.1 Provide Shop Drawings for:

1.3.1.1 All hydronic valves (except control valves)

2 **PRODUCTS**

2.1 GENERAL

2.1.1 All valves shall be of one manufacture unless otherwise noted in the Contract Documents and should have the manufacturer's name and pressure rating clearly marked on the body. Valves to conform to the current of ANSI, ASTM, ASME, and applicable Manufacturers' Standardization Society Specification (MSS).

2.1.2 Bronze valves up to and including 1034kPa (150 psi) steam pressure shall be manufactured to ASTM B62-93 standard. Bronze valves up to 1379kPa (200 psi) and 2068kPa (300 psi) steam pressure shall be manufactured to ASTM B61-93 standard. Bronze valves used in water systems may be cast bronze to ASTM B584-87 alloy CDA-836.

2.1.3 Iron body valves shall be ductile iron manufactured to ASTM A536-84 Grade 65-45-12 or cast iron ASTM A126-95 Class B standard where ductile iron is not available.

2.1.4 All valves shall have a CRN registration number.

2.1.5 Valve Materials

2.1.5.1 Bronze: to ASTM B62 or B61 as applicable

Project Name: CITY OF TORONTO - DAYCARE CENTRE (METRO HALL)
Project No.: 2021-0245
Section Name: **Hydronic Valves**
Section No.: **23 05 23**
Date: January 26, 2024

- 2.1.5.2 Brass: to ASTM B283 C3770
- 2.1.5.3 Cast Iron: to ASTM A126, Class B
- 2.1.5.4 Forge Steel: to ASTM A105N
- 2.1.5.5 Cast Steel: to ASTM A216WCB
- 2.1.6 Valve Markings
 - 2.1.6.1 All pressure ratings, manufacturers' trademark and size to conform as per MSS-SP-25.
- 2.1.7 End Connections
 - 2.1.7.1 Threaded ends: to ASME B1.20.1
 - 2.1.7.2 Solder ends: to ASME B16.18
 - 2.1.7.3 Flanged ends: to ASME B16.1 (Class 125)
 - 2.1.7.4 Face To Face dimensions: to ASME B16.10
 - 2.1.7.5 Fanged ends: to ASME B16.5
 - 2.1.7.6 Butt Weld Ends: to ASME 16.25
 - 2.1.7.7 Socket Weld Ends: to ASME B.16.11
- 2.1.8 Testing & Design
 - 2.1.8.1 MSS-SP-80 - Bronze, Gate & Check Valves
 - 2.1.8.2 MSS-SP-110 - Ball Valves
 - 2.1.8.3 MSS -SP-70, 85, 71 - Cast Iron Gate, Globe & Check Valve
 - 2.1.8.4 MSS-SP-72 - American Valve
 - 2.1.8.5 MSS-SP-67 - Kitz, Apollo, Toyo, Demco & WKM E, Butterfly Valves
 - 2.1.8.6 API 602 - Forge Steel Valves (Design)
 - 2.1.8.7 API 598 - Cast Steel Valves, Forge Steel Valves (Testing)
 - 2.1.8.8 API 609 - WKM High Performance BFV

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2.1.8.9 API 600 - Cast Steel Valves (Design)

2.2 VALVES FOR LOW PRESSURE SERVICE

2.2.1 This Subsection applies to valves used in heating and chilled water systems, condenser water systems, and chemical feed systems up to 1,034 kPa (150 psi) system operating pressure.

2.2.2 Gate Valves

2.2.2.1 50mm (2") dia. or less - shall be Class 125, all bronze, with solid wedge disc, rising stem.

Threaded ends - Toyo 293
- Kitz 24
- Crane 428

Soldered ends - Toyo 299
- Kitz 44
- Crane 1334

2.2.2.1.1 For application where non-rising stem is required.

Threaded ends - Toyo 280A
- Kitz 40
- Crane 438

Soldered ends - Toyo 281A
- Kitz 41
- Crane 1324

2.2.2.2 65mm (2-½") dia. and over - shall be Class 125, iron body/bronze mounted, with O.S. & Y., solid wedge design.

Flanged ends - Toyo 421
- Kitz 72
- Jenkins Fig. 454J
- Crane 465 ½

2.2.2.2.1 For application where non-rising stem is required.

Flanged ends - Toyo 415
- Kitz 75
- Jenkins Fig. 452J
- Crane 461

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2.2.3 Globe Valves

2.2.3.1 50mm (2") dia. or less - shall be Class 125, all bronze, with rising stem, fitted with PTFE disc.

Threaded ends - Toyo 220
- Kitz 03
- Crane 7TF

Soldered ends - Toyo 212
- Kitz 10
- Crane 1310

2.2.3.2 65mm (2-1/2") dia. and over - shall be Class 125, iron body/bronze mounted, O.S. & Y.

Flanged ends - Toyo 400A
- Kitz 76
- Crane 351

Alternative - Jenkins Fig. 2342J (renewable bronze seat and disc)

2.2.4 Check Valves

2.2.4.1 50mm (2") dia. or less - shall be Class 125, all bronze, Y pattern swing check.

Threaded ends - Toyo 236
- Kitz 22
- Crane 37

Soldered ends - Toyo 237
- Kitz 23
- Crane 1342

2.2.4.1.1 If lift check valve required.

Threaded ends - Kitz 36 (vertical)
- Jenkins Fig. 117ATJ (horizontal)
- Jenkins Fig. 119J (vertical)
- Crane 29 (vertical)
- Crane 27TF (horizontal)

2.2.4.2 65mm (2-1/2") dia. and over - shall be Class 125, iron body/bronze mounted or stainless steel, with bolted bonnet.

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Flanged ends - Toyo 435A
- Kitz 78
- Jenkins Fig. 587J
- Duo Check II (Wafer style)
- Mueller 71 series
- Crane 373
- Check Rite CET (Wafer Style)
- Moygro W12A-16V (Wafer Style)

Grooved ends - Victaulic Series 712 (horizontal), 716 (vertical)
or 779 with Venturi-taps

2.2.4.2.1 If silent check valve is required - cast iron body, bronze trim, EPDM seat, spring loaded center guided disc, stainless steel spring and shaft.

Flanged ends - Apco or Smolenski
- Mueller

Grooved ends - Victaulic 716 - 65mm (2-1/2") to 300mm (12")
- Victaulic AGS W715 - 350mm (14") to 750mm (30")

2.2.5 Ball Valves

2.2.5.1 50mm (2") dia. or less - shall be rated for 1034kPa (150 psi) steam, 4137kPa (600 psi) non-shock cold water or oil, with full or standard port brass or bronze body, brass chrome plated ball, Teflon seats and packing.

Threaded ends - Toyo 5044A
- Kitz 58
- Apollo 77C-100
- MAS B-3
- Victaulic Series 722

Soldered ends - Toyo 5049A
- Kitz 59
- Apollo 77C-200
- MAS B-4

2.2.5.2 For hot water heating applications, stainless steel ball and stem.

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Threaded ends - Toyo 5043-S
- Kitz 58M/68AM-LL
- Apollo 76F-100
Soldered ends - Toyo 5041S
- Kitz 59M/69AM-LL

2.2.6 Butterfly Valves

2.2.6.1 65mm (2-½") dia. and up to 300mm (12") dia. - shall be Class 125, cast or ductile iron full lug body with bronze disk, stainless steel stems, EPDM resilient seat, with a 1379kPa (200 psi) single flange shut off rating (dead end service) and 121°C (250°F) temperature rating.

2.2.6.2 Valves 50mm (2") dia. and up to 100mm (4") dia. shall have a 10-position lever. Valves 150mm (6") dia. and above shall have hand wheel gear activator.

Lug Style - Newman Hattersley Fig. 45-31532x
- Kitz 6122EL/G
- Toyo 918BESL/G
- Jenkins Fig. 2232ExJ
- De Zurik BGM
- Apollo 143-DBE-11/12
- Crane 44BXZ
- Centerline 200 series
- MAS D-Series LD4AE

2.2.6.3 Grooved end butterfly valves:

2.2.6.3.1 DN50 – DN300 (2" – 12") shall be rated to 2,068 kPa (300 psi) and dead-end service capable to full rated pressure. Body material shall be ductile iron with blow-out proof stainless steel stem, electroless nickel coated ductile iron disc, pressure responsive EPDM seat for water service with temperature range of –34°C to +110°C (-30°F to 230°F). Stem shall be offset from the disc centerline to provide full 360-degree circumferential seating.

- Victaulic Vic-300 MasterSeal.

2.2.6.3.2 DN350 – DN750 (14" – 30") shall be rated to 2,068 kPa (300 psi) and dead-end service capable to full rated pressure. Body material shall be ductile iron with blow-out proof stainless steel stem, PPS (polyphenylene sulfide) coated ductile iron disc, and EPDM seal for water service with temperature range of –34°C to +110°C

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(-30°F to 230°F). Stem shall be offset from the disc centerline to provide full 360-degree circumferential seating.

- Victaulic AGS Series W706
(W709 for services to 1,270 kPa (175 psi))

2.2.7 Plug Valves

2.2.7.1 DN80 (3") dia. or less - shall be Class 125, bronze eccentric plug valve, with memory stop and drip cap, grooved, flanged or screwed ends, as appropriate for piping system.

- DeZurik PEC Series

2.2.7.2 DN100 (4") dia. up to DN300 (12") dia. - shall be Class 125, bronze eccentric plug valve, with handwheel gear, and grooved, flanged or screwed ends, as appropriate for piping system.

- DeZurik PEC Series

- Victaulic Series 377

(grooved ends, rated to 1,270 kPa (175 psi))

2.2.8 Each hydronic terminal unit shall be provided with a 'Dahl' radiator valve, series 121 with soldered connection, on the supply and return lines.

2.3 VALVES FOR MEDIUM PRESSURE SERVICE

2.3.1 This Subsection applies to valves used in heating and chilled water systems, condenser water systems, and chemical feed systems up to 1,724 kPa (250 psi) system operating pressure.

2.3.2 Gate Valves

2.3.2.1 50mm (2") dia. or less - shall be Class 150, all bronze, with solid wedge disc, rising stem.

Threaded ends - Toyo 298
- Kitz 42
- Crane 431UB

Soldered ends - Kitz 43
- Crane 1334

2.3.2.1.1 For application where non-rising stem is required.

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Threaded ends - Toyo 204
- Kitz 46
- Crane 437

Soldered ends - Kitz 64
- Crane 1324

2.3.2.2 65mm (2-½") dia. and over - shall be Class 150, cast carbon steel, with bolted bonnet, O.S. & Y., ½ Stellite trim, graphite packing.

Flanged ends - Bonney Forge 1-11-RF
- Kitz 150 SCLS
- Crane 47XUF
- Beric 101-RF-AA08-H
- Powell 1503-FC8G

2.3.3 Globe Valves

2.3.3.1 50mm (2") dia. or less - shall be Class 150, all bronze, with rising stem, fitted with PTFE disc.

Threaded ends - Toyo 221
- Kitz 09
- Crane 7TF

Soldered ends - Kitz 10
- Crane 1310

2.3.3.2 65mm (2-½") dia. and over - shall be Class 150, cast carbon steel, with bolted bonnet, O.S. & Y., ½ Stellite trim, graphite packing.

Flanged ends - Bonney Forge 1-31-RF
- Kitz 150 SCJS
- Crane 143XU
- Beric 201-RF-AA08-H
- Powell 1531-FC8G

2.3.4 Check Valves

2.3.4.1 50mm (2") dia. or less - shall be Class 150, all bronze, Y pattern swing check.

Threaded ends - Toyo 238
- Kitz 29
- Crane 137

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- Soldered ends
 - Kitz 30
 - Crane 1342
- 2.3.4.1.1 If lift check valve required.
 - Threaded ends
 - Kitz 36 (vertical)
 - Crane 27TF (horizontal)
- 2.3.4.2 65mm (2-½") dia. and over - shall be Class 150, cast carbon steel, with bolted cover, ½ Stellite trim, stainless steel inserted flexible graphite gasket. Valve shall be silent check.
 - Flanged ends
 - Bonney Forge 1-61-RF
 - Kitz 150 SCOS
 - Centreline 800 series
 - Duo Check II lug type
 - Mueller Series 72
 - Beric 301-RF-AAO8-X
 - Check Rite 210CET (Wafer Style)
 - Powell 1561-FC8G
 - Moygro (Wafer Style)
 - Grooved ends
 - Victaulic Series 712 (horizontal), 716 (vertical), W715 and 779 with Venturi taps
- 2.3.5 Ball Valves
 - 2.3.5.1 50mm (2") dia. or less - shall be rated for 1034kPa (150 psi) steam, 4137kPa (600 psi) non-shock cold water or oil, full port brass or bronze body, brass chrome plated ball, Teflon seats and packing.
 - Threaded ends
 - Toyo 5044A
 - Kitz 58
 - Apollo 77C-100
 - MAS B3
 - Victaulic Series 722
 - Soldered ends
 - Toyo 5049A
 - Kitz 59
 - Apollo 77C-200
 - MAS B4
 - 2.3.5.2 For hot water heating applications, stainless steel ball and stem.

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Threaded ends - Toyo 5043-S
- Kitz 58M/68AM-LL
- Apollo 76F-100
Soldered ends - Toyo 5041S
- Kitz 59M/69AM-LL

2.3.6 Butterfly Valves

2.3.6.1 65mm (2-½") dia. and up to 300mm (12") dia. - shall be Class 150, carbon steel full lug body with stainless steel shaft and disk, RTFE packing and seat, and bi-directional bubble tight shut off to the full ASME rating.

2.3.6.2 Valves 65mm (2-½") dia. and up to 100mm (4") dia. shall have a 10-position lever. Valves 150mm (6") dia. and above shall have hand wheel gear activator.

Lug Style - Flowseal 1LA-121-TTG
- WKM B5113-02-S02-11-HL/G
- Bray Series 41-466
- Powell 1572-QCRTXXXGLV/GXX

2.3.6.3 Grooved end butterfly valves:

2.3.6.3.1 DN50 – DN300 (2" – 12") shall be rated to 2,068 kPa (300 psi) and dead-end service capable to full rated pressure. Body material shall be ductile iron with blow-out proof stainless steel stem, electroless nickel coated ductile iron disc, pressure responsive EPDM seat for water service with temperature range of –34°C to +110°C (-30°F to 230°F). Stem shall be offset from the disc centerline to provide full 360-degree circumferential seating.

- Victaulic Vic-300 MasterSeal.

2.3.6.3.2 DN350 – DN750 (14" – 30") shall be rated to 2,068 kPa (300 psi) and dead-end service capable to full rated pressure. Body material shall be ductile iron with blow-out proof stainless steel stem, PPS (polyphenylene sulfide) coated ductile iron disc, and EPDM seal for water service with temperature range of –34°C to +110°C (-30°F to 230°F). Stem shall be offset from the disc centerline to provide full 360-degree circumferential seating.

- Victaulic AGS Series W706.

2.4 VALVES FOR HIGH PRESSURE SERVICE

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2.4.1 This Subsection applies to valves used in heating and chilled water systems, condenser water systems, and chemical feed systems over 1,724 kPa (250 psi) system operating pressure.

2.4.2 Gate Valves

2.4.2.1 50mm (2") dia. or less - shall be Class 800, forge steel body, with O.S. & Y., bolted bonnet, ½ Stellite trim, graphite packing.

Threaded ends - Bonney Forge HL-11-T
- Beric 501-TX8A08
- Powell GA08TA58GB

2.4.2.2 65mm (2-½") dia. and over - shall be Class 300, cast carbon steel, with O.S. & Y., bolted bonnet, ½ Stellite trim, graphite packing.

Flanged ends - Bonney Forge 3-11-RF
- Kitz 300 SCLS
- Beric 103-RF-AA08-H
- Powell 3003-FC8G

2.4.3 Globe Valves

2.4.3.1 50mm (2") dia. or less - shall be Class 800, forge steel body, O.S. & Y., bolted bonnet, ½ Stellite trim, graphite packing.

Threaded ends - Bonney Forge HL-31-T
- Beric 502-TX8A08
- Powell GL08TA58GB

2.4.3.2 65mm (2-½") dia. and over - shall be Class 300, cast carbon steel, with O.S. & Y., bolted bonnet, ½ Stellite trim, graphite packing.

Flanged ends - Bonney Forge 3-31-RF
- Kitz 300 SCJS
- Beric 203-RF-AA08-H
- Powell 3031-FC8G

2.4.4 Check Valves

2.4.4.1 50mm (2") dia. or less - shall be swing type Class 800, forge steel body, with bolted bonnet, ½ Stellite trim, and graphite gasket.

Threaded ends - Bonney Forge HL-61-T
- Beric 504-TX8A08
- Powell SW08TA58GB

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2.4.4.2 65mm (2-½") dia. and over –shall be Class 300, cast carbon steel, with bolted cover, stainless steel inserted flexible graphite gasket.

Flanged ends - Bonney Forge 3-61-RF
- Kitz 300 SCOS
- Beric 303-RF-AA08-X
- Check Rite Model 210 (Wafer Style)
- Powell 3061-FC8G
- Moygro (Wafer Style)

2.4.5 Ball Valves

2.4.5.1 50mm (2") dia. or less - shall be rated for 1034kPa (150 psi) steam, 4137kPa (600 psi) non-shock cold water or oil, full port brass or bronze body, brass chrome plated solid ball, Teflon seats and packing.

Threaded ends - Toyo 5044A
- Kitz 58
- Apollo 77C-100
- MAS B3

Soldered ends - Toyo 5049A
- Kitz 59
- Apollo 77C-200
- MAS B4

2.4.5.2 For hot water heating applications, stainless steel ball and stem.

Threaded ends - Toyo 5043-S
- Kitz 58M/68AM-LL
- Apollo 76F-100

Soldered ends - Toyo 5041S
- Kitz 59M/69AM-LL

2.4.6 Butterfly Valves

2.4.6.1 65mm (2-½") dia. and up to 300mm (12") dia. - shall be Class 300, carbon steel full lug body with stainless steel shaft and disk, RTFE packing and seat, and bi-directional bubble tight shut off to the full ASME rating.

2.4.6.2 Valves 65mm (2-½") dia. and up to 100mm (4") dia. shall have a 10-position lever. Valves 150mm (6") dia. and above shall have hand wheel gear activator.

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Lug Style - WKM B5313-02-S02-11-HL/G
- Bray Series 43-466
- Powell 3072-QCRTXXXGLV/GXX

2.4.6.3 Grooved end butterfly valves:

2.4.6.3.1 DN50 – DN300 (2" – 12") shall be rated to 2,068 kPa (300 psi) and dead-end service capable to full rated pressure. Body material shall be ductile iron with blow-out proof stainless steel stem, electroless nickel coated ductile iron disc, pressure responsive EPDM seat for water service with temperature range of –34°C to +110°C (-30°F to 230°F). Stem shall be offset from the disc centerline to provide full 360-degree circumferential seating.

- Victaulic Vic-300 MasterSeal.

2.4.6.3.2 DN350 – DN750 (14" – 30") shall be rated to 2,068 kPa (300 psi) and dead-end service capable to full rated pressure. Body material shall be ductile iron with blow-out proof stainless steel stem, PPS (polyphenylene sulfide) coated ductile iron disc, and EPDM seal for water service with temperature range of –34°C to +110°C (-30°F to 230°F). Stem shall be offset from the disc centerline to provide full 360-degree circumferential seating.

- Victaulic AGS Series W706.

2.5 CIRCUIT BALANCING VALVES

2.5.1 Valve body shall be ductile iron with grooved, flanged, or screwed ends, as appropriate for piping system.

2.5.2 Valves shall have metering ports incorporating EPT check valves on both sides of the seat.

2.5.3 Valves shall be "Y" pattern modified equal percentage globe. Each valve shall be capable of precise flow measurement and positive shut-off.

2.5.4 Valves shall have minimum of four full 360° adjustment turns of the handwheel with a micrometer type indicator and a tamper-resistant memory.

2.5.5 Valve components shall be suitable for intended application.

2.5.6 Provide a computerized digital flow meter for future use by the Owner. Meter shall be preprogrammed with circuit setter

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calibration curves, and be capable of:

- 2.5.6.1 Direct flow readout
- 2.5.6.2 Proportional balancing
- 2.5.6.3 Computing required valve setting
- 2.5.6.4 Differential pressure measurement
- 2.5.6.5 Temperature measurement
- 2.5.6.6 Airflow measurement
- 2.5.6.7 Leak testing
- 2.5.7 The flow meter shall have automatic calibration and air purging, and be complete with hard lockable case, hoses, fittings, temperature probe, 0 – 18m w.g. (0 – 60 ft w.g.) transducer, and quick connect connections.
- 2.5.8 Select circuit balancing valve size to give a pressure drop at 100% open between 3.0 kPa (0.43 psi) and 21 kPa (3.0 psi). Select valves located remote from the pumps in the circuit near minimum pressure drop, and those located near the pumps at higher pressure drop.
- 2.5.9 Provide preformed rigid insulation for valves.
- 2.5.10 DN50 (2”) and smaller: Victaulic / TA Hydronics Series 786 STAS or 787 STAD, RWV 9517 (NPT) / 9519 (soldered)
- 2.5.11 DN 65 (2-½”) and larger: Victaulic / TA Hydronics Series 788 STAF or 789 STAG, RWV 9574P
- 2.5.12 Terminal Unit Coil Connection Kits
- 2.5.12.1 At Contractor’s option and as detailed in schematics, terminal unit coil kits may be used in lieu of traditional coil installation. Victaulic Series 799 / 79V Koil-Kit Coil Pack shall include the following components: 78Y strainer / ball valve combination (or 78T where strainer is not required), two optional coil hoses, Series 78U union port and a balancing valve (series 78K or TA series 786/787) sized to flow rate.

3 EXECUTION

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3.1 GENERAL

- 3.1.1 Valves shall be the same size as the line in which installed.
- 3.1.2 Valves shall be located in such a manner that the top works, operators, and bonnets may be easily removed.
- 3.1.3 Stems of valves shall be positioned for maximum ease in use, but in no event in a manner causing a hazard, or with stem down unless specifically shown as such.
- 3.1.4 Provide valves where shown on the Drawings, or on schematic diagrams, or in details, or as specified in the Contract Documents.
- 3.1.5 Provide drain valves at all low points of system. Drain valves shall be ball or gate valve with cap and chain.
- 3.1.6 Provide chain wheel operators and operating chain for all valves located more than 2.1m (7 ft) above floor or walkway. Provide chain of sufficient length to extend to within 2.1m (7 ft) of operating platform or floor for free hanging chains, or to within 1.5m (5 ft) of floor in locations where chain can be secured to a wall or column. Provide wall hook as required for securing chain to wall or column.

3.2 GATE AND BUTTERFLY VALVES

- 3.2.1 Provide gate and/or butterfly valves:
 - 3.2.1.1 Where indicated on the Drawings and in the Specification.
 - 3.2.1.2 Entering and leaving all equipment and terminal units.
 - 3.2.1.3 On all branches.
 - 3.2.1.4 As isolation of each floor for all services.
 - 3.2.1.5 At the base of all risers.

3.3 GLOBE VALVES

- 3.3.1 Provide globe valves:
 - 3.3.1.1 Where indicated on the Drawings and in the Specification.
 - 3.3.1.2 On all bypass systems.
 - 3.3.1.3 Where required for throttling control.

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3.4 BALL VALVES

3.4.1 Provide ball valves where indicated on the Drawings and in the Specification.

3.4.2 For pipe sizes DN50 (2") and smaller, ball valves may be substituted for gate and globe valves.

3.5 CHECK VALVES

3.5.1 Provide check valves:

3.5.1.1 Where indicated on the Drawings and in the Specification.

3.5.1.2 On the discharge of all pumps (silent check).

3.5.1.3 On the discharge of multiple equipment.

3.6 RADIATION VALVES

3.6.1 Provide radiation valves on the supply and return lines at each radiation heating element.

3.7 DRAIN VALVES

3.7.1 Install 20mm (¾") dia. drain valves at all down-fed terminal heating and/or cooling units.

3.7.2 Install 40mm (1-½") dia. or line size valves at low points and other drain points on system.

3.7.3 Install 40mm (1-½") dia. valves for flushing purposes.

3.8 CIRCUIT BALANCING VALVES

3.8.1 Provide ball, globe, or eccentric plug valves for throttling or controlling flow where indicated on the Drawings and in the Specification except where circuit balancing valves are specified.

3.8.1.1 Provide ball, globe, or eccentric plug valves in return piping connections to radiators, forced flow heaters, unit heaters, and wallfin heaters.

3.8.2 Provide circuit balancing valves as follows:

3.8.2.1 Where indicated on the Drawings and in the Specification.

3.8.2.2 In return branch mains and branch connections to return mains.

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- 3.8.2.3 In each return riser.
- 3.8.2.4 In return piping connections to air handling unit heating and cooling coils, fan coil units, heat pump units, reheat coils in air terminal control units, and any other equipment not listed under Paragraph 3.8.1.1.
- 3.8.3 Do not locate handwheel or measuring ports facing downward (to prevent build-up of sedimentation).
- 3.8.4 Position handwheel scale and ports for easy access.
- 3.8.5 Locate balancing valves a minimum of five pipe diameters downstream of any piping, and a minimum of ten pipe diameters from any pump. Maintain two pipe diameters downstream of any balancing valves free of any fitting.
- 3.8.6 Insulate balancing valves with preformed insulation provided by valve manufacturer.
- 3.8.7 Calibrated balancing valves and automatic flow-control valves shall not be used on equipment where pressure independent control valves are installed.

END OF SECTION

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Section No.: **23 05 36**
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Section No.: **23 05 36**
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1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 - General Requirements, shall apply to and govern this Section.

1.2 SCOPE OF WORK

1.2.1 Provide all labour, materials, tools equipment, training commissioning and certification required to complete the work as shown on the Drawings and specified in this Section, including:

1.2.1.1 All motor starters for mechanical equipment.

1.2.1.2 All motor control centres for mechanical equipment.

1.2.2 Division 26 – Electrical shall provide all Motor Control Centres (MCC's) and loose motor starters.

1.2.3 Provide Division 26 – Electrical with a complete motor list, including nominal power, voltage, phase, application, starter type and control interlocks.

1.3 SUBMITTALS

1.3.1 Provide shop drawings for:

1.3.1.1 All motor starters.

1.3.1.2 All motor control centres.

1.4 ELECTRICAL EQUIPMENT AND WORK

1.4.1 Read together with Division 26 – Electrical and adhere to its requirements. Supply and install all electrical apparatus, which is required and is not covered by Division 26 – Electrical.

2 **PRODUCTS**

2.1 MOTOR CONTROL CENTRES

2.1.1 Not Used.

2.2 MOTOR STARTERS

2.2.1 Provide where indicated, shown on the Motor Starter Schedules

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and as specified in this Section separate motor starters not forming part of a motor control centre for all mechanical equipment (except those equipped with packaged starters).

- 2.2.2 Motor starters shall be supplied by the manufacturer of the motor control centres specified, and shall meet the requirements therein complete with disconnect switch, fuses, control transformer, and all auxiliary devices.
- 2.2.3 Provide combination type with non-fused disconnect switch for individual motor starters equal to CGE CR 208, where overcurrent protection has been provided at motor control centre or distribution source.
- 2.2.4 Provide combination type with fusible disconnect switches equal to CGE CR 208 for grouped motor starters supplied from a common feeder or splitter. Include all interconnection power wiring.
- 2.2.5 Manual starters for single phase fractional horsepower motors unless otherwise indicated shall be equal to CGE CR 1061 with pilot light in cover. In finished areas, provide flush mounted units with stainless steel covers and pilot lights.
- 2.2.6 Where starters are grouped, provide a common backboard, interlocking and control wiring indicated on the Motor Starter Schedules and engraved nameplates indicating source of control supply if separate from the starter.

3 **EXECUTION**

3.1 MOTOR CONTROL CENTRES

3.1.1 Not Used.

3.2 MOTOR STARTERS

3.2.1 Provide lamacoid plastic plates identifying all starters. Provide warning label for motors under remote control. Adhere to Section 20 05 53 – Identification colour scheme for tags.

END OF SECTION

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1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 - General Requirements, shall apply to and govern this Section.

1.2 SCOPE OF WORK

1.2.1 Provide all labour, materials, tools equipment, training commissioning and certification required to complete the work as shown on the Drawings and specified in this Section, including:

1.2.1.1 Chilled water piping system.

1.2.1.2 Space heating hot water piping system.

1.2.1.3 Chilled glycol piping system.

1.2.1.4 Heating glycol piping system.

1.2.1.5 Condenser water piping system.

1.2.1.6 Condensate drainage system.

1.2.1.7 Chemical feed system.

1.2.2 Refer to Section 20 25 00 – Water Treatment for flushing, cleaning and chemical treatment.

1.2.3 Refer to Section 22 11 19 – Domestic Water Piping Specialties for backflow preventers.

1.3 REGULATORY REQUIREMENTS

1.3.1 In addition to specific requirements for pipe fittings as further specified in this document and where applicable, the equipment shall comply with the Boiler and Pressure Vessels Act (the “Act”) and CSA Standard B51.

1.3.2 In compliance with the Act and relevant Codes, all fittings shall be registered by the manufacturer, and shall be identified by the appropriate Canadian registration number.

1.3.3 Where fittings are provided without the appropriate Canadian registration number, the Contractor shall obtain a copy of the manufacturer's Statutory Declaration as provided to the authorities

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having jurisdiction.

1.3.4 All welding and fabrication shall be to the requirements of the ANSI/ASME B31.9 code for pressure piping and CSA standard B51 code for the Construction and Inspection of Boilers and Pressure Vessels.

1.3.5 All copper piping shall be certified to ASTM Standard B88 for Seamless Copper Water Tube.

2 **PRODUCTS**

2.1 PIPE AND FITTINGS

2.1.1 For 860 kPa (125 psi) or lower operating pressure use Class 125 fittings. For 860 kPa to 1,172 kPa (125 psi to 170 psi) operating pressure use Class 150 fittings. For 1,172 kPa to 3,034 kPa (170 psi to 440 psi) operating pressure use Class 300 fittings.

2.1.2 Heating water, chilled water, condenser water, and glycol piping shall be Schedule 40 black steel pipe; stretch reduced continuous weld, ASTM A53.

2.1.3 Condensate drain piping shall be type DWV copper drainage tube with cast brass fittings and 50/50 solder joints. Provide screwed cleanout tees and crosses at all changes in direction.

2.1.4 Mechanical couplings (e.g. Victaulic) shall be permitted for heating, chilled and condenser water, and glycol systems, provided:

2.1.4.1 The couplings are located in accessible locations, unless otherwise approved by the engineer.

2.1.4.2 All couplings and fittings are by one manufacturer, suitable for pressure and temperature of respective system.

2.1.4.3 Rigid (Victaulic Style 107H Quick-Vic) couplings with offsetting angle bolt pads and AGS rigid couplings (Victaulic Style W07) are used in mechanical rooms.

2.1.4.4 Flexible (Victaulic Style 177 or AGS Style W77) couplings may be used in equipment drops in lieu of flexible connectors and where vibration attenuation and stress relief are required.

2.1.4.5 Couplings for Schedule 40 piping to be manufactured from two (2) ductile iron housings conforming to ASTM-A536 and be complete with a Grade 'EHP' EPDM gasket, suitable for water service to

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121°C (250°F). Flange adapters for sizes DN50 (2") to DN300 (12") to be ductile iron ASTM-A536, Victaulic Style 741. Flange adapters for sizes DN350 (14") to DN750 (30") shall be Victaulic W741 or W45R flanged adapter nipple with AGS grooved end.

2.1.4.6 Fittings for Schedule 40 piping shall be manufactured from ductile iron conforming to ASTM-A536, wrought steel conforming to ASTM-A234, or segmentally welded from steel pipe conforming to ASTM-A53, with grooves designed to accept grooved end couplings.

3 **EXECUTION**

3.1 GENERAL

3.1.1 Ream all piping and keep plugged to prevent entry of dirt. Use pipes, which conform to CSA and ASTM standards.

3.1.2 Cut true and thoroughly ream all pipe before installation.

3.1.3 Install all piping in the best professional manner and in accordance with the best practices of the trade.

3.1.4 Install piping so that there is no interference with the installation of equipment, other piping, systems, ducts or the work of other Subcontractors.

3.1.5 Consider the piping shown on the Drawings as diagrammatic, for clearness in indicating the general runs and connections and that the piping may, or may not, in all parts be shown in the true position. This does not relieve the Contractor's responsibility for the proper erection of the systems of piping in every respect suitable for the work intended.

3.1.6 Install piping in designated spaces, shafts, and chases. Space and arrange piping to best utilize available space. Arrange grouped valves in equally spaced steps or in straight rows.

3.1.7 Layout and install piping, valves, fittings and cleanouts to facilitate easy maintenance. Install valves and control devices in locations where they can be reached from the floor, platform, or an 2.4m (8 ft) high stepladder. The maximum reach allowed to operate and to service any device shall be 600mm (24"). Do not locate any valves, couplings, or flanged/union connections directly above electrical panels, motor starters or MCCs.

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- 3.1.8 Install control valves with stems in vertical position with adequate clearance for removal of actuators.
- 3.1.9 Install eccentric reducers in all reductions of piping size. Maintain level on the top of pipes for water services and on bottom of pipe for steam. Provide proper venting and drainage.
- 3.1.10 Traps and fittings shall be of the same material, quality, and thickness as the piping to which they are attached.
- 3.1.11 Ensure that welding is performed, using either gas or electric welding equipment. Thoroughly clean pipe surfaces and level the ends of each pipe and fitting before welding. Securely align and space piping so that the width of circumferential welds is two and one-half times the pipe wall thickness. Ensure that the deposited metal forms a gradual increase in thickness from the outside surface to the centre of the weld.
- 3.1.12 Ensure that the pipe welding is done by a welder holding a certificate from TSSA or from the Canadian Welding Bureau (CWB) for the class of piping to be welded.
- 3.1.13 When welding or cutting with a torch, take every precaution to prevent fire. Ensure that welding or torch cutting operators have a fully charged 4.5kg (10 lb.) carbon dioxide fire extinguisher with them, when welding or cutting in building, or tunnels. Protect wooden structures with asbestos blanket.
- 3.1.14 Ensure that fabrication, welded or otherwise, meets the requirements of the ASA B31.9 Code for Pressure Piping, the CSA B51 Code for Boiler, Pressure Vessel, and Pressure Piping, and all requirements of the Boilers and Pressure Vessels Act of the Province of Ontario.
- 3.1.15 Use only fittings, or other materials to be incorporated in the work, which are approved by TSSA's Boiler and Pressure Vessels Safety Program, for the class of work for which they are used.
- 3.1.16 Thoroughly clean the inside of fittings and outside of pipe with steel wool and coat with flux, before soldering any copper pipe work joint. Remove the working parts of valves before soldering commences, and replace after soldering is complete.
- 3.1.17 Provide swing joints in runouts to units, off horizontal mains.
- 3.1.18 Maintain minimum 25mm (1") space between adjacent flanges or

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pipe insulation (whichever has the largest diameter).

- 3.1.19 All buried steel piping shall be protected with Insul-mastic Eastern Ltd. coal tar epoxy and wrapped with Polyken tape. Overlap joints and seams 50mm (2") and double cover at elbows and fittings.
- 3.1.20 Provide full size flushing ports with valves of DN40 (1-1/2") size at the lowest point in each system with a vent at the high point. Grade piping and/or add additional valved and capped drain points to permit complete drainage of entire system.
- 3.1.21 Provide unions or flanges at all connections to equipment or fixtures requiring servicing or replacement. Provide Van Stone style flanges where applicable.
- 3.1.21.1 Unions or flanges for servicing are not required in installations using Victaulic couplings. (The couplings shall serve as disconnect points.)
- 3.1.22 All capped connections for piping DN65 (2-1/2") or larger shall be terminated with flange and blind flange.
- 3.2 **PIPE AND FITTINGS**
- 3.2.1 Piping DN65 (2-1/2") dia. and larger shall be welded using 'Weld-O-Lets', Victaulic Mechanical-T, or factory manufactured tees. Piping DN50 (2") dia. and smaller shall be screwed with cast iron fittings. Long radius forged welding elbows shall be used at all turns unless approved by the engineer.
- 3.2.2 Branch piping two sizes smaller than the main may be cut directly into the main and welded or hole-cut with Victaulic Mechanical-T fittings.
- 3.2.3 Provide screwed clean-out tees and crosses at all changes in direction of condensate drain piping.
- 3.2.4 Provide di-electric connections for cathodic protection wherever pipes of dissimilar material are connected together (Victaulic Style 47 Di-electric Waterway).
- 3.2.5 In copper pipes, provide wrought copper unions with soldered joints for pipe up to and including DN50 (2"), and 1,035 kPa (150 psi) cast brass flanges for pipes DN65 (2-1/2") or larger.
- 3.2.6 Install all grooved end components as per manufacturers' latest recommendation. All grooved products shall be of one

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manufacturer. 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. The 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.

3.2.7 Provide valve bypass arrangement for water differential pressure transmitters. Coordinate exact quantity and location with the Subcontractor responsible for the work of Division 25 – Integrated Automation.

3.3 VENTING

3.3.1 On all up-feed coils, radiation, etc. provide a screwdriver operated manual air vent at the high point.

3.3.2 At all high points of the piping system provide a valved automatic float air vent. Pipe discharge to floor drains or to janitor sink with DN15 (1/2") dia. tubing.

3.3.3 Main vents in mechanical room shall be high capacity, Sarco model 13W with DN10 (3/8") dia. discharge tubing piped to the hub drain.

3.4 DRAINS

3.4.1 Provide drains at all low points of all liquid carrying systems and at other locations shown on the Drawings.

3.4.2 Drains shall consist of a capped DN20 (3/4") threaded hose end valve and cap, location to allow easy connection of drain hose.

3.5 FLUSHING AND CLEANING

3.5.1 General

3.5.1.1 Inspect the systems, and remove any heavy debris and excessive oil and dirt.

3.5.1.2 Flush all completed systems with clear water at the highest obtainable pressure and velocity.

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3.5.1.3 During flushing and cleaning, maintain all isolating and control valves in the open position.

3.6 WATER FILL

3.6.1 Provide each water system with an 'Armstrong' make-up water combination feeder consisting of backflow preventer stop and check valve, strainer, pressure reducing valve, pressure gauge, and full sized quick fill by-pass.

3.6.2 Provide make-up water connections with shut-off valve to all equipment requiring same, such as boilers, cooling towers, etc.

3.7 TESTS

3.7.1 After all pipes have been placed in position, the tightness of all joints and the soundness of all pipes shall be tested as follows:

3.7.1.1 Test all water piping with cold water at a pressure of 1-½ times the working pressure, but not less than 1,035 kPa (150 psi), for a period of not less than four (4) hours, without any drop in pressure.

3.7.1.2 Any leaks found shall be made tight while under pressure. If this is not possible, piping shall be removed, refitted, and retested. Caulking of threaded joints shall not be accepted.

3.8 COMPLETION

3.8.1 Provide a declaration, signed by a responsible officer of the Division 23 – HVAC Subcontractor indicating that the following procedures and tests have been performed in accordance with the drawings and specifications. Provide two (2) copies of the signed declaration to the Consultant.

3.8.1.1 Water pressure test performed and leak free.

END OF SECTION

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- 1 **GENERAL**
- 1.1 GENERAL
- 1.1.1 Section 20 00 00 - General Requirements, shall apply to and govern this Section.
- 1.2 SCOPE OF WORK
- 1.2.1 Provide all labour, materials, tools equipment, training commissioning and certification required to complete the work as shown on the Drawings and specified in this Section, including:
 - 1.2.1.1 All rigid supply, return and exhaust air ductwork and plenums.
 - 1.2.1.2 All flexible ductwork.
 - 1.2.1.3 Emergency generator ventilation system.
 - 1.2.1.4 Balancing dampers.
 - 1.2.1.5 Fire dampers.
 - 1.2.1.6 Flexible connections.
 - 1.2.1.7 Acoustic lining.
 - 1.2.1.8 Combination fire/smoke dampers.
 - 1.2.1.9 Backdraft dampers.
 - 1.2.1.10 Wall boxes.
- 1.2.2 Control and smoke dampers, airflow measuring stations shall be supplied under the work of Division 25 – Integrated Automation and installed as per of the work of this Section.
- 1.3 SUBMITTALS
- 1.3.1 Submit shop drawings for all products supplied in this Section.
- 1.4 DEFINITIONS
- 1.4.1 References to SMACNA shall mean “HVAC Duct Construction Standards, Metal and Flexible”, current edition.
- 2 **PRODUCTS**

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2.1 DUCTWORK

- 2.1.1 Fabricate the following ductwork from galvanized steel, in accordance with requirements of SMACNA 1000 Pa (4" w.g.) pressure class:
- 2.1.1.1 All supply air ductwork from air handling units to air terminal control units.
- 2.1.1.2 All ventilation air supply ductwork.
- 2.1.1.3 All ductwork used for smoke exhaust, including relief air ductwork.
- 2.1.1.4 Kitchen make-up air supply ductwork.
- 2.1.2 Fabricate the following ductwork from aluminum in accordance with requirements of SMACNA 500 Pa (2" w.g.) pressure class:
- 2.1.2.1 Dishwasher exhaust ductwork.
- 2.1.2.2 Shower exhaust.
- 2.1.3 Fabricate the following ductwork from 1.6mm (16-gauge) welded black iron:
- 2.1.3.1 Kitchen exhaust ductwork.
- 2.1.4 Fabricate the following ductwork from galvanized steel, in accordance with requirements of SMACNA 500 Pa (2" w.g.) pressure class:
- 2.1.4.1 All remaining rigid rectangular ductwork and plenums.
- 2.1.5 Galvanized steel shall be Class G90 have a coating thickness of 275 g/m² (0.9 oz./sq.ft) total both sides galvanizing coat to ASTM A653 standards.
- 2.1.6 Aluminum shall be utility grade with not more than 0.40% copper minimum tensile strength of 110.3 MPa (16,000 psi) and suitable for Pittsburg lock seam construction. Refer to SMACNA manual for conversion of galvanized duct thickness to acceptable aluminum duct thickness.
- 2.1.7 Construct round ductwork to meet the requirements of SMACNA 1500 Pa (6" w.g.) pressure class and as follows:
- 2.1.7.1 Provide welded slip joint construction round duct fittings. Wipe

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pipe and fittings with Durodyne S-2 duct sealer before assembly. Secure joints with self-tapping screws, and then brush again with thick coat of duct sealer.

2.1.7.2 Provide die-formed round elbows through to 200mm (8") diameter constructed by 1.0mm (20-gauge) galvanized steel. Provide five-section construction for larger elbows.

2.1.7.3 Provide conical round tees.

2.1.8 Construct flat oval ductwork using galvanized steel construction as follows:

2.1.8.1 Factory fabricated by United Sheet Metal, spiral uniseal through 500mm (20") minor axis, 0.7mm (24-gauge) for up to 600mm (24") major axis.

2.1.8.2 Fittings shall be continuous weld, 1.0mm (20-gauge) up to 900mm (36") major axis.

2.1.8.3 Elbows shall be easy bend.

2.1.8.4 Transitions shall have OTR-10 reinforcement.

2.2 BALANCING DAMPERS

2.2.1 Construct all dampers of the same type of material used for the ductwork.

2.2.2 For dampers in rectangular ductwork:

2.2.2.1 Construct volume dampers not greater than 225mm (9") in height of minimum 1.6mm (16-gauge) steel, centrally hinged. Use a Durodyne type KS-385 linkage.

2.2.2.2 Construct volume dampers with a height greater than 225mm (9") of not less than 1.6mm (16-gauge) steel with reinforced leaves, centrally hinged, bronze or nylon bushings, mounted on a 13mm (½") square rod in 2.7mm (12-gauge), 38mm (1-½") channel frame, securely held by a Durodyne KP-22 locking quadrant with indicating device. The dampers shall be of multi-blade, opposed type construction with a maximum blade length not exceeding 1.2m (4 ft) and a maximum blade height of 150mm (6").

2.2.2.3 Allowable leakage when closed against 1kPa (4" w.g.) at 7.62 m/s (1,500 fpm) face velocity 10%. Provide threaded rod and nut (metric thread) lever adjustment with washer and locknut.

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- 2.2.2.4 Place quadrants on insulated cuts on a bracket so that the quadrant lock is outside the insulation at all times. Place quadrants such that the limiting two (2) positions of the damper correspond to the limiting positions of the quadrant.
- 2.2.3 For dampers in round ductwork, use double thickness, aerodynamically shaped, butterfly dampers with rounded edges, tack welded to steel shafts set in nylon bushings complete with glands and asbestos rope packing. Use quadrants as described for low-pressure ductwork louver dampers. Use dampers constructed to function at the indicated pressures, smoothly without undue noise or vibration. Allowable leakage 5% against 1.5kPa (6" w.g.) and at 10.2 m/s (2,000 fpm) face velocity.
- 2.2.4 Splitter dampers to be constructed of galvanized sheet metal, two (2) gauges heavier than the duct, maximum 1.3mm (18-gauge). Splitter dampers up to 600mm (24") will be securely attached to a single steel pivot rod, which will be set in metal sockets attached to duct. End of the splitter to be turned over to form a teardrop and on this end the rod will be connected. On splitter dampers 625mm (25") and larger, provide two (2) rods. These rods will be provided with setscrew locking devices to hold position. Splitter dampers to be made rigid by reinforcing them. Duct panels surrounding splitter damper will not be cross-broken, but will be reinforced to prevent sagging or drumming. Length of splitter shall be at least 300mm (12") long or 1-1/2 times the width of the smaller branch whichever is longer.
- 2.2.5 Quadrants on insulated ducts to be placed on a bracket so that quadrant lock is on surface of insulation. Quadrants will be placed so that the limiting two (2) positions of the damper correspond to the limiting positions of the quadrant.
- 2.3 FIRE DAMPERS
- 2.3.1 Provide, where shown and required by ordinance or codes, fire dampers made to NFPA Standard 90A and ULC listed and to the approval of all authorities having jurisdiction. Fire damper shall be complete with steel frame, fusible link, steel blades, stainless steel closure springs and blade lock for horizontal curtain type dampers.
- 2.3.2 Dampers shall be Type 'B' (with pocket) unless space limitations do not permit.
- 2.3.3 Provide horizontal or vertical fire dampers to suit each application.

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2.3.4 Provide dynamic fire dampers for air systems which fan blowers do not shut down during a fire alarm. Provide static fire dampers for air systems which fan blowers shut down during a fire alarm.

2.4 FLEXIBLE CONNECTIONS

2.4.1 Connect fan units to ductwork by means of 150mm (6") wide heavy 'Ventglas' fabric securely fastened to equipment and ductwork by a galvanized steel band, provided with tightening screws. Ensure that all connections are leakproof. Provide 1.3mm (18-gauge) protective collar over flexible connections.

2.5 FLEXIBLE DUCTWORK

2.5.1 Connections to diffusers will be by means of Flexmaster T/L triple-lock aluminum flexible ducting made of dead soft aluminum, and manufactured in a manner to produce a triple-lock mechanical seam forming a continuous and secure air tight joint.

2.6 ACOUSTIC DUCT LINING

2.6.1 Where indicated on drawings, line ductwork inside with fibreglass acoustic duct insulation. Insulation to comply with ULC S110-M.

2.6.2 Facing for low velocity duct liner (max. 12.2 m/s - 2,400 fpm) shall be a tightly bonded mat, stenciled as per NFPA 90.

2.6.3 Facing for circular ducts and medium/high velocity ductwork (over 12.2 m/s - 2,400 fpm), or where indicated on drawings shall be with perforated, minimum 28 percent open area, minimum 0.85mm (22-gauge) thick galvanized steel finish.

2.6.4 Provide lining with minimum thickness and density as follows:

2.6.4.1 In ductwork 25 mm (1") at 24 kg/m³ (1-½ lb/ft³), unless otherwise noted on drawings.

2.6.4.2 In plenums 50 mm (2") at 32 kg/m³ (2 lb/ft³).

2.6.4.3 In linear slot diffuser plenums 13 mm (½") at 24 kg/m³ (1-½ lb/ft³).

2.6.5 Lining media shall have a flamespread classification of not greater than 25, when tested in accordance with ASTM E84, NFPA Standard 255, CAN 4-S102, or UL No. 723. Furthermore, fuel contribution and smoke development rating shall not be greater than 50, when tested in accordance with ASTM E84, NFPA Standard 255, CAN 4-S102, or UL No. 723.

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- 2.6.6 Lining shall be suitable for duct velocity of 30.5 m/s (6,000 fpm), without erosion damage.
- 2.6.7 Media shall have the following physical properties:
- 2.6.7.1 Maximum thermal conductivity of 1.42 W/m² °C (0.24 BTU/ft² hr °F), at 25mm (1") thickness and 24 kg/m³ (1-½ lb/ft³) density.
- 2.6.7.2 Sound absorption coefficient (NRC) of minimum 0.7, at 25mm (1") thickness and 24 kg/m³ (1-½ lb/ft³) density (ASTM C423).
- 2.7 BACKDRAFT DAMPERS
- 2.7.1 Backdraft dampers shall have galvanized steel channel frames, full blade-length shafts, brass, ball or nylon bearings, neoprene blade strips secured to pivot side of blades, counter balance weights and suitable for vertical or horizontal mounting.
- 2.7.2 Maximum blade length shall be 750mm (30"). Use multiple units for larger sizes.
- 2.7.3 Maximum resistance to air flow shall be 50 Pa (0.2" w.g.) at design airflow. Increase damper size to meet pressure drop requirement.
- 2.8 COMBINATION FIRE AND SMOKE DAMPERS
- 2.8.1 Combination fire/smoke dampers to be Ruskin FSD35 Class III dampers to maintain fire-rating integrity of membrane being pierced. Minimum fire rating shall be 1-½ hours in accordance with UL555.
- 2.8.2 Assembly to have the following construction:
- 2.8.2.1 Frame: 127 x minimum 1.6 mm (5 inches x minimum 16 gage) roll formed, galvanized steel hat-shaped channel, reinforced at corners. Structurally equivalent to 2.3 mm (13 gage) U-channel type frame.
- 2.8.2.2 Blades: Opposed, single skin with 3 longitudinal grooves, minimum 1.6 mm (16 gage) galvanized steel, width maximum 152 mm (6 inches). Flat blades are not acceptable.
- 2.8.2.3 Bearings: Self-lubricating stainless steel sleeve type, turning in extruded hole in frame.
- 2.8.2.4 Jamb seal: Stainless steel, flexible metal compression type. Glue-on seals are not acceptable.

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- 2.8.2.5 Linkage: Concealed in frame.
- 2.8.2.6 Axles: Minimum 13mm (½ inch) diameter plated steel, hex-shaped, mechanically attached to blade.
- 2.8.2.7 Mounting: Vertical or Horizontal.
- 2.8.2.8 Temperature release device: Heat-Actuated, Quick Detect
- 2.8.2.8.1 Close (in a controlled manner) and lock damper during test, smoke detection, power failure, or fire conditions through actuator closure spring. At no time shall actuator disengage from damper blades.
- 2.8.2.8.2 Allow damper to be automatically and remotely reset after test or power failure conditions. After exposure to high temperature or fire, inspect damper before reset to ensure proper operation.
- 2.8.2.8.3 Controlled closing and locking of damper in 7 to 15 seconds to allow duct pressure to equalize. Instantaneous closure is not acceptable.
- 2.8.2.9 Actuator: Electric 120 V, 60 Hz, two-position, fail close, externally mounted.
- 2.8.2.10 Finish: Mill galvanized.
- 2.8.2.11 One piece mounting angle with pre-punched screw holes.
- 2.8.2.12 Factory sleeve: Minimum 1.0mm (20 gage) thickness, minimum 432mm (17 inches long. Silicone caulk factory applied to sleeve at damper frame to comply with leakage rating requirements.
- 2.8.2.13 Break-away connections
- 2.8.3 Optional accessories:
 - 2.8.3.1 UL classified dual temperature fire stat, allowing the damper to be reopened after initial closure on heat.
 - 2.8.3.2 Two position indicator switches linked directly to damper blade to remotely indicate damper blade position.
 - 2.8.3.3 Phototelectronic type/Ionization type duct smoke detector, factory mount.
- 2.8.4 Provide multiple dampers where sizes exceed code limitations.

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2.8.5 Select dampers with airflow resistance not exceeding 13 Pa (0.05" w.g.) at design flow rates.

2.9 WALL INTAKE AND EXHAUST BOXES

2.9.1 Intake/Exhaust wall boxes shall be provided equal to Airvent Metal Products model Type A or Type R. Boxes to be constructed of galvanized (corrosion resistant) steel with flanged profile. Air flow pattern shall have a designed velocity differential ratio to prevent the bifurcated air streams from mixing in a high-rise application. The boxes shall be of modular design to allow for left or right duct connections. The boxes shall incorporate spring assisted damper system. The damper mechanisms shall be factory adjusted to suit the building height and barometric condition. Damper blade shall be under constant tension to prevent damper chatter due to wind and stack effect. Both the hinge assembly and the damper tension device shall be completely out of the air stream. Provide tie-down straps for masonry and precast installation. Seams of boxes to be sealed internally using a sealant for leak resistance, ASTM-331, UL listed, conforming to NFPA 90A and 90B with 0 flame spread and smoke development rating. Alternatively, boxes to be of welded construction.

3 **EXECUTION**

3.1 DUCTWORK

3.1.1 All ductwork construction and installation to be in accordance with recommendations of the current SMACNA standards unless otherwise noted in this Section.

3.1.2 Sheet metal, which is not to be insulated, will be cross-broken on the four sides of each panel section. All vertical and horizontal sheet metal barriers, duct offsets; elbows, as well as the panels of straight sections of ducts will be cross-broken. Cross-breaking to be applied to the sheet metal between the standing seams or reinforcing angles. The centre of the cross-break will be of the required height to assure surfaces being rigid. Insulated sheet metal and ducts will not be cross-broken.

3.1.3 Where it is necessary that ducts be divided, due to pipes, hangers, or other obstructions, which must pass through the ducts, provide teardrop shaped deflectors around these obstructions so that they will not interfere with the movement of air. Ductwork around these deflectors to be increased in size to maintain equivalent free area around deflectors. Holes in ductwork to be caulked and cover-

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plated to close any space left between edge of hole and obstruction passing through ducts. The passing of pipes or other obstructions through ducts will only be done when authorized at the Site, by the Consultant.

- 3.1.4 In square elbows and in elbows where radius is less than $1\frac{1}{2}$ x width of duct, sheet metal deflector vanes will be installed the full height of duct, being securely riveted in place. All vanes to be double thickness vanes of same gauge as duct in which they are installed. Vanes to be tack welded. For vane lengths over 1.2m (4 ft) tack weld vanes to 9mm ($\frac{3}{8}$ ") tie-rod at mid-span.
- 3.1.5 All necessary allowances and provisions will be made in the installation of the ducts for structural framing of the building and when changes or offsets are necessary, the required areas shall be maintained. All of these changes however, must be approved, and installed as directed by the Consultant at that time.
- 3.1.6 During installation, the open ends of ducts must be protected with blank, flanged sheet metal baffles, securely attached to prevent debris and dirt from entering.
- 3.1.7 Where ducts are shown connecting to masonry openings and/or along the edges of all plenums at floors, walls, etc., provide a continuous 38mm x 38mm x 4.7mm ($1\frac{1}{2}$ " x $1\frac{1}{2}$ " x $\frac{3}{16}$ ") galvanized angle steel, which will be bolted to the structure and made airtight to same by applying caulking compound on the angles before they are drawn down tight. The sheet metal at these locations will be bolted to the angle steel framing.
- 3.1.8 All air ducts, casings, plenums, etc., to be constructed of lock forming quality prime galvanized steel sheets, which are free from blisters, slivers, imperfectly coated spots, etc., no second quality sheet metal allowed.
- 3.1.9 Ducts to be constructed using double or Pittsburgh lock corner seams. All seams to be hammered down and made airtight. For transverse joint refer to current ASHRAE Guide for low-pressure ductwork.
- 3.1.10 Gauges and reinforcing of sheet metal ductwork will be as indicated in the current SMACNA manual, except 0.55mm (26-gauge) ductwork will not be allowed.
- 3.1.11 All sheet metal connections for apparatus plenum chambers, etc., to be constructed on 1.3mm (18-gauge) metal reinforced with

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38mm x 38mm x 4.7mm (1-1/2" x 1-1/2" x 3/16") galvanized angles up to 2.4m (8 ft) in height. When height exceeds 2.4m (8 ft) angles shall not be less than 50mm x 50mm x 6mm (2" x 2" x 1/4"). In all case provide connections structurally designed for maximum fan pressures.

- 3.1.12 Angles on all apparatus and plenum chambers to be installed on not more than 1.2m (4 ft) centres and at all vertical and longitudinal seams on the plenum construction.
- 3.1.13 Ensure that all openings required through floors, walls, partitions, etc., for the duct system are provided in the exact location.
- 3.1.14 The bottom joint and 150mm (6") of vertical joint on outside air intake ducts and mixing chamber ducts will be soldered and made watertight. Provide drain connection and run copper drainpipe to nearest floor drain.
- 3.1.15 Provide 50mm (2") insulated sheet metal blank off panels behind unused portions of exterior louvers.
- 3.1.16 Connect flexible ductwork using stainless steel worm drive clamps, adjustable clamps, or duct straps applied over two wraps of duct tape.
- 3.1.17 Maximum length of flexible ducts shall be 3.6m (12 ft). Utilize rigid ductwork as required to meet this requirement.
- 3.1.18 Install flexible ductwork clear of ceiling assemblies, light fixtures, etc. Support by 25mm (1"), 0.85mm (22-gauge) galvanized steel straps at 1.5m (5 ft) centres.
- 3.1.19 Frame and install motorized dampers. Attach each motorized damper module to channel framing.
- 3.1.20 Seal all ductwork in accordance with the appropriate SMACNA "Standard Duct Sealing Requirements". All sealants shall be ULC listed in accordance with standard S-102. Where insulation is applied internally to ductwork, metal duct shall act as vapour barrier and all joints to be completely sealed. Ductwork shall be leak tested at the rated pressure in accordance with SMACNA HVAC Duct Leakage Test Manual. A leak test report shall be provided to the Consultant. Duct sealing and leak testing shall be conducted before ductwork is insulated or concealed by drywall to allow for re-sealing or repairing duct sections.

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- 3.1.21 Ductwork modification:
 - 3.1.21.1 Make all necessary allowances and provisions for the structural framing of the building. Do not execute any such changes without permission of the Consultant.
 - 3.1.21.2 Transform or divide low-pressure ducts (up to 500 Pa / 2" w.g. static pressure) as may be required. Maintain the indicated cross sectional areas. Do not exceed an aspect ratio of 4 to 1. Install air stream deflectors when pipes and other small obstructions must pass through ducts, but maintain the free passage area.
 - 3.1.21.3 Transform rectangular ducts for pressures higher than 500 Pa (2" w.g.). Do not exceed the initial pressure drop. Do not exceed an aspect ratio of 4 to 1. Do not pass any obstructions through any of these ducts.
 - 3.1.21.4 Round or oval ducts for pressures higher than 500 Pa (2" w.g.). Do not change dimensions without obtaining approval. Do not pass any obstructions through any of these ducts.
- 3.2 **BALANCING DAMPERS**
 - 3.2.1 Provide balancing dampers in all locations necessary for balancing the air system including but not necessarily limited to the following locations:
 - 3.2.1.1 Where ducts enter or leave duct shafts, (including ducts to last floor where shafts may not exist).
 - 3.2.1.2 In all supply branches without reheat coil stations (e.g. corridors, electrical rooms, etc.).
 - 3.2.1.3 In all other locations shown on the Drawings.
 - 3.2.2 Note: For clarity of Drawings, balancing dampers mentioned under paragraphs 3.2.1.1. and 3.2.1.2. are not shown or indicated on the Drawings, but must be supplied and installed.
 - 3.2.3 In each branch connection, install splitter dampers in supply ducts and louver dampers in return ducts.
 - 3.2.4 Install duct mounted louver type dampers between angle steel duct framing, using neoprene gasket. In stainless steel ducts, cover the neoprene gaskets with Teflon tape.
 - 3.2.5 Bolt all dampers in plenum wall to a counter frame using a

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neoprene gasket between damper and wall.

3.2.6 Install access doors and panels at all dampers, to provide access to the entire damper assembly.

3.3 FIRE DAMPERS, COMBINATION SMOKE/FIRE DAMPERS

3.3.1 Before proceeding with any work, submit erection drawings approved by all authorities having jurisdiction showing location and construction details of all fire dampers.

3.3.2 Install dampers at locations indicated on the drawings and in accordance with manufacturer's UL approved installation instructions.

3.3.3 Install dampers square and free from racking with blades running horizontally.

3.3.4 Provide steel retaining angle and steel wall sleeve/collar for proper installation of the damper.

3.3.5 Do not compress or stretch damper frame into duct or opening.

3.3.6 Handle damper using sleeve or frame. Do not lift damper using blades, actuator, or jackshaft.

3.3.7 Enlarge duct sections around fire dampers, to allow unrestricted duct area while damper is in open position. Provide approved type access doors with airtight gaskets, for inspection and servicing of fire dampers. Provide dampers in supply and return take-offs at each floor of the multiple louver type.

3.3.8 Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.

3.3.9 Provide fire dampers in all ducts over 0.013m² (0.14 sq.ft) in area in the location shown on drawings, whether or not specifically requested by ordinances and codes.

3.3.10 For stainless steel exhaust ducts provide butterfly fire dampers constructed of stainless steel.

3.3.11 Line side power wiring and control wiring connections to fire alarm system for combination fire/smoke dampers shall be provided by Division 26 - Electrical. Coordinate wiring requirements and exact location of dampers with Division 26 - Electrical Contractor.

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3.4 CONTROL DAMPERS

3.4.1 Install automatic control dampers in all relief ducts to the outside, in all return ducts to the main air handling units from all main return-relief fans, and elsewhere where shown. Install all damper sections between angle steel frames attached to the ductwork.

3.5 WATERPROOF EXHAUST

3.5.1 Provide waterproof ductwork where aluminum ductwork is specified in the Contract Documents. All joints shall be made watertight using caulking. Slope ducts back to source to facilitate drainage. Where this is not feasible, provide intermediate drains piped to nearest floor drain. All joints shall be made watertight.

3.6 KITCHEN EXHAUST DUCTS

3.6.1 Provide at each change in direction and at every floor in a riser a minimum 450mm x 300mm (18" x 12") access door for inspection and cleaning. Provide access doors in lateral runs not further than 6m (20 ft) on centre. Provide residue trap at the base of each riser with provision for cleanout.

3.6.2 Maintain the integrity of all fire rating.

3.6.3 Fabrication and installation shall be in strict accordance with NFPA 96.

3.7 CLEANING OF AIR SYSTEMS

3.7.1 Wipe clean all ductwork internally before erection.

3.7.2 After completing the systems, vacuum clean all ductwork and all apparatus internally through cleanouts.

3.7.3 Run air systems for at least twelve (12) operational hours using throwaway filters in place of permanent filters. Include for additional throwaway filter as well as for filters for all air handling units provided under this Contract.

3.7.4 Have all ductwork inspected for internal cleanliness. Obtain the Consultant's permission for the installation of all permanent filters in order to facilitate balancing.

3.8 DUCT ACCESS PANELS AND TEST HOLES

3.8.1 Access Panels:

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- 3.8.1.1 Provide all access doors of the same material as used for the ducts in which they are to be installed. Ensure through gasketing and suitable fastening materials that the entire systems are completely free from corrosion, water leakage (washable ducts), and air leakage (all ducts).
- 3.8.1.2 Ensure that all duct access doors are easily accessible through the structure.
- 3.8.1.3 All access doors will be in accordance with NFPA Standard 90-A. Construct all duct or apparatus access panels from double thickness frame, 25mm (1") apart, with necessary reinforcing for rigidity. Provide access panels on insulated ducts apparatus with 25mm (1") space filled with fibreglass insulation. Make panels airtight with a continuous rubber gasket. Provide openings in ductwork or casings with continuous galvanized reinforcing bars, extended on insulated ductwork or casings, to the face of the insulation.
- 3.8.1.4 Provide 450mm x 450mm (18" x 18") and smaller panels with at least two (2) brass window sash fasteners, larger panels with at least two (2) brass pin hinges and two (2) fasteners. Make fasteners on wall-through panels operational from inside and outside. Provide all panels with brass drawer type handles (two (2) minimum, each).
- 3.8.1.5 Provide access panels where shown, and in the following locations whether shown or not:
 - 3.8.1.5.1 In ductwork to facilitate full cleaning of all ducts.
 - 3.8.1.5.2 Bottom of all duct risers.
 - 3.8.1.5.3 Next to outside air intakes and outlets.
 - 3.8.1.5.4 At fire dampers.
 - 3.8.1.5.5 Into plenums and apparatus casings to facilitate maintenance and cleaning of all components.
 - 3.8.1.5.6 Immediately upstream and downstream of each reheat coil.
- 3.8.1.6 In ducts vulnerable to settlement of liquids or solids, provide reach-through type access doors size 250mm x 200mm (10" x 8") of rigid construction complete with frame and counter frame, bolted and gasketed. Provide insulated doors in ducts that are to be used for

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access.

- 3.8.1.7 In all other ducts provide access doors of adequate size to allow for inspection, cleaning and for general maintenance, of dampers, filters, louvers, birdscreens, coils, thermostats, thermometers, firestats, fire linkages and all other duct mounted appurtenances. Provide reach-through type access doors of rigid construction with frame and counter-frame, hinged and sash locked with gasket. Insulate doors for ducts that are to be insulated.
- 3.8.2 Test Holes:
- 3.8.2.1 At each main branch in ductwork and at each fan discharge and suction, provide sufficient number of Pitot tube test holes for balancing systems. Also, provide test holes for traverse at fan discharge.
- 3.8.2.2 Test holes to be located within easy reach of catwalks or ladders.
- 3.8.2.3 Each test hole will have 19mm ($\frac{3}{4}$ ") clear opening, provided with a metal ring plate with a threaded hole, and a matching screwed head plug. Where these plugs are installed in insulated ductwork, provide an extension collar against which the insulation can be finished.
- 3.8.2.4 Reinforced holes to be provided where thermometers, manometers, thermostats, gauges, damper rods, etc., occur in ductwork. Extended collars will be provided for the reinforced holes where these occur on insulated ductwork.
- 3.8.2.5 Where copper tubing passes through ductwork, or casing, provide a rubber grommet to prevent damage to copper tubing.
- 3.9 ACOUSTIC DUCT LINING
- 3.9.1 Secure to ductwork with approved fire retardant adhesive suitable for fibreglass insulation using 100% coverage and 2.7mm (12-gauge) anchors, or minimum 1.9mm (14-gauge) weld pins on 400mm (16") centres. Cut-off excess fastener length after mechanical fasteners (speed clips) have been applied. Transverse joints shall be firmly butted with no gaps and longitudinal corner joints shall be overlapped and compressed. Coat all joints, raw edges, rips, and protrusions with approved mastic. Provide continuous sheet metal edge protectors at entering and leaving edges of lined duct sections, and all joints.

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- 3.9.2 Duct dimensions shown are clear inside dimensions. Increase duct dimensions to suit thickness of duct lining.
- 3.9.3 Unless noted otherwise in the Contract Documents, acoustic insulation shall be installed in accordance with SMACNA Standard for Metal and Flexible Duct.
- 3.9.4 Extent of ductwork acoustic lining:
 - 3.9.4.1 Downstream of air terminal control units (CAV, VAV and fan powered), except units supplied with integral attenuator, for min. 1,524mm (5 ft) length.
 - 3.9.4.2 Downstream of heat pump units, for min. 2,438mm (8 ft) overall length, or min. 914mm (3 ft) length beyond the first 90 degree elbow.
 - 3.9.4.3 All toilet exhaust branch ducts which serve different toilet rooms from same riser on the same level unless at least 5m (16 ft) of ductwork, including at least three (3) of 90 degree elbow separate grilles in separate rooms.
 - 3.9.4.4 Air transfer ducts for full length.
 - 3.9.4.5 Return air stub ducts at shaft intake openings for full length.
 - 3.9.4.6 All ductwork serving spaces with noise criteria of NC-30 or lower.
 - 3.9.4.7 Where indicated on the Drawings.
- 3.9.5 Where ductwork velocities exceed 12.2 m/s (2,000 fpm), use of internal lining shall be reviewed with the Consultant in fulfilling the above requirements. If internal lining is deemed unsatisfactory for the particular application, provide perforated metal facing over internal lining, or sound traps as directed.
- 3.10 **INSULATED PLENUMS AND CASINGS**
 - 3.10.1 Provide insulated metal sandwich panels for all exterior intake and exhaust air plenums consisting of prefabricated 1.3mm (18-gauge) galvanized sheet metal panels and 50mm (2") rigid fibreglass insulation with interlocking joints securely fastened.
 - 3.10.2 Provide steel supports, joiner sections, floor channels, opening frames and sealing materials. Provide 1.3mm (18-gauge) minimum channel stiffeners at not greater than 800mm (32") centres.

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- 3.10.3 Connect corners and butt joints with 1.6mm (16-gauge) galvanized sections. Seal all joints with rubber mastic. Use angle joints to attach panel edges to walls.
- 3.10.4 Construct entire plenum to resist deflection and seal sufficiently to avoid air leakage when subjected to a pressure differential between inside and outside of up to 2,490 Pa (10" w.g.)
- 3.10.5 Provide access doors suitable for personnel pass through.
- 3.10.6 Insulate plenum floors with 25mm (1") rigid fibreglass insulation and cover with 1.6mm (16-gauge) galvanized sheet metal panels.
- 3.10.7 Seal penetrations through plenum walls with gland seals.
- 3.10.8 Construct drain pans from 1.6mm (16-gauge) type 304 stainless steel. Weld all joints. Install DN32 (1-¼") DWV drain connection to nearest drain complete with deep seal trap (minimum 100mm / 4"). Install to completely drain the pan.

END OF SECTION

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3.2	Sound Proof Construction for Duct Penetrations

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1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 – General Requirements, shall apply to and govern this Section.

1.2 SCOPE OF WORK

1.2.1 Provide all labour, materials, tools, equipment, training commissioning and certification required to complete the work as shown on the Drawings and specified in this Section, including:

1.2.1.1 Complete noise control system to prevent noise levels from exceeding the room criteria listed in Table 1, Chapter 48 of the ASHRAE 2011 HVAC Applications Handbook.

1.2.2 System shall include sound attenuating units (silencers), sound proofing construction, and external sound proofing, provided under this Section, and acoustic duct lining provided under Section 23 30 13 – Ductwork and Accessories.

1.2.3 In addition to the work covered under this Section, coordinate the equipment supplied under the work of other Sections of this Division and of other Divisions, to comply with the requirements contained in this Section.

1.3 SUBMITTALS

1.3.1 The Division 23 – HVAC Subcontractor shall supply to the noise control manufacturer approved drawings of all equipment to be acoustically attenuated, including sound power level data.

1.3.2 The noise control manufacturer shall supply shop drawings of all silencers to be used on the project. The data shall include dynamic insertion loss, generated noise and pressure drop. Data shall be certified by a qualified independent testing laboratory.

1.3.2.1 The insertion loss shall consist of sound pressure level in the diffuse sound field of a reverberant room where a silencer is substituted for the same length of empty duct and the rest of the system unchanged.

1.3.2.2 The test method used by the Independent Testing Laboratory certifying the silencer data shall be fully described.

1.3.2.3 The certification of the pressure drop, insertion loss, and generated

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noise data shall be based upon tests of the same silencer for all measurements.

- 1.3.3 Submit letter from manufacturer certifying silencers have been installed in accordance with their recommendations and the contract documents.
- 1.4 QUALITY ASSURANCE
 - 1.4.1 Noise levels due to equipment and ductwork shall permit attaining sound pressure levels in all eight (8) octave bands in occupied spaces conforming to room criteria listed in Table 1, Chapter 48 of the ASHRAE 2011 HVAC Applications Handbook.
 - 1.4.2 Acoustical Performance within Equipment Spaces:
 - 1.4.2.1 Equipment room noise levels and noise transmission to adjacent buildings shall comply with the local statutory requirements.
 - 1.4.3 Motor Acoustical Performance:
 - 1.4.3.1 All motor drives when installed per plans and specifications shall operate with noise levels not exceeding 80 dBA.
 - 1.4.3.2 Noise levels shall be determined in accordance with IEEE Standard #85 Test "Procedure for Airborne Noise Measurements on Rotating Electric Equipment".
 - 1.4.4 Transformer Acoustical Performance:
 - 1.4.4.1 Maximum permissible sound pressure level when operated under installed conditions shall be 80 dBA when measured with an ANSI S1.4-1983 "Type 1" sound level meter at any point which is 1.0m (40") from the equipment housing.
 - 1.4.5 Air Distribution System; Pressure Reducing Device Noise.
 - 1.4.5.1 Maximum permissible sound power levels in octave bands of airborne transmission through the combination of grille, registers, diffusers, terminal units, related pressure reducing devices and fan coil units, when operated in installed condition per Plans and Specifications, shall be no greater than the maximum in the following table for diffuser heights of less than 4m (13 feet) above finished floor level:

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Air Distribution System Equipment/Terminal Device Noise			
Maximum PWL (dB re: 10 ⁻¹² Watt)			
Octave Band	NC-35	NC-40	NC-45
1	62	66	68
2	56	60	63
3	49	54	58
4	46	51	56
5	43	48	53
6	42	47	52
7	41	46	51
8	42	47	52

1.4.5.2 The contractor is hereby advised to exercise the following in order to assure satisfactory acoustical performance of the terminal devices:

1.4.5.2.1 Provide proper duct connections to the terminal inlets, with at least three (3) duct diameters of straight ductwork, either flexible or sheet metal, before the duct attachment to the terminal.

1.4.5.2.2 Ensure proper air balancing.

1.4.5.2.3 Avoid excessive dampening near the terminals.

1.4.6 Variable Volume (VAV) Box, Fan Powered VAV Box, Fan Coil and Heat Pump Unit Above Ceiling; Radiated Noise:

1.4.6.1 Maximum permissible radiated sound power levels in octave bands when operated over occupied spaces in an installed condition, above a ceiling, shall be as per the following table:

Maximum Radiated Sound Power (dB re: 10 ⁻¹² Watt)			
Octave Band	NC-35	NC-40	NC-45

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Maximum Radiated Sound Power (dB re: 10 ⁻¹² Watt)			
Octave Band	NC-35	NC-40	NC-45
1	72	76	79
2	70	74	77
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2 PRODUCTS

2.1 GENERAL

- 2.1.1 Silencers shall be of the size, configuration, capacity, and acoustic performance as specified in the Silencer Schedule in the Contract Documents. All silencers shall be factory fabricated and supplied by the same manufacturer.
- 2.1.2 Silencer performance including silencers with fibreglass cloth and Mylar encapsulated media must have been substantiated by laboratory testing according to ASTM E477 and so certified when submitted for approval.
- 2.1.3 Silencer inlet and outlet connection dimensions must be equal to the duct sizes shown on the Drawings. Duct transitions at silencers are not permitted unless shown on the Contract Drawings. A sheet metal elbow in combination with a rectangular silencer is not acceptable as an elbow silencer.
- 2.1.4 Completely prefabricate all silencers using incombustible materials. Silencers shall have rounded inlets and tapered diffuser outlets. Equip circular silencers with centre bodies with spun noses and tapered diffuser outlets.
- 2.1.5 Media shall be incombustible acoustic quality, shot free fibreglass

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insulation with long, resilient fibres bonded with thermosetting resin. Density shall be required to insure conformance with laboratory test data. Fibreglass shall be packed with a minimum 10% compression during silencer assembly. Media shall be bacteria and fungus resistant, resilient such that it will not crumble or break and conform to irregular surfaces. Media shall not cause or accelerate corrosion of aluminum or steel. Mineral wool will not be permitted as a substitute for fibreglass.

- 2.1.6 Media shall have a flamespread classification of not greater than 25, when tested in accordance with ASTM E84, NFPA Standard 255, or UL No. 723. Furthermore, fuel contribution and smoke development rating shall not be greater than 50, when tested in accordance with ASTM E84, NFPA Standard 255 or UL No. 723
- 2.1.7 Silencers shall have 50mm (2") slip connections unless specified otherwise in the Contract Documents. Silencers shall be constructed from galvanized sheet metal or steel sheet. If steel sheet is used, silencers shall be painted with anti-rust prime coat. Supply lifting lugs on units with cross sectional dimensions larger than 600mm (24"). Where silencer is mounted in stainless steel ductwork, the silencer shall be all stainless steel construction to match the ductwork gauges used.
- 2.1.8 Where indicated on the Silencer Schedule, media shall be encapsulated in fibreglass cloth or Mylar film to prevent erosion, shedding, and impregnation of the fibreglass media.
- 2.1.9 All perforated metal shall be adequately stiffened to insure flatness and form. All seams and joints should be mastic filled to insure airtight construction.
- 2.1.10 Silencers shall not fail structurally when subjected to a differential air pressure of 1,992 Pa (8" w.g.)
- 2.2 RECTANGULAR/ELBOW SILENCERS
- 2.2.1 Rectangular silencers shall be constructed according to one of the following classes. Silencers over 1200 mm (48") in any one cross sectional dimension shall be constructed in modules not exceeding 1200 mm (48").
- 2.2.2 Class I: Outer shell shall be minimum 0.85mm (22-gauge) and 0.55mm (26-gauge) inner perforated liner of galvanized steel with airtight mastic filled seams and 50 mm (2") slip connections at each end.

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2.2.3 Class II: Outer shell shall be minimum 1.3mm (18-gauge) and 0.85mm (22-gauge) inner perforated liner of galvanized steel with spot-welded and caulked seams and steel angle flanges at each end.

2.2.4 Class III: The outer casing shall be a minimum of 1.6mm (16-gauge) hot rolled steel with all seams continuously welded, 0.85mm (22-gauge) inner perforated liner of galvanized steel and steel angle flanges at each end.

2.3 CROSSTALK SILENCERS

2.3.1 Crosstalk silencers shall be constructed of 0.85mm (22-gauge) galvanized outer shell and 0.55mm (26-gauge) galvanized perforated metal.

2.4 HTL CASINGS

2.4.1 Where indicated on the Silencer Schedule, silencers shall have breakout/in protection (HTL - Type I, II, III) externally applied and completely sealed to the silencer casing by the silencer manufacturer to assure quality controlled transmission loss. The HTL walls shall consist of media, airspace, mass and outer protective metal skin, as required, to obtain the specified room NC level. Standard acoustical panels will not be accepted as HTL Walls.

2.4.2 Such HTL walls will extend from within the mechanical equipment room to a point at which flanking through the silencer casing is not a problem.

2.4.3 Mechanical attachment of the HTL walls to the silencer casing is only permitted at the mechanical room end of the silencer and the termination point of the HTL Wall treatment.

2.5 ACOUSTIC PERFORMANCE

2.5.1 Silencer dynamic insertion loss shall not be less than that listed in the Silencer Schedule. Select silencers to provide the performance stipulated by paragraph 1.2.1.1.

2.5.2 Silencer generated noise shall not be greater than that listed in the Silencer Schedule.

2.5.3 Acoustic performance shall include dynamic insertion loss and generated noise for forward flow (air and noise in same direction)

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or reverse flow (air and noise in opposite direction) in accordance with project's air distribution system requirements.

2.5.4 All silencer ratings shall be determined in a duct-to-reverberant room test facility, which provides for airflow in both directions through the test silencer in accordance with the ASTM E477-99 test standard. The test set-up, procedure, and facility shall eliminate all effects due to flanking, directivity, end reflection, standing waves, and reverberation room absorption.

2.6 AERODYNAMIC PERFORMANCE

2.6.1 Silencer pressure drops shall not exceed those listed in the Silencer Schedule. Silencer pressure drop measurements shall be made in accordance with the ASTM E477-99 test standard. Tests shall be conducted and reported on the identical units for which acoustical data is presented.

3 **EXECUTION**

3.1 GENERAL

3.1.1 Protect all acoustic media from dirt and moisture during construction.

3.1.2 Have the manufacturer inspect the complete installation after system start-up and submit a letter to the Consultant stating that the complete vibration isolation and noise control installation is installed in accordance with its Drawings and instructions and operates to its satisfaction.

3.1.3 After the system has been air balanced, the noise control manufacturer shall visit the job and check the sound levels in those areas requested by the Consultant. Conduct sound tests as requested by the Consultant. Determine the necessary corrective measures if applicable, and submit a written report.

3.1.4 Sound measurements shall be in accordance with the "American Standard Method for the Physical Measurement of Sound S1.2".

3.1.5 Sound measuring equipment shall be in accordance with ANSI Standards S1.4 or S1.11.

3.1.6 Maximum static pressure loss:

3.1.6.1 After installation measure total system pressure before and after attenuators.

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3.1.6.2 If pressure loss exceeds maximum static pressure loss shown in Schedules, at no charge, replace attenuators and/or modify entrance and/or discharge aerodynamic flow to obtain specified performance.

3.2 SOUND PROOF CONSTRUCTION FOR DUCT PENETRATIONS

3.2.1 Required for openings between ductwork and following construction:

3.2.1.1 Equipment room walls.

3.2.1.2 Floors, except in shafts.

3.2.2 Sound proofing

3.2.2.1 Fill openings with fibrous glass blanket or board for full depth of penetration.

3.2.3 Caulk each side of opening with non-hardening, non-aging caulking compound similar to Johns Manville "Duxeal".

END OF SECTION

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1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 - General Requirements, shall apply to and govern this Section.

1.2 SCOPE OF WORK

1.2.1 Provide all labour, materials, tools equipment, training commissioning and certification required to complete the work as shown on the Drawings and specified in this Section, including:

1.2.1.1 All fans, not part of equipment assemblies.

1.3 SUBMITTALS

1.3.1 Provide shop drawings for all fans. Shop drawings shall include sound power levels for inlet and outlet at rated capacity, and fan curves.

1.3.2 As a minimum, provide the following information:

1.3.2.1 Product data sheets indicating rated capacities, sound power levels for inlet and outlet at rated capacity, and fan curves for 75%, 100% and 125% of rated RPM.

1.3.2.2 Physical outline dimension drawing showing required clearances, weights, and location and size of connection entries.

1.3.3 Provide manufacturer's certification letter. Refer to Section 20 00 00 – General Requirements.

2 **PRODUCTS**

2.1 GENERAL

2.1.1 Provide all fans indicated on the Drawings.

2.1.2 Provide all fan ratings based upon tests performed in accordance with code adopted jointly by the ASHRAE and AMCA. Provide each fan with the AMCA seal. Provide fans with a high efficiency and a pressure characteristic that is constantly rising from free delivery to shut-off. Fans to have non-overloading horsepower characteristics.

2.1.3 The fan manufacturer shall provide certified performance curves of

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capacity vs. static pressure; BHP vs. capacity and noise sound power; values at rated RPM and at 75% and 125% of rated RPM. When installed, the fan not performing to the curve will be tested by the fan manufacturer and be 'made good' at no cost to the Owner.

- 2.1.4 Provide all fan wheels statically and dynamically balanced in the manufacturer's plant in accordance with AMCA Standard 204, Balance Quality and Vibration Levels for Fans. Fans to operate quietly and without pulsations.
- 2.1.5 The fan manufacturer shall check that the motor horsepower specified in the Contract Documents is sufficient to accelerate the fan to operating speed without motor overload within normal time limits. If it is found insufficient, the Consultant shall be notified, prior to tendering, and a larger motor and starter will be provided to prevent overloading. If, when installed, motor overload and stopping occur due to fan inertia, the fan manufacturer shall pay all costs incurred for changing motors, starters, wiring, etc.
- 2.1.6 Fans used for smoke exhaust shall be suitable for continuous operation at 205°C (400°F).
- 2.1.7 Fan belts shall be oil and heat resistant, non-static type. Drives shall be precision-machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower.
- 2.1.8 For belt driven fans with variable pitch motor drive, the drive must be factory set to the specified fan RPM.
- 2.1.9 For belt driven fans with fixed drives, allow for one (1) drive change for air balancing purposes (parts only, labour by the Subcontractor responsible for the Air Balancing work under Section 20 05 93).
- 2.2 CENTRIFUGAL INLINE FANS – SQI/SQN SERIES
- 2.2.1 Fan shall be duct mounted, belt driven centrifugal square inline (HP – high pressure).
- 2.2.2 (SQI-B, SQI-HP) The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. Housing shall be minimum 1.3mm (18-gauge) steel with airflow straightening vanes and integral duct flanges. Adjustable motor plate shall utilize threaded studs for positive belt tensioning. Access door and mounting feet shall be located in the specified position.

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- 2.2.3 (SQN-B, SQN-HP) The fan shall be of bolted construction utilizing corrosion resistant fasteners. Housing shall be minimum 1.3mm (18-gauge) galvanized steel with integral duct collars. Bolted access doors shall be provided on three sides, sealed with closed cell neoprene gasketing. Pivoting motor plate shall utilize threaded L-bolt design for positive belt tensioning. Housing shall be pre-drilled to accommodate universal mounting feet for vertical or horizontal installation.
- 2.2.4 Unit shall bear an engraved aluminum nameplate. Nameplate shall indicate design airflow, static pressure, and maximum fan RPM. Unit shall be shipped in ISTA certified transit tested packaging.
- 2.2.5 (SQI-B, SQI-HP only) All steel fan components shall have an electrostatically applied, baked polyester powder coating. Each component shall be subject to a five stage environmentally friendly wash system, followed by a minimum 2-mil thick baked powder finish. Paint must exceed 1,000-hour salt spray under ASTM B117 test method.
- 2.2.6 Wheel shall be centrifugal backward inclined, constructed of 100% aluminum, including a precision-machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency.
- 2.2.7 Motor shall be heavy-duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase, and enclosure.
- 2.2.8 Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy-duty regreasable ball type in a cast iron housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
- 2.2.9 Supply the following accessories unless described otherwise in the plans and schedules:
- 2.2.9.1 UL safety disconnect switch
- 2.2.9.2 Wiring between motor and disconnect switch
- 2.2.9.3 Spring vibration isolator set
- 2.2.9.4 Flexible duct connectors (intake and discharge side)

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2.3 DUCT/CEILING INLINE FANS – GN/GC SERIES

- 2.3.1 Fan shall be inline (GN) or ceiling (GC) mounted, direct driven, centrifugal exhaust fan.
- 2.3.2 The fan wheel housing and integral outlet duct shall be injection molded from a specially engineered resin exceeding UL requirements for smoke and heat generation. The outlet duct shall have provision for an aluminum backdraft damper with continuous aluminum hinge rod. The inlet box shall be minimum 0.85mm (22-gauge) galvanized steel. Motor shall be isolation mounted to a one piece galvanized stamped steel integral motor mount/inlet. A field wiring compartment with disconnect receptacle shall be standard. Unit shall be shipped in ISTA Certified Transit Tested Packaging.
- 2.3.3 (GN) To accommodate different mounting positions, an adjustable prepunched mounting bracket shall be provided.
- 2.3.4 (GC) To accommodate different ceiling thickness, an adjustable prepunched mounting bracket shall be provided. A white, high impact styrene injection molded grill shall be provided as standard. Unit shall be designed with provision for field conversion from ceiling to in-line.
- 2.3.5 Wheel shall be centrifugal forward curved type, injection molded of polypropylene resin.
- 2.3.6 Motor shall be open drip proof type with permanently lubricated bearings and include impedance or thermal overload protection and disconnect plug. Motor shall be furnished at the specified voltage.
- 2.3.7 The following accessories shall be provided by the manufacturer:
- 2.3.7.1 Fan mount speed controller
- 2.3.7.2 Wiring between motor and speed controller.
- 2.3.7.3 Reinforced aluminum backdraft damper with continuous hinge rod.

3 **EXECUTION**

3.1 INSTALLATION

- 3.1.1 Install fans as shown, with resilient mountings and fan restraining snubbers as specified with vibration isolation and flexible electrical leads.

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- 3.1.2 Install fans with flexible connections on inlet ductwork and on discharge ductwork in accordance with Section 23 30 13 – Ductwork and Accessories.
- 3.1.3 Provide and install guards on inlets and/or discharge for all fans which are not duct connected.
- 3.1.4 Align shafts, belt drive, and motor, adjust belt tension, and check motor rotation before start-up.
- 3.1.5 Protect motors and fans during construction and rotate fans, by hand, every month between delivery and acceptance of building.
- 3.1.6 Provide torque restrains consisting of spring hangers mounted at 45° angle, for axial fans with 3.73 kW (5 HP) or larger motor and/or 623 Pa (2.5") ESP, installed with flexible connectors.
- 3.1.7 Adjust variable pitch fan/motor sheaves during balancing to achieve specified air quantities.
- 3.1.8 Provide sheaves and belts for final air balance where specified in the Contract Documents.

END OF SECTION

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1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 - General Requirements, shall apply to and govern this Section.

1.2 SCOPE OF WORK

1.2.1 Provide all labour, materials, tools equipment, training commissioning and certification required to complete the work as shown on the Drawings and specified in this Section, including:

1.2.1.1 All VAV terminal units.

1.2.1.2 All fan powered VAV terminal units.

1.2.2 Power wiring shall be connected under the work of Division 26 - Electrical.

1.3 SUBMITTALS

1.3.1 Provide shop drawings for all terminal units.

1.3.2 In addition to general submittal requirements, shop drawings shall include sound power data in accordance with the following:

1.3.2.1 All sound power data shall be based on tests conducted in accordance with ANSI/AHRI Standard 880-2011 in an AHRI certified laboratory.

1.3.2.2 Sound data shall include both valve and fan simultaneous operation, and fan only operation (for fan powered boxes).

1.3.2.3 Sound power level in decibels (re. 10** - 12w) shall be submitted for octave bands 2 through 7 for both discharge and radiated sound power. The data shall be tabulated for design minimum inlet static pressure, and minimum inlet pressure plus 25mm w.g. (1" w.g.), with fan operating at an external static pressure of 13mm w.g. (1/2") (for fan powered terminal).

2 **PRODUCTS**

2.1 GENERAL

2.1.1 The Contract Documents are based on selected manufacturer as scheduled or shown in the tender form. If an alternate supplier

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from the approved equals list is used, the noise and vibration levels of the alternate product shall be equal to or less than the specified products. Any additional noise attenuation features required to meet the noise and vibration performance of the specified boxes shall be provided by this Division at no additional cost to the Owner.

- 2.1.2 Terminal units shall be certified under the AHRI Standard 880 Certification Program and carry the AHRI Seal. Noncertified terminals may be submitted after testing at an independent testing laboratory under conditions selected by the engineering consultant in full compliance with AHRI Standard 880. These tests must be witnessed by the engineering consultant with all costs to be borne by the terminal manufacturer. Testing does not ensure acceptance.
- 2.1.3 All components shall be factory installed, wired, calibrated, and tested by the box manufacturer to ensure a fully functional unit.
- 2.1.4 Provide a single 120V (208V for fan powered terminals) power wire for connection to adjacent junction box.

2.2 VARIABLE VOLUME TERMINALS

- 2.2.1 Provide single duct, variable air volume terminals of the sizes and capacities shown in the drawings.
- 2.2.2 The terminal casing shall be minimum 0.76mm (22-gauge) galvanized steel, internally lined with 12mm (½ inch) dual density insulation which complies with requirements of UL 181 and NFPA 90A. All exposed insulation edges shall be coated with NFPA 90A approved sealant to prevent entrainment of fibers in the airstream. The discharge connection shall be slip and drive construction for attachment to metal ductwork. The casing shall be constructed to hold leakage to the maximum values shown in L/s (cfm) in the below table:

Inlet Size	dPs, Pa (in wg)			
	125 (0.5")	250 (1")	500 (2")	750 (3")
4, 5, 6	0.9 (2)	1.4 (3)	1.8 (4)	2.4 (5)
7, 8	1.8 (4)	2.4 (5)	3.3 (7)	4.2 (9)
9, 10	1.8 (4)	2.8 (6)	3.6 (8)	4.8 (10)

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Inlet Size	dPs, Pa (in wg)			
	125 (0.5")	250 (1")	500 (2")	750 (3")
12	2.4 (5)	3.3 (7)	4.8 (10)	5.6 (12)
14	2.8 (6)	4.2 (9)	6.1 (13)	7.2 (16)
16	3.3 (7)	4.8 (10)	6.6 (14)	8.0 (17)

2.2.3

The damper shall be heavy gauge steel with shaft rotating in self-lubricating bearings. Nylon bearings are not acceptable. Shaft shall be clearly marked on the end to indicate damper position. Stickers or other removable markings are not acceptable. The damper shall incorporate a mechanical stop to prevent overstroking and a synthetic seal to limit close-off leakage to the maximum values shown in L/s (cfm) in the below table:

Inlet Size	dPs, Pa (in wg)			
	250 (1")	500 (2")	1,000 (4")	1,500 (6")
4, 5, 6	1.4 (3)	1.8 (4)	2.8 (6)	3.3 (7)
7, 8	1.4 (3)	1.8 (4)	2.8 (6)	3.3 (7)
9, 10	1.4 (3)	1.8 (4)	2.8 (6)	3.3 (7)
12	1.4 (3)	1.8 (4)	2.8 (6)	3.3 (7)
14	1.4 (3)	2.4 (5)	3.3 (7)	3.6 (8)
16	1.8 (4)	2.4 (5)	3.3 (7)	4.2 (9)

2.2.4

Actuators shall be capable of supplying at least 3.9 Nm (35-inch lbs) of torque to the damper shaft and shall be mounted externally for service access. Terminals with internal actuator mounting or linkage connection must include gasketed access panel, removable without disturbing ductwork. Casing with access panel shall be constructed to hold leakage to the maximum values shown in table contained in Subsection 2.2.2 above.

2.2.5

At an inlet velocity of 10.2 m/s (2,000 fpm), the minimum static pressure required to operate any terminal size shall not exceed 32

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Pa (0.13 inch w.g.) for the basic terminal.

2.3 CONTROLS

- 2.3.1 The terminal unit supplier shall provide the airflow sensor, and control transformer.
- 2.3.2 Actuators, flow transducers, zone sensors, and controllers shall be supplied by the Subcontractor responsible for the controls work under Section 25 11 00 to the terminal unit manufacturer for installation, testing, and calibration by the terminal unit manufacturer at the expense of the terminal unit manufacturer. Refer to Division 25 – Integrated Automation.
- 2.3.3 Airflow sensor shall be designed to provide a differential pressure signal, which is amplified over the full capacity range of the terminal. Pressure measuring taps shall be provided external to the unit.
- 2.3.4 Provide all necessary internal control tubing, wiring, and mounting brackets for a complete operating unit.
- 2.3.5 All control components shall be mounted inside a protective metal shroud provided by the terminal unit manufacturer.
- 2.3.6 Primary air delivery shall be pressure independent. Room temperature control shall operate satisfactorily at primary supply duct static pressures ranging from 249 to 1245 Pa (1" to 5" w.g.) Maximum and minimum terminal unit volumes shall be factory set and calibrated. Settings shall be field adjustable.

3 **EXECUTION**

3.1 INSTALLATION

- 3.1.1 Install VAV and FPVAV terminal units in accordance with manufacturer's recommendations.
- 3.1.2 Each terminal unit shall be clearly marked with an identification label listing the terminal's tag number, and minimum and maximum air settings. Coordinate terminal tag number with the Subcontractor responsible for the work of Division 25 - Integrated Automation.
- 3.1.3 Suspend terminals from slab using threaded rod hangers and angle iron trapeze hangers. Refer to Section 20 05 48 - Vibration Isolation for isolator requirements.

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3.1.4 Refer to Section 23 30 13 – Ductwork and Accessories for acoustic lining requirements of downstream ductwork.

END OF SECTION

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3.1	Air Outlets (Diffusers, Grilles and Registers)

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1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 - General Requirements, shall apply to and govern this Section.

1.2 SCOPE OF WORK

1.2.1 Provide all labour, materials, tools equipment, training commissioning and certification required to complete the work as shown on the Drawings and specified in this Section, including:

1.2.1.1 All supply, return, and exhaust air grilles and diffusers, including all specified ancillaries.

1.3 SUBMITTALS

1.3.1 Provide shop drawings for all registers, grilles, and diffusers.

1.3.2 Shop drawings to indicate dimensions, construction details, finishes and materials, accessories, performance data including throw, pressure drop and sound performance at the specified air flow rates.

1.3.3 Review requirements of outlets as to size, finish, and type of mounting with the Consultant prior to submitting shop drawings and schedules of outlets.

2 **PRODUCTS**

2.1 GENERAL

2.1.1 Air outlet application to be based on required maximum space noise levels. Refer to Section 23 33 19 – Duct Silencers.

2.1.2 Provide baffles to direct air away from walls, columns or other obstructions within the radius of diffuser operation.

2.1.3 Provide plaster frame for diffusers located in plaster and gypsum board surfaces.

2.1.4 Provide anti-smudge frames or plaques on diffusers located in rough textured surfaces such as acoustical plaster.

2.2 REGISTERS, GRILLES AND DIFFUSERS

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2.2.1 Refer to the Diffuser and Grille Schedule on Drawings.

3 **EXECUTION**

3.1 AIR OUTLETS (DIFFUSERS, GRILLES AND REGISTERS)

3.1.1 Paint the inside of all duct openings with black flat paint before installing diffusers or registers to it.

3.1.2 Provide sponge rubber gasket around all register frames to ensure an airtight seal against finished wall or ceiling.

3.1.3 Registers and diffusers will be installed in such a manner as to facilitate repeated removals without damaging ceiling or wall construction and finish.

3.1.4 Positions indicated are approximate only. Check location of outlets with the Consultant and make necessary adjustments in position to conform to architectural features, sprinklers, symmetry and lighting arrangement.

3.1.5 Provide diffusers, grilles, and registers as shown on schedule.

END OF SECTION

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1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 - General Requirements, shall apply to and govern this Section.

1.2 SCOPE OF WORK

1.2.1 Provide all labour, materials, tools equipment, training commissioning and certification required to complete the work as shown on the Drawings and specified in this Section, including:

1.2.1.1 Ductwork connection to louvers. (Louvers provided by others).

1.2.1.2 All prefinished exterior and interior fixed louvers, not provided by the Architectural Division. Exterior exhaust louvres at suites are supplied by window system's manufacturer.

1.2.1.3 Ductwork connection to louvres.

1.3 SUBMITTALS

1.3.1 Provide submittals specified and as required to assess conformance with the Contract Documents, in accordance with the General Conditions.

1.3.2 Shop Drawings:

1.3.2.1 Submit shop drawings for review by Consultant.

1.3.2.2 Show complete layout of all louvres, full details of construction including sill, jamb and head members, structural supports, type and thickness of materials, duct connections, blank-off areas, all dimensions and all other items and accessories for a complete installation.

1.3.3 Samples:

1.3.3.1 Submit duplicate samples of each finish and colour required for Consultant approval.

1.4 DESIGN

1.4.1 Design all members to withstand within acceptable deflection limitations their own weight, and the minimum 138 kPa (20 psi) design load due to the pressure and suction of wind as calculated

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in accordance with the Building Code of Ontario, based on a 30-year probability.

- 1.4.2 Deflection limits for all members - a maximum of 1/175 of the span under design loading. Submit wind load calculations to the Consultant for approval before commencing fabrication.
- 1.4.3 Design louvres such that an area of 45% minimum of the face area allows free passage of air for standard louvres and 30.9% for acoustical louvres.
- 1.4.4 Fixed exterior louvres shall be storm-proof type. Fabricate exterior louvres without mullions or reinforcing visible on the outside. Finished appearance shall be that of continuous horizontal blades housed in a rectangular frame. Provide weep holes at 610 mm (24 inches) on centre for drainage to exterior.

1.5 DELIVERY AND STORAGE

- 1.5.1 Brace units to prevent distortion during shipment and protect finished surfaces by heavy wrappings.
- 1.5.2 Store in protective wrapping, until required for installation.

2 **PRODUCTS**

2.1 LOUVERS

- 2.1.1 Air louvers and birdscreen in outside wall for air intakes and outlets will be provided by Division 23.

2.2 MANUFACTURER AND TYPE

- 2.2.1 Louver specification is based on louvres as manufactured by Construction Specialties Ltd. Equivalent product manufactured by E.H. Price Limited and Empco are also acceptable provided they meet all design criteria and material standard.

- 2.2.2 Model numbers quoted are C/S.

2.2.2.1 Exterior Fixed Ventilation Louvres: C/S #4135

2.2.2.2 Interior Fixed Louvres: C/S GS #410

2.3 MATERIALS

- 2.3.1 Aluminum: Extrusions of aluminum alloy 6063-T5 temper.

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- 2.3.2 Steel: CSA G40.15 galvanized finish.
- 2.3.3 Fastenings: type 304 stainless steel.
- 2.3.4 Aluminum Finish: Fluoropolymer Kynar 500 Resin. "Acroflur" by Valspar (2 coat system) or Acrynar by PPG. Colour to be selected by the Consultant.
- 2.3.5 Bird Screens: Intercrimp, 1.6 mm (1/16") \varnothing aluminum wire, 12 mm (1/2") mesh in an extruded aluminum frame, for all exterior active louvres. Screening shall be replaceable within frames.
- 2.3.6 Insulation: Mineral wool Roxul RXL 40, 90 mm (3.5") thick.
- 2.3.7 Steel Sheet: 1.90mm (14-ga.) flat galv. steel to ASTM A-446 grade A, G90 coating hot-dip.
- 2.3.8 Steel Finish: Baked enamel, manufacturers standard. Colour from standard range.
- 2.4 **FABRICATION**
- 2.4.1 Fit and assemble in shop.
- 2.4.2 Provide for anticipated expansion and contraction of frames and supports at maximum 6.1 m (20 ft) on centre.
- 2.4.3 Accurately fit elements at intersections and joints, plumb and level.
- 2.4.4 Isolate dissimilar metals, metal and concrete and metal and masonry with heavy coat of bituminous paint.
- 2.4.5 Fabricate aluminum frame and sill from minimum 200mm (0.08") thick aluminum extrusions, blades to be 102 mm (4") wide x 3.18 mm (0.125") storm proof type, with reinforcing bosses. Galvanized steel louvres to be fabricated out of 1.32mm (18-ga.) galv. steel sheet, blades to be roll-formed and stepped for max. weather resistance.
- 2.4.6 Structural supports to be minimum 51 x 51 x 6 mm (2" x 2" x 1/6") galv. steel angles or extruded aluminum tees.
- 2.4.7 Provide all accessories and other items for a complete installation.
- 2.4.8 Provide necessary templates and instructions where fastenings or anchors have to be built in by others. Verify dimensions on the site before preparing drawings or proceeding with shop work.

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2.4.9 Supply and build in 1.29mm (16-ga.) sheet aluminum flashing at head and sills to prevent entry of moisture into building.

3 EXECUTION

3.1 INSTALLATION

3.1.1 This Contractor shall provide insulated galvanized sheet metal blank-offs on all unused sections of the louvers. Blank-off sections shall be a sandwich panel made of 1.3mm (18-gauge) outer skin, 51mm (2") rigid fibreglass insulation, and 1.0mm (20-gauge) inner skin. Panels shall be securely fastened to louvre and caulked airtight.

3.2 EXAMINATION

3.2.1 Examine surfaces to which louvers are to be attached and do not commence installation unless such surfaces are satisfactory.

3.2.2 Commencement of installation will denote acceptance of surfaces.

3.3 INSTALLATION

3.3.1 Installation of louvers by the louver manufacturer's own erection crews.

3.3.2 Install louvers plumb, true and in line. Provide bird screens to active sections of fixed louvers and where free flow-through ventilation is required.

3.3.3 Installed units shall be free of rattle, vibration, and distortion.

3.3.4 Provide and install 51 mm (2") thick insulated blank-off metal panel to inactive sections of louvers. Match colour of metal to colour of louvers. Panels shall be securely fastened to louvers and caulked airtight.

3.3.5 Install steel louvers to interior of air intake shafts in parking levels, where supply fans are installed. All exterior louvers to be aluminum.

END OF SECTION



DIVISION 25 – INTEGRATED AUTOMATION
SPECIFICATIONS
FOR THE
CITY OF TORONTO - DAYCARE CENTRE (METRO HALL)
55 JOHN STREET
TORONTO, ONTARIO

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Our Project No. 2021-0245

Issued for Approval

January 26, 2024

DISCIPLINES MECHANICAL
ELECTRICAL
PLUMBING
LIGHTING DESIGN
COMMUNICATIONS & AV
SECURITY & RISK
COMMISSIONING
ENERGY SERVICES

SEAL:



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Section Name: **Table of Contents**
Section No.: **Division 25 - Integrated Automation**
Date: **August 23, 2023**

Section 25 00 00	General Requirements
Section 25 11 00	Basic Materials, Interface Devices and Sensors
Section 25 90 00	Sequences of Operation
Appendix A	Standard Building Automation System (BAS) Owner Requirements

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1 **GENERAL**

1.1 GENERAL

1.1.1 Section 20 00 00 – General Requirements shall apply to and govern this Section.

1.2 SCOPE OF WORK

1.2.1 Connect all mechanical equipment to existing Siemens Building Automation System (BAS) utilizing Direct Digital Control (DDC) to serve new mechanical and associated systems as described on the drawings and in this specification.

1.2.2 New controls components shall seamlessly integrate with existing building automation system (Siemens Apogee).

1.2.3 Building Automation System shall adhere to the requirements of Appendix A City of Toronto Building Automation (BAS) System Owner Requirements.

1.2.4 Provide all labour, materials, Products, equipment, and services to supply, install, and commission the electronic control and monitoring system with electronic actuation as specified in Specification Division 25 – Integrated Automation.

1.2.5 Provide all computer hardware and software, operator input/output communication devices, communication units, a communication interface to digital system controllers, field sensors, and controls as required to meet the specified performance.

1.2.6 Provide all labour, including calibration, commissioning, software programming and data base generation, generation of colour graphics and additional work necessary to provide a complete and fully operating system.

1.2.7 Provide all necessary wiring for fully complete and functional control system as specified in the Contract Documents.

1.3 GENERAL SYSTEM REQUIREMENTS

1.3.1 Provide a single architecture common data base microprocessor based electronic control and monitoring BAS system for air handling equipment, heating and cooling and other specified systems employing distributed processing and direct digital control (DDC) with electronic sensing and electronic actuation to conform with the specification requirements. The BAS shall consist of the

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following:

- 1.3.1.1 Stand-Alone DDC Controllers
- 1.3.1.2 Application Specific Controllers
- 1.3.2 The system shall be modular in nature and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, DDC Controllers, Application Specific Controllers, and operator devices.
- 1.3.3 The BAS shall be designed and implemented entirely for use and operation on the Internet and the Owner's Intranet. This functionality for operational access shall extend down to the field panel and field point level.
- 1.3.4 The primary Controls Application Nodes (AN) shall be fully IT compatible nodes operating over the industry standard IT infrastructure provided for the Project. The Subcontractor responsible for the work of Division 25 (BAS Contractor) shall coordinate with the IT infrastructure support staff or Subcontractors to ensure compatibility and performance of the operation of the BAS over the LAN/WAN made available for its shared use. If the Owner's LAN/WAN is not made available at time of commissioning, this Division shall supply an independent network cabling system for this Division's communication.
- 1.3.5 The Controls Systems Tier 1 network shall be configured on IT industry standard off-the-shelf technologies compatible with other building systems and Project network arrangements.
- 1.3.6 All aspects of the Controls Systems Operator Interface shall be provided to operate through an IT industry standard Web Browsers such as Internet Explorer, Firefox, Chrome or Opera.
- 1.3.7 The Web Browser based Operator Interface provided shall incorporate complete tool sets, operational information displays, multi-Window displays and other interactive aids to assist interpretation and ease of use. Simple HTML based web page displays are not acceptable.
- 1.3.8 The Web Browser based Operator Interface provided shall not require the procurement or licensing of any special or proprietary software from the BAS Contractor or its suppliers for the Controls Systems OWS.

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- 1.3.9 As required for the functional operation of the Controls Systems, the BAS Contractor shall provide all necessary digital processor programmable Server(s). These Server(s) shall be utilized for Controls Systems Application configuration, for archiving, reporting and trending of data, for Operator transaction archiving and reporting, for network information management, for alarm annunciation, for Operator Interface tasks, for Controls Application management and the like. These Server(s) shall utilize IT industry standard data base platforms such as Microsoft SQL Server and Microsoft Data Engine (MSDE) or approved equal.
- 1.3.10 Provide a fully distributed processing, on-line, real-time, direct digital control Controls Systems Application in compliance with all applicable codes and as approved by the Authorities Having Jurisdiction (AHJ) at the Site. All communication between Controls Application Nodes shall be digital only.
- 1.3.11 All Controls Systems Application facilities and features shall be accessible via Enterprise Intranet and Internet Browser with user ID or Password access control for user access.
- 1.3.12 The Controls Systems Application shall support auto-dial/auto-answer communications to allow Controls Systems Nodes to communicate with other remote Controls Systems Nodes via standard telephone lines. The lines shall be provided by the Owner at the Owner's cost.
- 1.3.13 The Controls Systems Application network shall utilize an open architecture capable of each and all of the following:
 - 1.3.13.1 Utilizing standard Ethernet communications and operate at a minimum speed of 100 Mb/sec.
 - 1.3.13.2 Connecting via BACnet at the Tier 1 level in accordance with ANSI/ASHRAE Standard 135-2001.
 - 1.3.13.3 Connecting via LonMark as per ANSI/EIA 709 (LonWorks) to LonMark FTT-10 transceivers at the Tier 2 level.
 - 1.3.13.4 Connecting via manufacturer specific Protocol at the Tier 2 level. (i.e. Johnson Controls N2).
- 1.3.14 Downloading and Uploading
 - 1.3.14.1 Provide the capability to generate and modify the Controls Systems Application software-based sequences, database

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elements, associated operational definition information, and user-required revisions to same at any designated Workstation together with the means to download same to the associated Controls Systems Application Node.

- 1.3.14.2 The Controls Systems Application software tool provided for the generation of custom and database definitions shall be resident in both the Controls Systems Application Node and Controls Systems Application Server(s).
- 1.3.14.3 Provide the capability to upload Controls Systems Application operating software information, database items, sequences, and alarms to designated Server(s).
- 1.3.14.4 The functions of this Part shall be governed by the codes, approvals, and regulations applying to this Controls Systems Application as provided.
- 1.3.15 System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. Each DDC Controller shall operate independently by performing its own specified control, alarm management, operator I/O and data collection. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.
- 1.3.16 DDC Controllers shall be able to access any data from, or send control commands and alarm reports directly to, any other DDC Controller or combination of controllers on the network without dependence upon a central processing device. DDC Controllers shall also be able to send alarm reports to multiple operator workstations without dependence upon a central processing device.
- 1.3.17 Provide English language operator interface using readily understood English language abbreviations and mnemonics.
- 1.3.18 Future buildings must have the ability to communicate to this building using the BACNet Protocol. The successful Controls Contractor shall provide a PICS (Protocol Implementation Conformance Statement) for the BACNet Gateway. (Minimum conformance of Class 4). The intent is to ensure that existing and future buildings using alternate manufacturers will be able to integrate to this building.

1.4 SYSTEM PERFORMANCE

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- 1.4.1 The system shall conform to the following:
 - 1.4.1.1 Graphic Display. The system shall be dashboard based, and also capable of displaying a graphic with 20 dynamic points/objects with all current data within 10 seconds.
 - 1.4.1.2 Graphic Refresh. The system shall update a graphic with 20 dynamic points/objects with all current data within 8 seconds.
 - 1.4.1.3 Object Command. The maximum time between the command of a binary object by the operator and the reaction by the device shall be less than 2 seconds. Analog objects should start to adjust within 2 seconds.
 - 1.4.1.4 Object Scan. All changes of state and change of analog values will be transmitted over the high-speed Ethernet network such that any data used or displayed at a controller or workstation will have been current within the previous 2 seconds.
 - 1.4.1.5 Alarm Response Time. The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed 45 seconds.
 - 1.4.1.6 Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 1 second. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
 - 1.4.1.7 Performance. Programmable controllers shall be able to execute DDC PID control loops at a frequency of at least once per second. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
 - 1.4.1.8 Multiple Alarm Annunciation. All workstations on the network must receive alarms within 5 seconds of each other.
 - 1.4.1.9 Reporting Accuracy. The system shall report all values with an end-to-end accuracy as listed or better than those listed in the below table.

Measured Variable	Reported Accuracy
Space Temperature	±0.5°C [±1°F]
Ducted Air	±0.5°C [±1°F]
Outside Air	±1.0°C [±2°F]
Dewpoint	±1.5°C [±3°F]

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Measured Variable	Reported Accuracy
Water Temperature	±0.5°C [±1°F]
Delta-T	±0.15°C [±0.25°F]
Relative Humidity	±5% RH
Water Flow	±5% of full scale
Airflow (terminal)	±10% of full scale (see Note
Airflow (measuring stations)	±5% of full scale
Air Pressure (ducts)	±25 Pa [±0.1 "W.G.]
Air Pressure (space)	±3 Pa [±0.01 "W.G.]
Water Pressure	±2% of full scale (see Note
Electrical (A, V, W, Power factor)	5% of reading (see Note 3)
Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO ₂)	±50 ppm
Note 1: 10%-100% of scale	
Note 2: For both absolute and differential	
Note 3: Not including utility-supplied meters	

1.4.1.10 Energy Reporting. The operating software shall have as standard, dashboard widgets which can be selected by the operator to create individual interface points as well as multi-trend graphics as standard.

1.4.1.11 Stability of Control. Control loops shall maintain measured variable at setpoint within the tolerances listed in the below table.

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±50 Pa [±0.2" w.g.] ±3 Pa [±0.01" w.g.]	0-1.5 kPa [0-6" w.g.] -25 to 25 Pa [-0.1 to 0.1" w.g.]
Airflow	±10% of full scale	
Temperature	±0.5°C [±1.0°F]	
Humidity	±5% RH	
Fluid Pressure	±10 kPa [±1.5 psi]	0-1 kPa [1-150 psi]
Pressure Differential	±250 Pa [±1.0" w.g.]	0-12.5 kPa [0-50" w.g.]

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1.5 COMMUNICATION

- 1.5.1 All control products provided for this project shall comprise a BACnet internetwork. Communication involving control components (i.e., all types of controllers and Operator Workstations) shall conform to ANSI/ASHRAE Standard 135-2004, BACnet.
- 1.5.2 Each BACnet device shall operate on the BACnet Data Link/Physical layer protocol specified for that device as defined in this Section.
- 1.5.3 The Contractor shall provide all communication media, connectors, repeaters, bridges, hubs, switches, and routers necessary for the internetwork.
- 1.5.4 All controllers shall have a communication port for connections with the Operator Workstations using the BACnet Data Link/ Physical layer protocol.
- 1.5.5 Communication services over the internetwork shall result in operator interface and value passing that is transparent to the internetwork architecture as follows:
- 1.5.6 Connection of an Operator Workstation device to any one controller on the internetwork will allow the operator to interface with all other controllers as if that interface were directly connected to the other controllers. Data, status information, reports, system software, custom programs, etc., for all controllers shall be available for viewing and editing from any one controller on the internetwork.
- 1.5.7 All database values (e.g., objects, software variables, custom program variables) of any one controller shall be readable by any other controller on the internetwork. This value passing shall be automatically performed by a controller when a reference to an object name not located in that controller is entered into the controller's database. An operator/installer shall not be required to set up any communication services to perform internetwork value passing.
- 1.5.8 The time clocks in all applicable controllers shall be automatically synchronized daily. An operator change to the time clock in any controller shall be automatically broadcast to all controllers on the network.

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- 1.5.9 The network shall have the following minimum capacity for future expansion:
 - 1.5.9.1 Each Building Controller shall have routing capacity for 99 controllers.
 - 1.5.9.2 The Building Controller network shall have capacity for 1000 Building Controllers.
 - 1.5.9.3 The system shall have an overall capacity for 12,500 Building Controller, Advanced Application Controller, and Application Specific Controller input/output objects.
- 1.6 QUALITY ASSURANCE
 - 1.6.1 All labour, material, equipment and software not specifically referred to herein or on the plans, but are required to meet the functional intent, shall be provided without additional cost to the Owner.
 - 1.6.2 Materials and equipment shall be the catalogue products of a single manufacturer regularly engaged in production and installation of automatic temperature control systems and shall be manufacturer's latest standard design that complies with the specification requirements. Products referenced under this Section establish the minimum acceptable standards of the Product features, quality, and performance.
 - 1.6.3 The BAS Contractors shall be manufacturers or licensed factory representatives and installers of the manufacturers, specified for the local area in which the Site is located.
 - 1.6.4 The installing Subcontractor shall have an established working relationship with the Control System Manufacturer.
 - 1.6.5 The installing Subcontractor shall have successfully completed Control System Manufacturer's classes on the control system. The installing Subcontractor shall present for review the certification of completed training, including the hours of instruction and course outlines upon request.
 - 1.6.6 All products used in this installation shall be new, currently under manufacture, and shall be applied in standard off the shelf products. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner or Consultant in writing. Spare parts shall be available for at least 5

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years after completion of this Contract.

1.6.7 The BAS Contractor shall have single source responsibility for the complete installation and proper operation of the DDC control system and BAS, including debugging and proper calibration of each component in the entire system.

1.6.8 During the initial design the Owner will supply the BAS Contractor a range of BACnet addresses the BAS will run on. The BAS network will run either BACnet over IP or BACnet over MSTP. All BAS points will be network visible so that other BACnet systems can auto discover them. The Contractor shall consult with the Owner during the development of addresses.

1.6.9 The BAS shall be compatible with future control Products for 10 years or more.

1.6.10 Include all software, associated licensing, upgrades, and labour/materials for two (2) years from the date of the Total Performance of the Work.

1.7 REFERENCE STANDARDS

1.7.1 All work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of the local, provincial, and federal authorities. Such codes, when more restrictive, shall take precedence over these plans and Specifications.

1.7.2 Provide electrical and electronic equipment which is CSA approved where such approval is required by the regulatory authorities.

1.7.3 Provide ASCII American Standard for Communication and Information Interchange code input/output devices with standard EIA Electronic Industry Association interface.

1.8 SUBMITTALS

1.8.1 The Contractor shall provide shop drawings or other submittals on all hardware, software, and installation to be provided. No work may begin on any segment of this project until submittals have been reviewed and approved for conformity with the design intent. All drawings shall be done in DXF or pdf format and provided on magnetic/optical disk and as full-size drawings. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted

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piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is to cover. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Submittals shall include:

- 1.8.1.1 A complete bill of materials of equipment to be used shall be listed indicating quantity, manufacturer, model number, and other relevant technical data.
- 1.8.1.2 Manufacturer's description and technical data, such as performance curves, product specification sheets, and installation/maintenance instructions for each system component.
- 1.8.1.3 Wiring diagrams and layouts for each control panel. Show all termination numbers.
- 1.8.1.4 A schematic diagram for all control wiring, communication wiring and power wiring shall be provided. Provide a schematic drawing of the central system installation. Label all cables and ports with computer manufacturers' model numbers, function and data link protocol(s). Show all interface wiring to the control system.
- 1.8.1.5 Schematic diagrams for all field sensors and controllers. Provide floor plans of all sensor locations and control hardware on the BAS graphics as it relates to the equipment being controlled.
- 1.8.1.6 Provide detailed riser diagrams of wiring between central control unit, operator workstation(s), routers, gateways and all control panels.
- 1.8.1.7 Examples of the color graphic dashboard screens shall be provided. Provide 3 screen shots from 5 existing projects representing various systems. For each screen, provide a conceptual layout of pictures and data, and show or explain which other screens can be directly accessed.
- 1.8.1.8 A schematic diagram of each controlled system. The schematics shall have all control points/objects labeled and with point/object names shown or listed. The schematics shall graphically show the location of all control elements in the system.
- 1.8.1.9 A complete control points list.
- 1.8.1.10 An instrumentation list for each controlled system. Each element of the controlled system shall be listed in table format. The table shall show element name, type of device, manufacturer, model

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number, and product data sheet number.

- 1.8.1.11 A complete description of the operation of the control system, including sequences of operation. The description shall include and reference a schematic diagram of the controlled system.
- 1.8.1.12 A point/object list for each system controller including inputs and outputs (I/O), point/object number, the controlled device associated with the I/O point/object, and the location of the I/O device. Software flag points/objects, alarm points/objects, etc.
- 1.8.1.13 A BACnet Protocol Implementation Conformance Statement (PICS) for each type of controller and Operator Workstation included in the submittal. PICS shall include for each Product, as a minimum, a list of BACnet functional groups supported, BACnet services supported, BACnet data link options available and BACnet objects provided.
- 1.8.1.14 Point-to-point verification check sheets once completed.
- 1.8.2 Upon completion of the Work, provide a complete set of 'as-built' drawings, application software and layout colour graphics on compact disc. Drawings shall be provided as AutoCAD™ compatible files. Two complete sets of hard copies are also to be provided to the Owner.
- 1.9 **OWNERSHIP OF PROPRIETARY MATERIAL**
- 1.9.1 All project-developed software and documentation shall become the property of the Owner. These include, but are not limited to:
 - 1.9.1.1 Project graphic images
 - 1.9.1.2 Record drawings
 - 1.9.1.3 Project database
 - 1.9.1.4 Project-specific application programming code
 - 1.9.1.5 All documentation
- 2 **PRODUCTS**

Not used.
- 3 **EXECUTION**

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3.1 BAS DEMONSTRATION

- 3.1.1 All BAS Demonstration shall take place on the main Control Systems Server and WAN. Schedule to add system to main Control Systems Server and WAN with Owner at least two (2) weeks in advance to the demonstration. At the time of request, provide all documentation that the following criteria are met:
- 3.1.1.1 Updated BAS submittals in electronic and hard copy to the Owner including the updated riser diagram for the system.
- 3.1.1.2 Reports on verification of Network Layout Verification including but not limited to Building Controller locations, cable routes with length of cable between controllers and any trunk extenders or trunk isolators.
- 3.1.1.3 Reports on verification of electrical characteristics of BAS network, communications and electrical integrity of Building Controllers.
- 3.1.1.4 Reports on verification of traffic on BAS Network including but not limited to COVs between Building Controllers, point commands by the operator, point commands by program across the network, alarm reporting on the network, any unresolved points in the system, integrity of the ports on any Building Controller isolator/extender and results of Building Controller tests running at selected baud rate.
- 3.1.1.5 Demonstrate to the Owner the updates of databases without errors or faults between the temporary Control Systems Server and Building Controllers. If there is no temporary server, demonstrate to Owner after system is added to main Control Systems Server.
- 3.1.1.6 Reports on verification of system log files, interruption of log files of system traffic and overall acceptable operation of the system where a temporary Control Systems Server is utilized.
- 3.1.2 Demonstrate the operation of the BAS hardware, software, and all related components and systems to the satisfaction of the Owner. Schedule the demonstration with the Owner seven (7) calendar days in advance. Demonstration shall not be scheduled until all hardware and software submittals, and the Start-Up Test Report are approved. If the Work fails to conform to the Contract Documents, and additional Site visits by the Owner are to be scheduled for re-demonstration, the Contractor shall reimburse the Owner for costs of subsequent Site visits.

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- 3.1.3 The Contractor shall supply all personnel and equipment for the demonstration, including, but not limited to instruments, ladders, etc. The Contractor-supplied personnel must be competent with and knowledgeable of all project-specific hardware, software, and the HVAC systems. All training documentation and submittals shall be at the Site.
- 3.1.4 Demonstration shall typically involve small representative samples of systems/equipment randomly selected by the Owner.
- 3.1.5 The system shall be demonstrated following the same procedures used in the Start-Up Test by using the approved checklists. Demonstration shall include, but not necessarily be limited to, the following:
 - 3.1.5.1 Demonstrate that required software is installed on BAS workstations. Demonstrate that graphic screens, alarms, trends, and reports are installed as submitted and approved.
 - 3.1.5.2 Demonstrate that points specified and shown can be interrogated and/or commanded (as applicable) from all workstations, as specified in the Contract Documents.
 - 3.1.5.3 Demonstrate that remote dial-up communication abilities are in accordance with these Specifications.
 - 3.1.5.4 Demonstrate correct calibration of input/output devices using the same methods specified for the Start-Up Tests. A maximum of 10 percent of I/O points shall be selected at random by the Owner for demonstration. Upon failure of any device to meet the specified end-to-end accuracy, an additional 10 percent of I/O points shall be selected at random by the Owner for demonstration. This process shall be repeated until 100 percent of randomly selected I/O points have been demonstrated to meet specified end-to-end accuracy.
 - 3.1.5.5 Demonstrate that all DDC and other software programs exist at respective field panels. The Direct Digital Control (DDC) programming and point database shall be as submitted and approved.
 - 3.1.5.6 Demonstrate that all DDC programs accomplish the specified sequence of operation.
 - 3.1.5.7 Demonstrate that the panels and DDC network of panels automatically recover from power failures within five (5) minutes after power is restored.

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- 3.1.5.8 Demonstrate that the stand-alone operation of panels meets the requirements of these Specifications. Demonstrate that the panels' response to LAN communication failures meets the requirements of these Specifications.
- 3.1.5.9 Identify access to equipment selected by the Owner. Demonstrate that access is sufficient to perform required maintenance.
- 3.1.5.10 Demonstrate that required trend graphs and trend logs are set up per the requirements. Provide a sample of the data archive. Indicate the file names and locations.
- 3.1.6 BAS Demonstration shall be completed and approved prior to the Substantial Performance of the Work.
- 3.1.7 Any tests successfully completed during the demonstration will be recorded as passed for the functional performance testing and will not have to be retested.
- 3.2 **BAS ACCEPTANCE PERIOD**
- 3.2.1 After approval of the BAS Demonstration and prior to Total Performance of the Work, Acceptance Period shall commence. Acceptance Period shall not be scheduled until all HVAC systems are in operation and have been accepted, all required cleaning and lubrication has been completed (i.e., filters changed, piping flushed, strainers cleaned, and the like), and TAB report has been submitted and approved. Acceptance Period and its approval will be performed on a system-by-system basis if mutually agreed upon by the Contractor and the Owner.
- 3.2.2 Operational Test: At the beginning of the Acceptance Period, the system shall operate properly for set period as agreed with the Owner without malfunction, without alarm caused by control action or device failure, and with smooth and stable control of systems and equipment in conformance with these Specifications. At the end of this period, the Contractor shall forward the trend logs to the Owner for review. The Owner shall determine if the system is ready for functional performance testing and document any problems requiring the Contractor's attention.
- 3.2.2.1 If the systems are not ready for functional performance testing, the Contractor shall correct problems and provide notification to the Owner that all problems have been corrected. The Acceptance Period shall be restarted at a mutually scheduled time for an additional period.

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- 3.2.2.2 This process shall be repeated until Owner issues notice that the BAS is ready for functional performance testing.
- 3.2.3 During the Acceptance Period, the Contractor shall maintain a hard copy log of all alarms generated by the BAS. For each alarm received, the Contractor shall diagnose the cause of the alarm, and shall list on the log for each alarm, the diagnosed cause of the alarm, and the corrective action taken. If in the Contractor's opinion, the cause of the alarm is not the responsibility of the Contractor, the Contractor shall immediately notify the Owner.
- 3.2.4 Once 5 consecutive days of alarm-free operation are complete and documented, operator training may begin.
- 3.3 TRAINING
- 3.3.1 Upon completion of the work and prior to the Substantial Performance of the Work, the Owner's operating and maintenance personnel shall be given complete instructions on the operation and maintenance of the complete system. Include a description of the information flow from field sensors, contacts and devices to the ASCs. Give an overview of the system's communication network to provide a better understanding to the operator of the interplay between initiating devices, field hardware panels, system communications, and their importance within the operating BAS.
- 3.3.2 An Owner's manual prepared for this project by BAS Contractor shall be used in conjunction with the training. Two copies of the Owner's manual shall be provided.
- 3.3.3 During system commissioning and at such time as acceptable performance of the BAS hardware and software has been established, the BAS Contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall take place during normal working hours and shall be performed by a competent representative of the BAS Contractor, familiar with the BAS software, hardware, and accessories.
- 3.3.4 The Subcontractor responsible for the work of Division 25 shall provide instruction to the Owner's designated personnel on the operation of all equipment within the central equipment center and describe its intended use with respect to the programmed functions specified. Operator orientation of the BAS shall include, but not be limited to, the overall operational program, equipment functions (both individually and as part of the total integrated system), commands, system generation, advisories, and appropriate

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operator intervention required in responding to the system's operation.

3.4 WARRANTY

3.4.1 Labor and materials for the control system specified shall be warranted free from defects for a period of 24 months after final completion and acceptance. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to the Owner. The Contractor shall respond to the Owner's request for warranty service within 24 hours during normal business hours.

3.4.2 All work shall have a single warranty date, even when the Owner has received beneficial use due to an early system start-up. If the work specified is split into multiple contracts or a multi-phase contract, then each contract or phase shall have a separate warranty start date and period.

3.4.3 At the end of the final start-up, testing, and commissioning phase, if equipment and systems are operating satisfactorily to the Owner, the Owner will sign certificates certifying that the control system's operation has been tested and accepted in accordance with the terms of this specification. The date of acceptance shall be the start of warranty.

3.4.4 Operator workstation software, project-specific software, graphic software, database software, and firmware updates which resolve known software deficiencies as identified by the Contractor shall be provided at no charge during the warranty period. Any upgrades or functional enhancements associated with the above mentioned items also can be provided during the warranty period for an additional charge to the Owner by purchasing an in-warranty technical support agreement from the Contractor. Written authorization by the Owner must, however, be granted prior to the installation of any of the above-mentioned items.

3.4.5 The control contractor shall have in place the capability to monitor the operation of the system on a 24-hour basis.

3.4.6 Parts, which have a wear-out characteristic, such as printer ink cartridges, etc., shall not be counted as failures within the terms of this warranty, if they fail or become worn out beyond their stated life expectancy.

3.5 WARRANTY PHASE BAS OPPOSITE SEASON TRENDING AND

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- 3.5.1 Throughout the warranty phase, trend logs shall be maintained. The Contractor shall forward archive trend logs to the Owner for review upon the Owner's request. The Owner will review these and notify the Contractor of any warranty work required.
- 3.5.2 Within twelve (12) months of the Substantial Performance of the Work, the Contractor shall schedule and conduct with the Owner an opposite season functional performance testing. The BAS Contractor shall participate in this testing and remedy any deficiencies identified.
- 3.6 BAS COMMISSIONING
- 3.6.1 Refer to Section 20 08 00 - Commissioning.
- 3.7 CONTROL STRATEGIES
- 3.7.1 Refer to Section 25 90 00 – Sequences of Operation for control sequences and to the associated control schematics on the Drawings for the required number of control loops. Provide all hardware and software necessary to achieve specified control. The sequence of events required for each control loop is described for each system in the control sequence.

END OF SECTION

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1 **GENERAL**

1.1 GENERAL

1.1.1 Sections 20 00 00 and 25 00 00 – General Requirements shall apply to and govern this Section.

1.1.2 Conform to the requirements of Section 26 00 00 - General Electrical Requirements.

1.2 SCOPE OF WORK

1.2.1 Provide all labour, materials, tools, equipment, training, commissioning and certification required to complete the work as shown on the Drawings and specified in this Section, including:

1.2.1.1 Wiring.

1.2.1.2 Control Valves and Actuators.

1.2.1.3 Control Dampers and Actuators.

1.2.1.4 Control Panels.

1.2.1.5 Sensors.

1.2.1.6 Electric Control Components (Switches, EP Valves, Thermostats, Relays, etc.).

1.2.1.7 Transducers.

1.2.1.8 Current Switches.

1.2.1.9 Nameplates.

1.2.1.10 Testing Equipment.

1.2.2 Provide the following electrical work as part of the work of this Section, complying with requirements of Division 26 – Electrical and the requirements of this Section.

1.2.2.1 Control wiring between field-installed controls, indicating devices, and unit control panels in this Section, and as specified in other Sections of this Division and under Divisions 20, 21, 22 and 23.

1.2.2.2 Interlock wiring between electrically interlocked devices, sensors, and between a hand or auto position of motor starters as indicated

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for all mechanical and controls.

- 1.2.2.3 Wiring associated with annunciator and alarm panels (remote alarm panels) and connections to their associated field devices.
- 1.2.2.4 Power wiring to field panels and other devices requiring a main supply from circuit breakers provided by Division 26 – Electrical in local emergency power and emergency lighting panels.
- 1.2.2.5 All other necessary wiring for fully complete and functional control system as specified in the Contract Documents.

1.3 ELECTRICAL WIRING

- 1.3.1 All wiring shall be in accordance with the latest edition of the Ontario Electrical Safety Code and Division 26 - Electrical. This includes wiring between control components and wiring from such components to electrical circuits of fans, pumps, and any other equipment.
- 1.3.2 Electrical interlock wiring of field devices (i.e., flow switches, thermostats) associated with equipment specified under other Sections of Division 25 and under Divisions 21, 22 and 23 is the responsibility of this Section, unless indicated otherwise in the Contract Documents.

1.4 CO-ORDINATION OF WORKS

- 1.4.1 The BAS Contractor shall design, provide, install, test, commission, and guarantee the system.
- 1.4.2 Provide all control devices, instrumentation, relays, auxiliary contacts, and transformers as specified in the Contract Documents and as required to meet the control and monitoring points and sequence of operation.
- 1.4.3 Extend control wiring requiring interfacing to systems by Division 26 – Electrical (i.e. fire alarm system, diesel generator control panel, etc.) to respective panel for termination by Division 26 - Electrical.
- 1.4.4 Dampers
 - 1.4.4.1 Manual balancing dampers, fire dampers, combination fire/smoke dampers and back draft dampers are provided as part of the work of their respective Divisions.

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- 1.4.5 Smoke dampers shall be supplied as part of the work of this Division and installed under Division 23 - HVAC. The BAS Contractor shall provide and connect all associated damper actuators and damper position sensor devices.
- 1.4.5.1 The BAS Contractor shall supply all remaining automatic control dampers not integral part of equipment specified elsewhere in Division 23. These dampers are to be installed as part of the work of Division 23 – HVAC under the direction of the BAS Contractor who will be fully responsible for the proper operation of the dampers. The BAS Contractor shall provide and connect all associated damper actuators.
- 1.4.5.2 The BAS Contractor shall provide and connect all damper actuators for dampers specified as an integral part of equipment specified elsewhere in the Contract Documents.
- 1.4.6 Automatic Control Valves
- 1.4.6.1 The BAS Contractor shall supply all automatic control valves required by the sequences of operation and not integral part of equipment specified elsewhere in Divisions 22 and 23. These valves are to be installed as part of the work of Division 22 – Plumbing and Division 23 – HVAC, under the direction of the BAS Contractor who will be fully responsible for the proper operation of the valves. The BAS Contractor shall provide and connect all associated valve actuators.
- 1.4.7 VAV and CAV Controls
- 1.4.7.1 Supply all actuators, flow transducers, and controllers to VAV/CAV terminal unit manufacturer for installation by the terminal unit manufacturer at the expense of the terminal unit manufacturer. Refer to Section 23 36 00 - Air Terminal Units.
- 1.4.8 Work by other sections
- 1.4.8.1 The following equipment is supplied by the BAS Contractor, installed under Division 22 and 23, and connected by the BAS Contractor.
- 1.4.8.1.1 Air flow measuring stations
- 1.4.8.1.2 Water pressure sensors
- 1.4.8.1.3 Water pressure taps, thermal wells, flow switches, flow meters, etc.

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that will have wet surfaces, shall be installed under the applicable piping Section under the direction of the BAS Contractor who will be fully responsible for the proper installation and application.

- 1.4.8.2 Division 26 - Electrical shall provide:
 - 1.4.8.2.1 120-volt AC 15 amp dedicated emergency power circuits for power to the Building Automation System, including all mechanical rooms and control panels.
 - 1.4.8.2.2 Termination at fire alarm system, diesel generator control panel, etc.
 - 1.4.8.3 All other installation work required for the complete installation of the Building Automation System shall be provided by the BAS Contractor.
 - 1.4.8.4 The BAS Contractor shall co-ordinate the control work involving Divisions 20, 21, 22, 23 and 26 - Electrical.

1.5 SUBMITTALS

- 1.5.1 Provide shop drawings for:
 - 1.5.1.1 Control Valves and Actuators.
 - 1.5.1.2 Control Dampers and Actuators.
 - 1.5.1.3 Control Panels.
 - 1.5.1.4 Sensors.
 - 1.5.1.5 Electric Control Components (Switches, EP Valves, Thermostats, Relays, etc.).
 - 1.5.1.6 Transducers.
 - 1.5.1.7 Current Switches.
 - 1.5.1.8 Testing Equipment.

2 **PRODUCTS**

2.1 GENERAL

- 2.1.1 All materials shall meet or exceed all applicable referenced standards, and conform to codes and ordinances of authorities

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having jurisdiction.

2.1.2 Provide electronic, and electric control products in sizes and capacities indicated, consisting of valves, dampers, controllers, sensors, and other components as required for complete installation. Except as otherwise indicated in the Contract Documents, provide manufacturer's standard materials and components as published in their product information; designed and constructed as recommended by manufacturer, and as required for application indicated.

2.2 **WIRING**

2.2.1 Communication Wiring:

2.2.1.1 Communication wiring shall be provided in a customized color jacketing material. Material color shall be as submitted and approved by the Owner. In addition, all wiring jackets shall be labeled "BAS" in three (3) foot or fewer intervals along the length of the jacket material. An example is provided below:

Purpose	Function	Color	Label
Building Level	Communication	Orange	BAS Building Level Communication
Floor level	Communication	Blue	BAS Floor Level Communication
Inputs/Outputs	Panel to device	White	BAS Input Output Device Cable
24VAC	Control power	White/Black tracer	BAS 24 VAC Control Power

2.2.1.2 The BAS Contractor shall supply all communication wiring between Building Controllers, Routers, Gateways, AAC's, ASC's and local and remote peripherals (e.g., operator workstations, printers, and modems).

2.2.1.3 Local Supervisory LAN: For any portions of this network required under this Section of the Specification, the BAS Contractor shall use multimode fiber (62.5 micron) or Category 5E cable per TIA/EIA 68 (10BaseT). Network shall be run with no splices and

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separate from any wiring over 30V.

- 2.2.1.4 Primary and Secondary Controller LANs: Communication wiring shall be individually 100% shielded pairs per manufacturer's recommendations for distances installed, with overall PVC cover, Class 2, plenum-rated run with no splices and separate from any wiring over 30V. Shield shall be terminated and wiring shall be grounded as recommended by building controller manufacturer.
- 2.2.2 Signal Wiring:
 - 2.2.2.1 Signal wiring to all field devices, including, but not limited to, all sensors, transducers, transmitters, switches, etc. shall be twisted, 100% shielded pair, minimum 18-gage wire, with PVC cover. Signal wiring shall be run with no splices and separate from any wiring above 30V.
 - 2.2.2.2 Signal wiring shield shall be grounded at controller end only unless otherwise recommended by the controller manufacturer.
- 2.2.3 Low Voltage Analog Output Wiring:
 - 2.2.3.1 Low voltage control wiring shall be minimum 18-gage, twisted pair, 100% shielded, with PVC cover, Class 2 plenum-rated. Low voltage control wiring shall be run with no splices separate from any wiring above 30V.
- 2.2.4 Control Panels:
 - 2.2.4.1 Provide control panels with suitable brackets for wall mounting, unless noted otherwise, for each control system. Locate panel adjacent to systems served. Mount center of control panels 1,524mm (60 inches) above finished floor or roof.
 - 2.2.4.2 Interior mount: Fabricate panels of 0.0625mm (16-gauge) furniture-grade steel, totally enclosed on four sides, with removable perforated backplane, hinged door and keyed lock, with manufacturer's standard shop-painted finish and color.
 - 2.2.4.3 Exterior mount: 0.0625mm (16-gauge) 304 or 316 stainless steel NEMA 4X enclosure. Panel shall have hinged door, keyed lock, and integral, thermostatically controlled heater. Provide hinged deadfront inside panel when flush-mounted control and/or indicating devices are included in panel. Fiberglass or aluminum, as applicable, to be used when gases that are being used in the panel area are corrosive to stainless steel.

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- 2.2.4.4 Provide UL-listed cabinets for use with line voltage devices.
- 2.2.4.5 Control panel shall be completely factory wired and piped, and all electrical connections made to a terminal strip.
- 2.2.4.6 All gauges and control components shall be identified by means of nameplates.
- 2.2.4.7 All control tubing and wiring shall be run neatly and orderly in open slot wiring duct with cover.
- 2.2.4.8 Provide a 150mm x 150mm (6" x 6") minimum wireway (metal wiring/tubing) trough across the entire width of the panel mounted to the top of the panel with close nipples of sufficient size for additional 50% wiring and tubing capacity. Wireways shall not be less than 610mm (24") in length. Control panel wiring shall be installed and distributed in the wireway to minimize routing of wiring and tubing within the control panel. Wireway construction to be the same as the associated control panel.
- 2.2.4.9 Complete wiring and tubing termination drawings shall be mounted in, and a second set mounted adjacent to, each panel in a frame with Lexan cover of sufficient size to be easily readable.
- 2.3 **AUTOMATIC CONTROL DAMPERS**
- 2.3.1 Provide factory fabricated automatic control dampers of sizes, velocity and pressure classes as required for smooth, stable, and controllable airflow. For dampers located near fan outlets, provide dampers rated for fan outlet velocity and close-off pressure, and recommended by damper manufacturer for fan discharge damper service. Control dampers used for smoke dampers shall comply with UL 555S. Control dampers used for fire dampers shall comply with UL 555.
- 2.3.2 Supply control dampers with a leakage rate of less than 15 L/s / m² (3 cfm/sq. ft.) at 249 Pa (1" w.g.) static pressure difference.
- 2.3.3 Use opposed blade type dampers for modulating service. Dampers for two position service, face and bypass and mixing may be parallel blade type.
- 2.3.4 Construct aluminum airfoil blades of minimum 2.0mm (12-gauge) extruded aluminum. Blades to be 150mm (6") wide single air foil design.

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- 2.3.5 Construct damper frames of extruded aluminum channel with grooved inserts for vinyl seals. Standard frames are 50mm x 100mm x 15mm (2" x 4" x 5/8") on linkage side, and 25mm x 100mm x 25mm (1" x 4" x 1") on the other sides.
- 2.3.6 Provide 22mm (7/8") hexagon extruded aluminum pivot rods that interlock into the blade section. Bearings to be double sealed type with a Celcon inner bearing on a rod within a Polycarbonate outer bearing inserted into frame so that the outer bearing cannot rotate.
- 2.3.7 Design the bearing to prevent metal-to-metal or metal-to-bearing riding surfaces. Interconnecting linkage shall have a separate Celcon bearing to eliminate friction in linkage.
- 2.3.8 Blade linkage hardware is to be installed in a frame out of the air stream. All hardware to be made of non-corrosive reinforced material or cadmium plated steel.
- 2.3.9 Supply overlapping damper seals that minimize air leakage.
- 2.3.10 Insulate all dampers in direct contact with outside air with 22mm (7/8") thick polyurethane foam. Blade construction must provide a 100% thermal break. Insulate frame with polystyrene.
- 2.3.11 Maximum allowable damper blade length is 1016mm (40") per section.
- 2.3.12 Provide dampers greater than two sections wide with a jackshaft.
- 2.3.13 Acceptable dampers are: T. A. MORRISON (TAMCO) 1000 / 9000 and RUSKIN CD-50 / CD-2000.
- 2.4 STANDARD SERVICE CONTROL VALVES
- 2.4.1 Control valve sizing and selection is the responsibility of the BAS Contractor. Provide a valve schedule that lists the requirements of the valves for Cv, close off, temperature, etc. This should be a result of analyzing the valves performance across the range of control.
- 2.4.2 Valves to be factory fabricated of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated in the Contract Documents.
- 2.4.3 Control valves shall be equipped with heavy-duty actuators, selected to proper close-off rating for each individual application.

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- 2.4.4 Minimum close-off rating shall be considered at dead head rating of the pump.
- 2.4.5 The control valve assembly shall be provided and delivered from a single manufacturer as a complete assembly.
- 2.4.6 Characterized Control Valves
- 2.4.6.1 50mm (2") and smaller: nickel-plated forged brass body rated at 2,758 kPa (400 psi), stainless steel ball and blowout proof stem, female NPT end fittings, with a dual EPDM O-ring packing design, fiberglass reinforced Teflon seats, and a TEFZEL flow characterizing disc. 20mm (¾") and smaller for terminal units: nickel plated forged brass body rated at 4,137 kPa (600 psi), chrome plated brass ball and blowout proof stem, female NPT end fittings, with a dual EPDM O-Ring packing design, fiberglass reinforced Teflon seats, and a TEFZEL flow characterizing disc.
- 2.4.6.2 65mm (2-1/2") through 80mm (3"): GG25 cast iron body according to ANSI Class 125, standard class B, stainless steel ball and blowout proof stem, flange to match ANSI 125 with a dual EPDM O-ring package design, PTFE seats, and a stainless steel flow characterizing disc.
- 2.4.7 Plug-Type Globe Pattern for Water Service:
- 2.4.7.1 Where not specifically indicated in the Contract Documents, modulating valves shall be sized for maximum full flow pressure drop between 50% and 100% of the branch circuit it is controlling unless scheduled otherwise. Two-position valves shall be same size as connecting piping or size using a pressure differential of 6.9 kPa (1 psi).
- 2.4.7.2 Single Seated (Two-way) Valves: Valves shall have equal-percentage characteristic for typical heat exchanger service and linear characteristic for building loop connections unless otherwise scheduled on the drawings. Valves shall have cage-type trim, providing seating and guiding surfaces for plug on 'top-and-bottom' guided plugs.
- 2.4.7.3 Double Seated (Three-way) Valves: Valves shall have linear characteristic. Valves shall be balanced-plug type, with cage-type trim providing seating and guiding surfaces on 'top-and-bottom' guided plugs.
- 2.4.7.4 Two- and Three-Way Modulating: twice the load pressure drop, but

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not more than 34.5 kPa (5 psig).

- 2.4.7.5 50mm (2") and smaller: ANSI Class 250 bronze body, stainless steel stem, brass plug, bronze seat, and a TFE packing.
- 2.4.7.6 65mm (2-1/2") and larger: ANSI Class 125 or 250 as applicable, cast iron body, stainless steel stem, bronze plug, bronze seat, and a TFE V-ring packing.
- 2.4.7.7 Two- and three-way globe valves shall be used only if characterized control valves do not fit the sizing criteria or application.
- 2.4.8 Plug-Type Globe Pattern for Steam Service:
 - 2.4.8.1 Two-Position: line size or sized using 10% of inlet gauge pressure.
 - 2.4.8.2 Modulating: 103 kPa (15 psig) or less: inlet steam pressure, the pressure drop shall be 80% of inlet gauge pressure. Higher than 103 kPa (15 psig) inlet steam pressure: the pressure drop shall be 42% of the inlet absolute pressure.
 - 2.4.8.3 Characteristics: Modified equal-percentage characteristics. Cage-type trim, providing seating and guiding surfaces for plug on "top and bottom" guided plugs.
 - 2.4.8.4 50mm (2") and smaller: ANSI Class 250 bronze body; stainless steel seat, stem and plug; and a TFE packing.
 - 2.4.8.5 65mm (2-1/2") and larger: ANSI Class 125 or 250 as applicable, cast iron body, stainless steel seat, stem and plug, and a TFE V-ring packing.
- 2.4.9 Ball Type:
 - 2.4.9.1 Brass or bronze body; one-, two-, or three-piece design; threaded ends; reinforced Teflon seat; stainless steel ball; standard or 'V' style port; stainless steel stem, blow-out proof design, extended to match thickness of insulation.
 - 2.4.9.2 Rating: Cold service pressure 4,138 kPa (600 psi) WOG; Steam working pressure 1,034 kPa (150 psi).
- 2.4.10 Segmented or Characterized Ball Type:
 - 2.4.10.1 Carbon steel (ASTM 216) body, one-piece design with wafer style ends; reinforced teflon (PTFE) seat; stainless steel ASTM A351

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ball; segmented design port with equal-percentage characteristic; stainless steel stem.

2.4.10.2 Rating: Cold service pressure 1,380 kPa (200 psi) WOG

2.4.11 Pressure Independent Control Valves

2.4.11.1 50mm (2") dia and smaller: forged brass body rated at no less than 2,758 kPa (400 psi), chrome plated brass ball and stem, female NPT union ends, dual EPDM lubricated O-rings and a brass or TEFZEL characterizing disc.

2.4.11.2 65mm (2-1/2") through 150mm (6") dia: GG25 cast iron body according to ANSI Class 125, standard class B, stainless steel ball and blowout proof stem, flange to match ANSI 125 with a dual EPDM O-ring packing design, PTFE seats, and a stainless steel flow characterizing disc.

2.4.11.3 Accuracy: The control valves shall accurately control the flow from 0 to 100% full rated flow with an operating pressure differential range of 34.5 kPa (5 psi) to 345 kPa (50 psi) differential across the valve with a valve body accuracy of +/- 5% variance due to differential pressure fluctuation or +/- 10% total assembly error incorporating differential pressure fluctuation, manufacturing tolerances and valve hysteresis.

2.4.11.4 Flow Characteristics: Equal percentage characteristics.

2.4.11.5 All actuators shall be capable of being electronically programmed in the field by use of external computer software or a dedicated handheld tool for the adjustment of flow. Programming using actuator mounted switches or multi-turn actuators are not acceptable. Actuators for 3-wire floating (tri-state) and for two-position 15mm (1/2") to 25mm (1") pressure independent control valves shall fail in place and have a mechanical device inserted between the valve and the actuator for the adjustment of flow.

2.4.11.6 Coil optimization 65mm (2-1/2") through 150mm (6") shall be accomplished by utilizing a pressure independent control valve assembly; two temperature sensors providing feedback of coil inlet water temperature and coil outlet water temperature; and a flow meter to provide analog flow feedback. Software shall control the valve to avoid the coil differential temperature from falling below a programmed setpoint. Independent trend logs data shall be available by means of BACnet MS/TP trending data to include, but not be limited, to inlet and outlet coil water temperatures, valve

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position, absolute flow, absolute valve position, absolute power and heating/cooling energy in BTU/hr.

- 2.4.11.7 The BAS Contractor shall ensure that the manufacturer provides a published commissioning procedure following the guidelines of the National Environmental Balancing Bureau (NEBB) and the Testing Adjusting Balancing Bureau (TABB).
- 2.4.11.8 The control valve shall require no maintenance and shall not include replaceable cartridges.
- 2.4.12 Butterfly valves may be provided for two-position service. Where indicated on the Drawings, supply motorized butterfly valves complete with pipe tee of same rating as piping specification. Supply tight shut-off valves equipped with a limit switch for position indication.
- 2.4.12.1 50mm (2") to 300mm (12"): valve body shall be full lugged cast iron 1,379 kPa (200 psig) body with a 304 stainless steel disc, EPDM seat, extended neck and shall meet ANSI Class 125/150 flange standards. Disc-to-stem connection shall utilize an internal spline. The shaft shall be supported at four locations by RPTFE bushings.
- 2.4.12.2 350mm (14") and larger: valve body shall be full lugged cast iron 1,034 kPa (150 psig) body with a 304 stainless steel disc, EPDM seat, extended neck and shall meet ANSI Class 125/150 flange standards. Disc-to-stem connection shall utilize a dual-pin method to prevent the disc from settling onto the liner. The shaft shall be supported at four locations by RPTFE bushings.
- 2.4.12.3 Butterfly valves for medium pressure service: valve body shall be full lugged carbon steel ANSI Class 300 body with a 316 stainless steel disc without a nylon coating, RTFE seat, and be ANSI Class 300 flange standards. Blowout-proof shaft shall be 17-4ph stainless steel and shall be supported at four locations by glass-backed TFE bushings. Valve packing shall be Chevron TFE and shall include fully adjustable packing flange and separable packing gland. Valve body shall have long stem design to allow for 50mm (2") insulation (minimum). Valve face-to-face dimensions shall comply with API 609 and MSS-SP-68. Valve assembly shall be completely assembled and tested, ready for installation.
- 2.4.13 The BAS Contractor shall ensure that the manufacturer warrants all components for a period of 5 years from the date of production, with the first two years unconditional.

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2.4.14 Cavitation Trim:

2.4.14.1 Provide cavitation trim where indicated and/or required, designed to eliminate cavitation and noise while maintaining an equal percentage characteristic. Trim shall be a series of plates with orifices to break the pressure drop into multi-stages.

2.5 VALVE AND DAMPER ACTUATORS

2.5.1 Size actuators and linkages to operate their appropriate dampers or valves with sufficient reserve torque or force to provide smooth modulating action or 2-position action as specified. Select spring-return actuators with manual override to provide positive shut-off of devices as they are applied.

2.5.2 Provide electric actuators of the enclosed reversible gear drive type that can accept modulating control signals as required. Actuators using balance relays or mechanical travel limiting switches are not acceptable.

2.5.3 Electric damper actuators shall be spring return on outdoor air service.

2.5.4 Valves installed for outdoor service applications must be provided with actuators that operate satisfactorily at -30°C (-22°F) through 50°C (122°F).

2.5.5 Coupling shall be V-bolt dual nut clamp with a V-shaped, toothed cradle.

2.5.6 Mounting: actuators shall be capable of being mechanically and electrically paralleled to increase torque if required.

2.5.7 Fail-Safe Operation: mechanical, spring-return mechanism

2.5.8 Actuators to be overload protected electronically throughout rotation and come with electronic fail safe actuator for pressure independent valves 50mm (2-1/2") through 150mm (6").

2.5.9 Proportional actuators shall be fully programmable through an EEPROM without the use of actuator mounted switches.

2.5.10 Housing: minimum requirement NEMA type 2 / IP54 mounted in any orientation.

2.6 POSITIONERS

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2.6.1 Positive positioning relays shall be provided on damper motors and valves when required to provide sufficient power, sequencing, repeatability, or speed of response. Positioner shall allow field adjustment of both starting pressure and operating span. Positioner shall provide an antilock feature and shall provide accurate positioning without excessive air bleed.

2.7 SMOKE DAMPERS

2.7.1 Provide Ruskin SD-35, Class I smoke dampers where indicated on the Drawings.

2.7.2 Provide parallel blade type dampers, suitable for horizontal or vertical mounting. Provide multiple dampers where sizes exceed code limitations.

2.7.3 Select dampers with airflow resistance not exceeding 13 Pa (0.05" w.g.) at design flow rates.

2.8 SMOKE DAMPER MOTORS

2.8.1 Size for torque required for damper seal at load conditions with one actuator per damper section. Mechanically paralleled or 'piggybacked' actuators are not permitted.

2.8.2 Coupling shall be V-bolt dual nut clamp with a V-shaped toothed cradle. Aluminum clamps or set screws are not acceptable.

2.8.3 Overload protection: microprocessor or an electronic based motor controller providing burnout protection if stalled before full rotation is reached. The actuator shall be electronically cut off at full open to eliminate noise generation with the holding noise level to be inaudible.

2.8.4 Actuator timing shall be per OBC and NFPA requirements.

2.8.5 Temperature rating: actuator shall have a UL555S listing by the damper manufacturer for 177°C (350°F).

2.8.6 Proportional smoke and fire damper actuators shall meet all requirements specified above and shall modulate 0-100% open in response to a 2-10vdc or 4-20mA control signal. A 2-10vdc feedback output shall provide a 2-10vdc signal for position indication.

2.8.7 Balancing smoke and fire damper actuators shall meet all requirements specified above and shall include an integral

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adjustable maximum opening potentiometer for airflow adjustment.

- 2.8.8 A manual override winder and locking mechanism shall be provided for override operation of the actuator on a loss of power to the actuator.
- 2.8.9 Actuator to include auxiliary switches for signaling, fan control, or position indication.
- 2.8.10 Housing for combination fire/smoke damper actuator to be steel, aluminum is not acceptable.
- 2.9 GENERAL FIELD DEVICES
- 2.9.1 Provide field devices for input and output of digital (binary) and analog signals into controllers (BCs, AACs, ASCs). Provide signal conditioning for all field devices as recommended by field device manufacturers and as required for proper operation in the system.
- 2.9.2 BAS Contractor shall assure that all field devices are compatible with controller hardware and software.
- 2.9.3 Field devices specified herein are generally 'two-wire' type transmitters, with power for the device to be supplied from the respective controller. If the controller provided is not equipped to provide this power, is not designed to work with 'two-wire' type transmitters, if field device is to serve as input to more than one controller, or where the length of wire to the controller will unacceptably affect the accuracy, the BAS Contractor shall provide 'four-wire' type equal transmitter and necessary regulated DC power supply or 120 VAC power supply, as required.
- 2.9.4 For field devices specified hereinafter that require signal conditioners, signal boosters, signal repeaters, or other devices for proper interface to controllers, the BAS Contractor shall provide proper devices, including 120V power as required. Such devices shall have accuracy and repeatability equal to, or better than, the accuracy and repeatability listed for respective field devices.
- 2.9.5 Accuracy: As stated in this Section, accuracy shall include combined effects of nonlinearity, non-repeatability and hysteresis.
- 2.10 ELECTRONIC TEMPERATURE SENSORS
- 2.10.1 Supply factory calibrated temperature sensors that utilize 1000-Ohm nickel wire or platinum (RTDs).

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- 2.10.2 Temperature sensors utilized for measuring duct temperatures shall incorporate an averaging style temperature element (RTD) of sufficient length to ensure a proper average of the variation across the full cross section of the duct.
- 2.10.3 Temperature sensors utilized for measurement of fluid temperatures shall incorporate a separate well of a material suitable for the service.
 - 2.10.3.1 Water service – brass
 - 2.10.3.2 Steam service - 304 SS
 - 2.10.3.3 Ethylene/propylene glycol service - 304 SS
- 2.10.4 Temperature sensors utilized for wall mounting in occupied spaces and connected to ASCs used for terminal unit control must be complete with a momentary contact switch for override initiation, concealed temperature setpoint adjustment and telephone style jack for connection of a portable service terminal.
- 2.10.5 Supply sensors with the following accuracy:
 - 2.10.5.1 Duct and water insertion sensors +/- 0.5% at 20°C (68°F)
 - 2.10.5.2 Duct averaging sensors +/- 1.0% at 20°C (68°F)
 - 2.10.5.3 Space sensors +/- 0.5% at 20°C (68°F)
- 2.11 **AIRFLOW MONITORING STATIONS**
 - 2.11.1 Airflow measuring stations must be designed and built to comply with, and provide results in accordance with accepted practice as defined for system testing in the ASHRAE Handbook of Fundamentals, as well as the Industrial Ventilation Handbook.
 - 2.11.2 Where required, incorporate air straightening to ensure an accurate flow profile.
 - 2.11.3 Utilize total pressure and static pressure probes and incorporate averaging manifolds, internal piping, and connections for an external differential pressure/flow transmitter. Hot wire anemometer technology is also acceptable
 - 2.11.4 Airflow stations incorporated into the flow channels of silencers must be a series of probes inserted and tubed together according to design criteria, to provide an acceptable airflow profile.

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2.11.5 Connect air flow monitoring devices supplied as part of equipment such as air terminal units to the BAS as required based on the Sequences of Operation set out in Section 25 90 00.

2.12 TEMPERATURE SWITCHES

2.12.1 Temperature sensing element shall be liquid, vapour, or bimetallic type.

2.12.2 Supply adjustable setpoint and differential.

2.12.3 Snap action type rated at 120 volts, 15 Amps, or 24 volts DC as required.

2.12.4 Sensors shall operate automatically and reset automatically. Temperature switches shall be of the following types:

2.12.4.1 Room Type suitable for wall mounting on standard electrical box with or without protective guard.

2.12.4.2 General Purpose Duct Type suitable for insertion into air ducts, insertion length of 450mm (18 inches).

2.12.4.3 Thermowell Type complete with compression fitting for 20mm (¾") NPT well mounting of length of 100 mm (4 inches). Immersion wells shall be stainless steel.

2.13 CARBON DIOXIDE SENSORS

2.13.1 Supply carbon dioxide sensors for air quality control purposes with the following characteristics:

2.13.1.1 Measurement Range – 0-2000 ppm CO₂

2.13.1.2 Accuracy +/- 100 ppm

2.13.1.3 Repeatability +/- 20 ppm

2.13.1.4 Drift +/- 100 ppm per year

2.13.1.5 Output Signal 0-10 VDC proportional over the 0-2000 ppm range

2.13.1.6 Response time 20 seconds maximum

2.13.1.7 Operating conditions 0-50°C (32-122°F), 10-100% RH non-condensing

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2.13.2 Provide one single point calibration kit

2.14 DAMPER STATUS SWITCHES

2.14.1 Damper status switches shall be lever operated, activated by damper blade movement, and mounted securely on damper frame.

2.14.2 Damper switch shall have contact rating of 5 Amperes at 120V AC and be C.S.A. approved.

2.15 OCCUPANCY SENSORS

2.15.1 Provide passive infrared sensors, which shall operate on 24 VDC, with a current draw of 26 mA. Sensors shall be sealed and gasketed and be moisture and dust proof. The passive infrared sensor shall utilize a temperature compensated dual element sensor and a multi-element Fresnel lens.

2.15.2 Provide isolated relay with normally open, normally closed, and common outputs for use with HVAC control.

2.16 CONTROL RELAYS

2.16.1 Supply and install load relays capable of switching 10 Amps at 120/1/60.

2.17 CONTROL TRANSFORMERS

2.17.1 Furnish and install control transformers as required. Control transformers shall be machine tool type, and shall be ULC and CSA listed. Primary and secondary sides shall have replaceable fuses in accordance with the NEC. Transformer shall be properly sized for application, and mounted in minimum NEMA 1 enclosure.

2.18 ELECTRIC PUSH BUTTON SWITCH

2.18.1 Switch shall be momentary contact, oil tight, push button, with number of N.O. and/or N.C. contacts as required. Contacts shall be snap-action type, and rated for minimum 120 VAC operation.

2.19 PILOT LIGHT

2.19.1 Panel-mounted pilot light shall be NEMA ICS 2 oil tight, transformer type, with screw terminals, push-to-test unit, LED type, rated for 120 VAC.

2.20 ALARM HORN

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2.20.1 Panel-mounted audible alarm horn shall be continuous tone, 120 VAC Sonalert solid-state electronic signal.

2.21 NAMEPLATES

2.21.1 Duct and pipe mounted sensors and panels shall be provided with minimum size 75mm x 25mm x 3.2mm (3" x 1" x 1/8") lamacoid nameplates, clearly identifying the equipment and functions with letter and number designation. Nameplates shall be mechanically secured and listed in the Operating and Maintenance manual.

2.22 TESTING EQUIPMENT

2.22.1 The BAS Contractor shall test and calibrate all signaling circuits of all field devices to ascertain that required digital and accurate analog signals are transmitted, received, and displayed at system operator terminals, and make all repairs and recalibrations required to complete test. The BAS Contractor shall be responsible for test equipment required to perform these tests and calibrations. Test equipment used for testing and calibration of field devices shall be at least twice as accurate as respective field device (e.g., if field device is +/- 0.5% accurate, test equipment shall be +/- 0.25% accurate over same range).

3 **EXECUTION**

3.1 PREPARATION

3.1.1 Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to the BAS Contractor.

3.2 GENERAL REQUIREMENTS

3.2.1 Installation shall meet or exceed all applicable federal, provincial, and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

3.2.2 Install systems and materials in accordance with manufacturer's instructions, roughing-in Drawings and details shown on Drawings. Install electrical components and use electrical products complying with requirements of the Ontario Electrical Safety Code and all local codes.

3.2.3 Install all equipment, accessories, conduits, and interconnecting

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wiring in a neat manner by skilled and qualified workmen using the latest standard practices of the industry.

- 3.2.4 Notify the Consultant in writing of any conflict between these specifications and manufacturer's instructions.
- 3.2.5 Retain, at no additional cost to the owner, original equipment suppliers to provide contacts that are required on the point schedules and in the software and sequences specified. Provide the necessary relays and transformers required to interconnect equipment.
- 3.2.6 All equipment installed shall be mechanically stable and, as necessary, fixed to wall or floor. Anti-vibration mounts shall be provided, if required, for the proper isolation of equipment.
- 3.2.7 Install equipment to allow for easy maintenance access. Ensure equipment does not interfere in any way with access to adjacent equipment and personal traffic in the surrounding space.
- 3.2.8 Install equipment in locations providing ventilation and ambient conditions for its specified function.
- 3.2.9 Install all electrical wiring in conformance with the requirements of the local electrical authority, the Ontario Building Code and, unless otherwise indicated in the Contract Documents, the Specification Sections of Division 26 – Electrical.
- 3.2.10 Install low voltage wiring in accordance with the control manufacturer's recommendations. Run all wiring in a protective conduit in areas where exposed or where required to meet with applicable codes. Plenum rated (FT6) type cables may be used in accordance with applicable codes, in concealed, accessible locations such as ceiling spaces and wall cavities.
- 3.2.11 Shield and ground communication trunk wiring at a single end. Do not splice trunk cables.
- 3.3 **INSTALLATION OF CONTROLLED DEVICES AND SENSORS**
- 3.3.1 Supply equipment to be installed under the work of other Divisions in accordance with their work schedule.
- 3.3.2 Coordinate final location of all sensors with the Consultant's field representative prior to installation.
- 3.3.3 Sensor assemblies and elements must be readily accessible.

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- Provide access doors as required to allow for easy replacement and servicing.
- 3.3.4 Support field mounted transmitters and sensors on pipe stands or channel brackets.
- 3.3.5 Locate all sensing elements to correctly sense measured variable. Isolate elements from vibrations and temperatures, which could affect measurement.
- 3.3.6 Install temperature sensing elements with thermal paste to ensure accurate reading.
- 3.3.7 Install averaging type RTDs in serpentine configuration with adequate provision for the mechanical protection of the sensor. Support along its entire length.
- 3.3.8 Modifications to plenum and ductwork must achieve the intent of the Contract Documents and adhere to the following:
- 3.3.9 Mount sensors with extension necks such that access to sensors is not restricted by insulation.
- 3.3.10 Keep cutting to a minimum and perform in a neat and workmanlike manner.
- 3.3.11 Provide patches and access covers of the same material and thickness as adjoining ductwork. Provide necessary reinforcing and fastening materials.
- 3.3.12 Repair insulation to maintain integrity of insulation and vapor barrier jacket. Use hydraulic insulating cement to fill voids and finish with material matching or compatible with adjacent jacket material.
- 3.3.13 Provide gaskets, seals, and insulation to restore to, or exceed as found conditions in areas where the BAS Contractor has made modifications.
- 3.3.14 All damper actuators shall be rigidly mounted and supplied with heavy-duty linkage consisting of a crank arm, pushrod, and swivel ball joint to connect to the damper shaft. Secure linkages in such a manner as to prevent slipping under normal operating torque.
- 3.3.15 Where the point schedules indicate that auxiliary contact provision, provide all instrumentation, wiring, conduit, power supplies, and services as required to integrate these points into the BAS.

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- 3.3.16 Provide interposing and motor control relays at the local item of equipment or at the associated MCC as applicable. Provide all relays, wiring, conduit, power supplies, and services as required integrating these points into the BAS.
- 3.3.17 Control Wiring:
- 3.3.17.1 The term "control wiring" is defined to include providing of wire, conduit, and miscellaneous materials as required for mounting and connection of electric control devices.
- 3.3.17.2 Install complete wiring system for electric control systems. Conceal wiring except in mechanical rooms and areas where other conduit and piping are exposed. Installation of wiring shall generally follow building lines. Install in accordance with the latest edition of the Ontario Electrical Safety Code and Division 26 - Electrical. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly.
- 3.3.17.3 Install control wiring conductors, without splices between terminal points, color-coded. Install in neat workmanlike manner, securely fastened.
- 3.3.17.4 Communication wiring, signal wiring and low voltage control wiring shall be installed separate from any wiring over 30V. Signal wiring shield shall be grounded at controller end only, unless otherwise recommended by the controller manufacturer.
- 3.3.17.5 All WAN and LAN communication wiring shield shall be terminated as recommended by controller manufacturer. All WAN and LAN communication wiring shall be labeled with a network number, device ID at each termination and shall correspond with the WAN and LAN system architecture and floor plan submittals.
- 3.3.17.6 Install all control wiring external to panels in electric metallic tubing or raceway. Installation of wiring shall generally follow building lines. Provide compression type connectors. Install wiring in galvanized rigid steel conduit at all exterior locations and where subjected to moisture. Install in PVC Schedule 40 conduit if encased in concrete. All conduits penetrating partitions, walls or floors shall be sealed with a submitted and approved fire/smoke sealant material to prevent migration of air through the conduit system.
- 3.3.17.6.1 The BAS Contractor shall be fully responsible for noise immunity

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and rewire in conduit if electrical or RF noise affects performance.

- 3.3.17.6.2 Accessible locations are defined as areas inside mechanical equipment enclosures, such as heating and cooling units, instrument panels etc.; in accessible pipe chases with easy access, or suspended ceilings with easy access. Installation of wiring shall generally follow building lines.
- 3.3.17.6.3 Run in a neat and orderly fashion, bundled where applicable, and completely suspended (strapped to rigid elements or routed through wiring rings) away from areas of normal access. Tie and support conductors neatly with suitable nylon ties and not to exceed 1.52m (5 foot) intervals.
- 3.3.17.6.4 Conductors shall not be supported by the ceiling system or ceiling support system. Conductors shall be pulled tight and be installed as high as practically possible in ceiling cavities. Wiring shall not be laid on the ceiling or duct.
- 3.3.17.6.5 Conductors shall not be installed between the top cord of a joist or beam and the bottom of roof decking.
- 3.3.17.7 Communication cabling shall be provided in an Owner approved color dedicated to the BAS.
- 3.3.17.8 Number-code or color-code conductors appropriately for future identification and servicing of control system. Code shall be as indicated on approved installation drawings.
- 3.3.18 Install control valves so that actuators, wiring, and tubing connections are accessible for maintenance. Where possible, install with valve stem axis vertical, with operator side up. Where vertical stem position is not possible or would result in poor access, valves may be installed with stem horizontal. Do not install valves with stem below horizontal, or down.
- 3.3.19 Averaging temperature sensors shall cover no more than 0.61 sq.m per linear meter (2 sq.ft per linear foot) of sensor length except where indicated. Sensor shall be installed in location where flow is sufficiently homogeneous and adequately mixed. Install averaging sensors in a serpentine configuration with adequate provision for the mechanical protection of the sensor. Support along its entire length.
- 3.3.20 Install airflow measuring stations per manufacturer's recommendations in an unobstructed straight length of duct

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(except those installations specifically designed for installation in fan inlet). For installations in fan inlets, provide on both inlets of double inlet fans and provide inlet cone adapter as recommended by AFM station manufacturer.

- 3.3.21 Install fluid flow sensors per manufacturer's recommendations in an unobstructed straight length of pipe.
- 3.3.22 Provide element guard for relative humidity sensors as recommended by manufacturer for high velocity installations. For high limit sensors, position remote enough to allow full moisture absorption into the air stream before reaching the sensor.
- 3.3.23 Water differential pressure transmitters shall be installed in a valve bypass arrangement to protect against over pressure damaging the transmitter. Establish required locations and coordinate installation of valve bypass with the respective Subcontractors.
- 3.3.24 Install steam differential pressure transmitters as shown on the Drawings per manufacturer's instructions.
- 3.3.25 Install pipe surface mount temperature sensors with thermally conductive paste at pipe contact point. Where sensor is to be installed on an insulated pipe, the BAS Contractor shall neatly cut insulation, install sensor, repair or replace insulation and vapor barrier, and adequately seal vapor barrier.
- 3.3.26 Where possible, install flow switches in a straight run of pipe at least 15 diameters in length to minimize false indications.
- 3.3.27 Adjust current switches for motor status monitoring so that setpoint is below minimum operating current and above motor no load current.
- 3.3.28 Supply Duct Pressure Transmitters:
 - 3.3.28.1 Install pressure tips with at least four (4) 'round equivalent' duct diameters of straight duct with no takeoffs upstream. Install static pressure tips securely fastened with tip facing upstream in accordance with manufacturer's installation instructions. Locate the transmitter at an accessible location to facilitate calibration.
 - 3.3.28.2 On VAV Systems, locate down-duct transmitter pressure tips approximately 2/3 of the hydraulic distance to the most remote terminal in the air system.

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3.4 IDENTIFICATION OF EQUIPMENT

- 3.4.1 Identify each piece of equipment, including sensors, controlled devices, and control panels, with a nameplate identifying the equipment and functions with a letter and number designation.
- 3.4.2 Nameplates shall be minimum size 75mm x 25mm (3" x 1") and 3.2mm (1/8") thick laminated plastic with black face and white center and 6.4mm (1/4") deep engraved lettering. Nameplates shall be securely attached to the equipment.
- 3.4.3 Printed nametags are acceptable for cabinet mounted components providing they are securely attached.

3.5 ACCEPTANCE AND TESTING PROCEDURES

- 3.5.1 The BAS Contractor shall request completion acceptance in writing and advise the Consultant of situations that would prevent a complete testing of overall system performance.
- 3.5.2 Work and/or systems installed under this Division and under Divisions 21, 22 and 23 shall be fully functioning prior to Demonstration and Acceptance Phase. The BAS Contractor shall start, test, adjust, and calibrate all work and/or systems under this Contract, as described below:
 - 3.5.2.1 Inspect the installation of all devices. Review the manufacturer's installation instructions and validate that the device is installed in accordance with them.
 - 3.5.2.2 Verify proper electrical voltages and amperages, and verify that all circuits are free from faults.
 - 3.5.2.3 Verify integrity/safety of all electrical connections.
 - 3.5.2.4 Coordinate with the Subcontractor responsible for the TAB work to obtain control settings that are determined from balancing procedures. Record the following control settings as obtained from the Subcontractor responsible for the TAB work, and note any TAB deficiencies in the BAS Start-Up Report:
 - 3.5.2.4.1 Optimum duct static pressure setpoints for VAV air handling units.
 - 3.5.2.4.2 Minimum outside air damper settings for air handling units.
 - 3.5.2.4.3 Optimum differential pressure setpoints for variable speed pumping systems.

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- 3.5.2.4.4 Calibration parameters for flow control devices such as VAV terminal units and flow measuring stations.
- 3.5.2.5 The BAS Contractor shall provide a hand-held device as a minimum to the Subcontractor responsible for the TAB work to facilitate calibration. Connection for any given device shall be local to it (i.e. at the VAV terminal unit or at the thermostat). Hand-held device or portable operator's terminal shall allow querying and editing of parameters required for proper calibration and start-up.
- 3.5.2.6 Test, calibrate, and set all digital and analog sensing and actuating devices. Calibrate each instrumentation device by making a comparison between the BAS display and the reading at the device, using an instrument, which shall be at least twice as accurate as the device to be calibrated (e.g., if field device is +/-0.5 percent accurate, test equipment shall be +/-0.25 percent accurate over same range). Record the measured value and displayed value for each device in the BAS Start-up Report.
- 3.5.2.7 Check and set zero and span adjustments for all transducers and transmitters.
- 3.5.2.8 For dampers and valves:
 - 3.5.2.8.1 Check for adequate installation including free travel throughout range and adequate seal.
 - 3.5.2.8.2 Where loops are sequenced, check for proper control without overlap.
- 3.5.2.9 For actuators:
 - 3.5.2.9.1 Check to insure that device seals tightly when the appropriate signal is applied to the operator.
 - 3.5.2.9.2 Check for appropriate fail position, and that the stroke and range is as required.
 - 3.5.2.9.3 For sequenced electronic actuators, calibrate per manufacturer's instructions to required ranges.
- 3.5.2.10 Check each digital control point by making a comparison between the control command at the CU and the status of the controlled device. Check each digital input point by making a comparison of the state of the sensing device and the Operator Interface display. Record the results for each device in the BAS Start-Up Report.

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- 3.5.2.11 For outputs to reset other manufacturer's devices (for example, VSDs) and for feedback from them, calibrate ranges to establish proper parameters. Coordinate with representative of the respective manufacturer and obtain their approval of the installation.
- 3.5.3 Sensor Checkout and Calibration:
 - 3.5.3.1 Verify that all sensor locations are appropriate and are away from causes of erratic operation. Verify that sensors with shielded cable are grounded only at one end. For sensor pairs that are used to determine a temperature or pressure difference, make sure they are reading within 0.1 degrees C (0.2 degrees F) of each other for temperature and within a tolerance equal to 2 percent of the reading of each other for pressure. Tolerances for critical applications may be tighter.
 - 3.5.3.2 Calibrate all sensors using one of the following procedures:
 - 3.5.3.2.1 Sensors without transmitters: Make a reading with a calibrated test instrument within 150mm (6 inches) of the site sensor at various points across the range. Verify that the sensor reading (via the permanent thermostat, gauge or BAS) is within the tolerances specified for the sensor. If not, adjust offset and range, or replace sensor. Where sensors are subject to wide variations in the sensed variable, calibrate sensor within the highest and lowest 20 percentage of the expected range.
 - 3.5.3.2.2 Sensors with transmitters: Disconnect sensor. Connect a signal generator in place of sensor. Connect ammeter in series between transmitter and BAS control panel. Using manufacturer's resistance-temperature data, simulate minimum desired temperature. Adjust transmitter potentiometer zero until the ammeter reads 4 mA. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the OI. Record all values and recalibrate controller as necessary to conform to tolerances. Reconnect sensor. Make a reading with a calibrated test instrument within 150mm (6 inches) of the site sensor. Verify that the sensor reading (via the permanent thermostat, gauge or BAS) is within the tolerances specified. If not, replace sensor and repeat. For pressure sensors, perform a similar process with a suitable signal generator.
 - 3.5.3.3 Sensors shall be within the tolerances specified for the device.
- 3.5.4 Coil Valve Leak Check:

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- 3.5.4.1 Verify proper close-off of the valves. Ensure the valve seats properly seat by simulating the maximum anticipated pressure difference across the circuit. Demonstrate to the Owner the verification of zero flow by measuring the coil differential pressure. If there is pressure differential, close the isolation valves to the coil to ensure the conditions change. If they do, this validates the valve is not closing. Remedy the condition by adjusting the stroke and range, increasing the actuator size/torque, replacing the seat, or replacing the valve as applicable.
- 3.5.5 Valve Stroke Setup and Check:
- 3.5.5.1 For all valve and actuator positions checked, verify the actual position against the Operator Interface readout.
- 3.5.5.2 Set pumps to normal operating mode. Command valve closed, verify that valve is closed, and adjust output zero signal as required. Command valve open, verify position is full open and adjust output signal as required. Command the valve to various few intermediate positions. If actual valve position doesn't reasonably correspond, replace actuator or add pilot positioner.
- 3.5.6 After completion of installation and in cooperation with Subcontractors responsible for the related work of other Specification Sections, adjust each control device and component to ensure that the operations are in accordance with the Sequences of Operation specified in Section 20 95 00.

END OF SECTION

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1 **GENERAL**

1.1 GENERAL

1.1.1 Sections 20 00 00 and 25 00 00 – General Requirements shall apply to and govern this Section.

1.2 SCOPE OF WORK

1.2.1 Refer to the below sequence of operation and associated control schematics for the required number of control loops. Provide all hardware and software necessary to achieve specified control. The sequence of events required for each control loop is described for each system in the control sequence.

1.2.2 Revise the controls shop drawing sequences of operation and create an “As-built or As Functioning Sequence of operation “to be included into the Operations and Maintenance Manuals.

1.2.3 The operators’ workstation to include a Sequence of Operation tab to provide a narrative to the operator regarding equipment / system operation.

2 **PRODUCTS**

Not used.

3 **EXECUTION**

3.1 GENERAL

3.1.1 When motorized equipment is operating, BAS shall totalize runtime in hours for use in maintenance operations.

3.1.2 Where parallel or duplex equipment is provided, BAS shall alternate lead equipment such that runtime is equalized.

3.1.3 Provide adjustable time delay between damper or valve opening and equipment start/stop to avoid operation with a closed system.

3.1.4 Select components to fail safe. Priority in descending order is: life safety, protection of equipment, and comfort.

3.1.5 Schedule operation of systems according to schedules provided by the Owner, and/or optimal start/stop program, and/or Operator keyboard entry.

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- 3.1.6 All low limit thermostats (freezestats), in addition to providing a DI control point, shall be hardwired to the equipment starter to shut down the system upon sensing an air temperature below 2°C (36°F).
- 3.1.7 Shut down fans upon detection (via BAS sensors) of supply or return air temperatures in excess of 67°C (135°F).
- 3.1.8 Co-ordinate the provision of duct mounted smoke detectors by Division 26 - Electrical. Detectors shall be hardwired to the respective fan starter to shut the fan down upon detection of smoke.
- 3.1.9 Co-ordinate fire alarm system fan shutdown where provided via the BAS with Division 26 - Electrical.
- 3.1.10 Fan systems shall not be started if motorized damper end switch indicates that the damper is not fully open. Alarm abnormal status of damper to BAS and start standby system if applicable.
- 3.1.11 Unscheduled shutdown of either the supply or return fan shall result in a system shutdown, and an abnormal status alarm condition at the BAS, and start-up of the standby system if applicable.
- 3.1.12 Static pressure control on all VAV air systems shall be sensed at a position 2/3 downstream of the supply fan. Shut system down if static pressure exceeds 498 Pa (2" w.c.)
- 3.1.13 Airside free cooling control shall be enabled based on enthalpy control.
- 3.1.14 All noted setpoints shall be operator-adjustable, and subject to tuning during system commissioning.
- 3.1.15 Status of motors shall be by current draw unless noted otherwise in the Contract Documents.
- 3.2 **FAN COIL UNITS**
- 3.2.1 Each fan coil unit shall be individually scheduled from the BAS. The operator shall also have the option of scheduling a group of fan coil units together on a single time schedule.
- 3.2.2 Controls Contractor is responsible for interfacing to fan coil unit thermostats or control boards to allow regular operation. Any relays required are the responsibility of the Controls Contractor.

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- 3.2.3 Fan coil unit DDC controller shall modulate the heating and chilled water valves to maintain space at the temperature setpoint. Cooling setpoint shall be initially set for 22.8°C (73°F). Cooling command shall be energized above 22.8°C (73°F). Heating command shall be energized below 21.7°C (71°F).
- 3.2.4 The supply fan shall run continuously when the unit is enabled. Supply fan shall be cycled in the night setback and setup modes as required to maintain the night setback/setup temperature setpoints.
- 3.3 AIR HANDLING UNIT
- 3.3.1 Unit off:
- 3.3.1.1 This mode is initiated by loss of supply or return fan status or by time schedule from BAS.
- 3.3.1.2 Outdoor air and exhaust dampers are closed, recirculation air damper is open. Supply and return fans are off. Glycol heating valve is open.
- 3.3.2 Start-up:
- 3.3.2.1 Start-up is initiated by time schedule from the BAS.
- 3.3.2.2 Outdoor air and exhaust dampers open to preset minimum position. Supply and return fans start.
- 3.3.3 Temperature Control:
- 3.3.3.1 Modulate the outdoor air and exhaust dampers between preset minimum and fully open positions, and the recirculation air damper to closed position based on comparison of return air and outdoor air temperature and of supply air temperature setpoint (economizer mode).
- 3.3.3.2 When the supply air temperature is below setpoint, initially 12.8°C (55°F) and the outdoor air damper is in preset minimum position, the glycol heating valve shall be enabled and modulated to maintain setpoint. Monitor glycol temperatures in and out of the coil. .
- 3.3.3.3 When the supply air temperature is above setpoint and the outdoor air damper is in preset minimum position, the cooling coil valve shall be enabled and modulated to maintain setpoint.
- 3.3.4 Demand Control Ventilation:

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- 3.3.4.1 The outside air damper shall modulate to maintain the minimum outside air design set point (adjustable)
- 3.3.4.2 The minimum outside air CFM will be increased on a trip and respond setpoint sequence. Each VAV zone associated with the HU will be capable of registering a vote for more ventilation air. Upon a demand for one or more CO2 sensors/zone, the outside air damper opening shall gradually increase up to the design maximum (adjustable)
- 3.3.4.3 As the demand for ventilation decreases from the CO2 sensors, the outside air damper shall gradually close to the minimum position.
- 3.3.5 Shutdown:
 - 3.3.5.1 Supply and return fans are off, outdoor air and exhaust dampers are closed, recirculation air damper is open. Heating valve is open.
 - 3.3.5.2 Alarm if the closed position end switch of the outdoor air or exhaust dampers did not make after two (2) minutes the unit is shut down.
- 3.3.6 Alarm at the BAS and modulate the glycol heating valve to fully open position if the freezestat is activated.
- 3.3.7 Monitor pressure drop across air filters.
- 3.3.8 The unit shall be started and stopped by the FMS based on an operator-defined time of day schedule. After hours, an override button on each VAV box thermostat will start the compartment unit serving that VAV box for a predetermined amount of time (initially 2 hours).
- 3.3.9 The air handling unit DDC controller shall maintain the duct static pressure by modulating the supply fan VFD from a static pressure sensor, located as shown on the drawings. If sensor is not located on drawings, it shall be located 2/3 of the way down the longest run of straight ductwork.
- 3.3.10 The controls contractor shall be responsible for providing a temperature and static pressure gauge in the supply ductwork at each compartment unit. Mount gauges in such a manner that they may be viewed by standing in the mechanical room without a ladder.

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3.3.11 Setpoint shall be adjusted by the BAS based on supply fan VFD speed as follows:

3.3.11.1 VFD < 40%, Setpoint = 18.3°C (65°F)

3.3.11.2 VFD > 80%, Setpoint = 12.8°C (55°F)

3.3.12 40% < VFD < 80%, Setpoint is linear between above values.

3.4 VAV BOXES

3.4.1 Modulate the damper to maintain the airflow setpoint as measured by the flow transducer. The airflow setpoint shall be changed based on the zone temperature. As the zone temperature rises above setpoint, the airflow setpoint is increased. Below the zone temperature setpoint, the airflow setpoint is lowered to minimum airflow. Airflow setpoints are indicated on the Drawings. Program all setpoints prior to air balancing.

3.4.2 Monitor all VAV discharge air temperatures

3.4.3 Interlocked with room CO2 sensor for demand control ventilation

3.4.4 Zone temperature setpoint shall be set at 23.1°C (73.5°F). Below 23.1°C (73.5°F), the VAV box shall be set to minimum flow. Unoccupied setpoint shall be set to 26.7°C (80°F). If the compartment unit serving the floor is on, but the VAV box is in unoccupied mode, the VAV box shall maintain unoccupied setpoint.

3.4.5 Zone thermostats shall have a programmable adjustment to allow occupant to adjust setpoint by +/- 1°C (1.8°F) (value is programmable). Temporary occupancy button on thermostat shall be a momentary contact. Pressing the button will energize the compartment unit serving that floor, and set the zone into occupied mode.

3.5 VAV BOXES WITH PERIMETER FAN COIL HEATING

3.5.1 Modulate the damper to maintain the airflow setpoint as measured by the flow transducer. The airflow setpoint shall be changed based on the zone temperature. As the zone temperature rises above setpoint, the airflow setpoint is increased. Below the zone temperature setpoint, the airflow setpoint is lowered to minimum airflow. Airflow setpoints are indicated on the Drawings. Program all setpoints prior to air balancing.

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- 3.5.2 Monitor all VAV discharge air temperatures
- 3.5.3 Interlocked with room CO2 sensor for demand control ventilation
- 3.5.4 Zone temperature setpoint shall be set at 23.1°C (73.5°F). Below 23.1°C (73.5°F), the VAV box shall be set to minimum flow. Heating shall be enabled & modulated to maintain setpoint less 1°C (1.8°F) deadband. Unoccupied setpoint shall be set to 26.7°C (80°F) (cooling) and 16.7°C (62°F) (heating). If the compartment unit serving the floor is on, but the VAV box is in unoccupied mode, the VAV box shall maintain unoccupied setpoint. During unoccupied hours, radiation heating shall maintain unoccupied setpoint.
- 3.6 ELECTRICAL ROOM VENTILATION
- 3.6.1 Through a DDC controller, a space temperature sensor shall sequence the exhaust fans to maintain space setpoint temperature according to the following schedule:
- exhaust fans on above 23.9°C (75°F)
- 3.7 MISCELLANEOUS EXHAUST FANS
- 3.7.1 When exhaust fan is off, close respective damper.
- 3.7.2 When exhaust fan is activated based on time of day schedule, open damper before starting fan.

END OF SECTION



Standard Building Automation System (BAS) Owner Requirements

APPENDIX A

November, 2019

Version & revision number: 6.1.5

This document is the standard for use in new construction, retrofits and upgrades in City of Toronto facilities and shall not be amended in any way without written consent from the Corporate Real Estate Management (CREM) Division.

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NOT REQUIRED

This section includes the central building automation system components and network protocol specifications. It may be used as section 23 09 23 or 23 09 93 depending on specification format used.

In addition to this section it will be necessary to add project specific sections for control components and sequences of operation.

The intent of this specification is to describe the minimum features required for a new installation. For renovation or refit type projects, it will be necessary to determine to what extent any existing system can be upgraded or modified within the parameters of the project budget to achieve the general intent of this specification and provide appropriate edits.

PART 1 - GENERAL

1.0 GENERAL REQUIREMENTS

- 1.1 Conform to all, "Mechanical General Provisions".
- 1.2 The "provide" in this Division shall be interpreted as "supply and install".
- 1.3 All work shall conform to Canadian Metric Practice Guide CSA CAN3-2234.1.76
- 1.4 Provide all required adapters between metric and imperial components.
- 1.5 Metric descriptions in this Division are nominal equivalents of Imperial values.
- 1.6 All equipment and material to be new, CSA certified, manufactured to minimum standard quoted including additional specified requirements.
- 1.7 Where there is no alternative to supply equipment that is not CSA certified, submit such equipment to Inspection Authorities for special inspection and obtain approval before delivery of equipment to site.
- 1.8 Use new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by the owner. Spare parts shall be available for at least five years after completion of this contract.
- 1.9 Use material and equipment available from a regular production by manufacturer concerned.

2.0 WORK INCLUDED

Add to this section any site specific qualifications that may apply to the specific project with respect to application of the specified requirements for the system.

- 2.1 The City of Toronto has standardized Building Automation Systems utilizing native BACnet area, system and application controllers. Extend the existing Framework as detailed herein.
- 2.2 The system shall support standard Web browser access via the City's Intranet/Internet. It shall support a minimum of 100 simultaneous users with the ability to access the graphical data and real time values simultaneously. (Refer to Section 7.16)
- 2.3 Provide an open protocol Building Automation System (BAS) incorporating Direct Digital Control (DDC), equipment monitoring, and control consisting of: A PC based Operator Work Station (OWS) with colour graphic data displays; Microcomputer based Building Controllers (BCs) and Microcomputer based Advanced Application Controllers (AACs) and Application Specific Controllers (ASCs) interfacing **directly** with sensors,

actuators and environmental delivery systems (i.e., HVAC units, boilers, chillers, lighting systems, etc.); electric controls and mechanical devices for all items indicated on drawings described herein including dampers, valves, panels and compressed air plant.

- 2.4 City of Toronto has standardized the use of Direct Digital Controllers (DDC) and End Devices. No **NEW** pneumatic control devices shall be connected or incorporated into the BAS network. It applies to new installations as well as retrofit applications.
- 2.5 Open Protocols by definition are to be BACnet (ASHRAE Standard 135 – Annex J) and Haystack only.
- 2.6 Provide BAS controllers (BCs, AACs and ASCs) based on native BACnet (ASHRAE Standard 135 – Annex J) protocols.
- 2.7 Provide submittals, data entry, electrical installation, programming, startup, test and validation acceptance documentation, and system warranty.

3.0 WORK BY OTHERS

- 3.1 Access doors and setting in place of valves, flow meters, water pressure and differential taps, flow switches, thermal wells, dampers, air flow stations, and current transformers shall be by others.

4.0 QUALITY ASSURANCE

4.1 Codes and Approvals:

- 4.1.1 Work, materials, and equipment shall comply with the Ontario Building Code, Ontario Electrical Code, ANSI/ASHRAE 135-2004: Data Communication Protocol for Building Automation and Control Systems (BACnet) and Authorities having jurisdiction over this work. All devices shall be ULC, UL or FM listed and labeled for the specific use, application and environment to which they are applied.
 - 4.1.2 The BAS shall comply with NFPA 90A Air Conditioning and 90B Warm Air Heating, Air Conditioning.
 - 4.1.3 All electronic equipment shall conform to the requirements of CSA for electromagnetic emissions standards and placed in approved locations such that it does not interfere with building equipment or computers.
- 4.2 Provide satisfactory operation without damage at 110% above and 85% below rated voltage and at 3 hertz variation in line frequency. Provide static, transient, and short circuit protection on all inputs and outputs. Communication lines shall be protected against incorrect wiring, static transients and induced magnetic interference. Bus connected devices shall be AC coupled, or equivalent so that any single device failure will not disrupt or halt bus communication.

5.0 ABBREVIATIONS AND SYMBOLS

- 5.1 All letter symbols and engineering unit abbreviations utilized in information displays ANSI/ISA S5.5 and printouts shall conform to ANSI 710.19/IEEE 260-letter symbols for SI and certain other units of measurement.
- 5.2 Specification Nomenclature - Acronyms used in this specification are as follows:

AAC	Advanced Application Controller
ASC	Application Specific Controller
BAS	Building Automation System
BC	Building Controller

BIBB	BACnet Interoperability Building Blocks
DDC	Direct Digital Controls
GUI	Graphical User Interface
HTTP	Hyper Text Transfer Protocol
LAN	Local Area Network
ODBC	Open Database Connectivity protocol
OOT	Object Oriented Technology
OPC	Object linking and embedding for Process Control
OWS	Operator Workstation
PDA	Personnel Data Assistant device
PICS	Protocol Implementation Conformance Statement
PWS	Portable Workstation
SNVTS	Standard Network Variables Types
SQL	Standard Query Language
TCP/IP	Transmission Control Protocol / Internet Protocol
TCU	Terminal Control Unit
WAN	Wide Area Network
WAP	Wireless Application Protocol device
WBI	Web Browser Interface
XML	Extensible Markup Language
XIF	External Interface Files

6.0 APPROVED CONTROL SYSTEMS

Applicable to new construction projects, new installations within existing buildings and major retrofit/overhaul of existing BAS systems.

6.1 Any vendors that are authorized dealers or distributors of the following control systems are acceptable:

- 6.1.1 Delta Controls
- 6.1.2 Reliable Controls
- 6.1.3 Schneider Electric SmartX series
- 6.1.4 Distech Controls
- 6.1.5 Johnson Controls Facility Explorer
- 6.1.6 Honeywell CIPer series, Spyder models 5 or 7

6.2 BAS Systems Integration:

- 6.2.1 All control systems must be integrated to the City's J2 Innovations Fluid Integration (FIN) server, including but not limited to the following:
 - 6.2.1.1 graphical user interface (monitoring & control)
 - 6.2.1.2 alarming
 - 6.2.1.3 data trending
 - 6.2.1.4 data archiving
 - 6.2.1.5 Project Haystack naming convention
- 6.2.2 The installer must be licensed by J2 Innovations to sell, install, program and configure Fluid INtegration (FIN).
- 6.2.3 Building Controllers (BC) must be Tridium Niagara JACE with the Haystack module and driver. The installer must be a licensed Tridium system integrator for any Tridium BCs or embedded or edge Niagara Framework products used. Soft JACE is not accepted.

6.3 Licensing Requirements

- 6.3.1 Licenses shall be provided to and in the name of the City of Toronto
- 6.3.2 Licenses shall be perpetual, transferrable, assignable and royalty-free

6.3.3 Tridium licenses shall allow all Workbench/Supervisor brands complete system access and functionality.

6.4 Installer and Manufacturer Qualifications

6.4.1 Installer shall have an established working relationship with Control System Manufacturer.

6.4.2 Installer shall have successfully completed Control System Manufacturer's control system training. Upon request, Installer shall present record of completed training including course outlines.

6.4.3 It is the intent of this specification to define an open protocol state-of-the-art distributed computerized Building Management and Control System which is user friendly, has known reliability, is extremely responsive, and which is to be designed, installed, implemented, and supported by a local office of approved bidders.

6.4.4 BAS contractor shall provide three locations of successful installations of similar open protocol computer based systems. Sites provided must consist of more than 150 hardware inputs/outputs. Project sites must be local to the location of this project.

6.5 System Administration

6.5.1 Administrator credentials shall be sent to BAS@Toronto.ca for retention by the City. Credentials shall include any and all accounts and passwords required for complete system access, including but not limited to Station and Platform credentials.

7.0 SYSTEM DESIGN

For retrofit projects where a gateway might be considered the most appropriate economic decision for interface to an existing automation system, remove article 7.2.

7.1 The system shall consist of a network of Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), and Smart Actuators (SA). Every device in the system which executes control logic and directly controls HVAC equipment must conform to a standard BACnet Device profile as specified in ANSI/ASHRAE 135-2004, BACnet Annex L. Unless otherwise specified, hardwired actuators and sensors may be used in lieu of BACnet Smart Actuators and Smart Sensors.

7.2 Systems utilizing gateways will not be considered. A gateway device is considered to be a device where only mapping of system points from one protocol to another occurs. A gateway device cannot perform higher-level energy management functions such as Outdoor Air Optimization, Electrical Demand Limiting and the like.

7.3 The Building Automation System software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. The supplied system must incorporate the ability to access all data using standard Web browsers without requiring proprietary operator interface and configuration programs. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on a BAS server for all database access. Systems requiring proprietary database and user interface programs shall not be acceptable.

7.4 A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a flat single tiered architecture shall not be acceptable. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

8.0 BACnet.

- 8.1 Building Controllers (BCs). Each BC shall conform to BACnet Building Controller (B-BC) device profile as specified in ANSI/ASHRAE 135-2004, BACnet Annex L and shall be listed as a certified B-BC in the BACnet Testing Laboratories (BTL) Product Listing.
- 8.2 Advanced Application Controllers (AACs). Each AAC shall conform to BACnet Advanced Application Controller (B-AAC) device profile as specified in ANSI/ASHRAE 135-2004, BACnet Annex L and shall be listed as a certified B-AAC in the BACnet Testing Laboratories (BTL) Product Listing.
- 8.3 Application Specific Controllers (ASCs). Each ASC shall conform to BACnet Application Specific Controller (B-ASC) device profile as specified in ANSI/ASHRAE 135-2004, BACnet Annex L and shall be listed as a certified B-ASC in the BACnet Testing Laboratories (BTL) Product Listing.
- 8.4 Smart Actuators (SAs). Each SA shall conform to BACnet Smart Actuator (B-SA) device profile as specified in ANSI/ASHRAE 135-2004, BACnet Annex L and shall be listed as a certified B-SA in the BACnet Testing Laboratories (BTL) Product Listing.
- 8.5 Smart Sensors (SSs). Each SS shall conform to BACnet Smart Sensor (B-SS) device profile as specified in ANSI/ASHRAE 135-2004, BACnet Annex L and shall be listed as a certified B-SS in the BACnet Testing Laboratories (BTL) Product Listing.

8.6 BACnet Communication.

- 8.6.1 Each BC shall reside on or be connected to a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing.
- 8.6.2 BACnet routing shall be performed by BCs or other BACnet device routers as necessary to connect BCs to networks of AACs and ASCs.
- 8.6.3 Each AAC shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BACnet/IP addressing, or it shall reside on a BACnet network using the MS/TP Data Link/Physical layer protocol.
- 8.6.4 Each ASC shall reside on a BACnet network using the MS/TP Data Link/Physical layer protocol.
- 8.6.5 Each SA shall reside on a BACnet network using the MS/TP Data Link/Physical layer protocol.
- 8.6.6 Each SS shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BACnet/IP addressing, or it shall reside on a BACnet network using MS/TP Data Link/Physical layer protocol.
- 8.6.7 The maximum number of controllers on an MS/TP network/subnet shall be no more than 64 or the manufacturer recommended limit, whichever is less.
- 8.6.8 An approved addressing scheme must be obtained from BAS@Toronto.ca and be included on project shop drawings (specifically the BAS network architecture diagrams) prior to installation. Buildings without approved schemes shall not exist on the City WAN.
- 8.6.9 BAS shall transfer data between controllers on a stand-alone BAS network. One (1) data drop per building will be provided to establish connection to central server. Should back end programming and configuration be inaccessible via this one (1) data drop, an additional data drop will be provided to allow City BAS Team to communicate to the base building control system using manufacturer software tools.
- 8.6.10 Access to City central servers will not be provided during construction. Database and graphics are merged with central server after project deficiency lists have been cleared (including graphics deficiencies). This merging must be coordinated with the application

- 8.6.11 The City Ethernet connection shall be fully segregated and isolated from the BAS LAN via the secondary BC Ethernet port. A City static IP address will be provided by Technical Services Division (TSD) for this connection. The City's divisional project manager or designate will coordinate this request.

9.0 COMMUNICATION

- 9.1 Service Port. Each controller shall provide a service communication port for connection to a Portable Operator's Terminal. Connection shall be extended to space temperature sensor ports where shown on drawings.
- 9.2 Signal Management. BC and ASC operating systems shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and to allow for central monitoring and alarms.
- 9.3 Data Sharing. Each BC and AAC shall share data as required with each networked BC and AAC.
- 9.4 Stand-Alone Operation. Each piece of equipment specified in the sequence of operation shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network.

10.0 ENVIRONMENT

Controller hardware shall be suitable for anticipated ambient conditions.

- 10.1 Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at -29°C to 60°C (-20°F to 140°F).
- 10.2 Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 0°C to 50°C (32°F to 120°F).

11.0 REAL-TIME CLOCK

- 11.1 Controllers that perform scheduling shall have a real-time clock.

12.0 SERVICEABILITY

- 12.1 Controllers shall have diagnostic LEDs for power, communication, and processor.
- 12.2 Wires shall be connected to a field-removable modular terminal strip or to a termination card connected by a ribbon cable.
- 12.3 Each BC and AAC shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.

13.0 MEMORY

- 13.1 Controller memory shall support operating system, database, and programming requirements.

- 13.2 Each BC and AAC shall retain BIOS and application programming for at least 72 hours in the event of power loss.
- 13.3 Each ASC and SA shall use nonvolatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.

14.0 IMMUNITY TO POWER AND NOISE

- 14.1 Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).

15.0 POWERFAIL RESTART

- 15.1 In the event of the loss of normal power, there shall be an orderly shutdown of all controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all controller configuration data, and battery back-up shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.
- 15.2 Upon restoration of normal power, the controller shall automatically resume full operation without manual intervention. The controllers shall incorporate random start sequences to ensure a power spike does not result.
- 15.3 Controller memory shall not be lost during a power failure.
- 15.4 The user shall have the capability of loading or re-loading all software via the OWS or the local terminal port.

16.0 DYNAMIC DATA ACCESS

- 16.1 All operator devices, either network resident or connected via dial-up modems, shall have the ability to access all point status and application report data, or execute control functions for any and all other devices via the local area network. Access to data shall be based upon logical identification of building equipment.

17.0 INPUT AND OUTPUT INTERFACE

- 17.1 General. Hard-wire input and output points to BCs, AACs, ASCs, or SAs.
- 17.2 Protection. Shorting an input or output point to itself, to another point, or to ground shall cause no controller damage. Input or output point contact with up to 24 V for any duration shall cause no controller damage.
- 17.3 Binary Inputs. Binary inputs shall monitor the on and off signal from a remote device. Binary inputs shall provide a wetting current of at least 12 mA and shall be protected against contact bounce and noise. Binary inputs shall sense dry contact closure without application of power external to the controller.
- 17.4 Pulse Accumulation Inputs. Pulse accumulation inputs shall conform to binary input requirements and shall accumulate up to 10 pulses per second.
- 17.5 Analog Inputs. Analog inputs shall monitor low-voltage (0-10 Vdc), current (4-20 mA), or resistance (thermistor or RTD) signals. Analog inputs shall be compatible with and field configurable to commonly available sensing devices.
- 17.6 Binary Outputs. Binary outputs shall send an on-or-off signal for on and off control. Building Controller binary outputs shall have three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation.
- 17.7 Analog Outputs. Analog outputs shall send a modulating 0-10 Vdc or 4-20 mA signal as required to properly control output devices. Each Building Controller analog output shall have a two-position (auto-manual) switch, a manually adjustable potentiometer, and status lights. Analog outputs shall not drift more than 0.4% of range annually.
- 17.8 Tri-State Outputs. Control three-point floating electronic actuators without feedback with tri-state outputs (two coordinated binary outputs). Tri-State outputs may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.
- 17.9 Universal Inputs and Outputs. Inputs and outputs that can be designated as either binary or analog in software shall conform to the provisions of this section that are appropriate for their designated use.

18.0 POWER SUPPLIES AND LINE FILTERING

- 18.1 Power Supplies: Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with CEC requirements. Limit connected loads to 80% of rated capacity.
- 18.1.1 DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes.

Unit shall have built-in over-voltage and over-current protection and shall be able to withstand 150% current overload for at least three seconds without trip-out or failure.

18.1.2 Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.

18.1.3 Line voltage units shall be UL recognized and CSA listed.

18.2 Power Line Filtering.

18.2.1 Provide internal or external transient voltage and surge suppression for workstations and controllers. Surge protection shall have:

18.2.1.1 Dielectric strength of 1000 V minimum

18.2.1.2 Response time of 10 nanoseconds or less

18.2.1.3 Transverse mode noise attenuation of 65 dB or greater

18.2.1.4 Common mode noise attenuation of 150 dB or greater at 40-100 Hz

19.0 AUXILIARY CONTROL DEVICES

19.1 Electric Damper and Valve Actuators.

19.1.1 Stall Protection. Mechanical or electronic stall protection shall prevent actuator damage throughout the actuator's rotation.

19.1.2 Spring-return Mechanism. Actuators used for power-failure and safety applications shall have an internal mechanical spring-return mechanism or an uninterruptible power supply (UPS).

19.1.3 Signal and Range. Proportional actuators shall accept a 0-10 Vdc or a 0-20 mA control signal and shall have a 2-10 Vdc or 4-20 mA operating range. (Floating motor actuators may be substituted for proportional actuators in terminal unit applications as described in paragraph 16.8)

19.1.4 Wiring. 24 Vac and 24 Vdc actuators shall operate on Class 2 wiring.

19.1.5 Manual Positioning. Operators shall be able to manually position each actuator when the actuator is not powered. Non-spring-return actuators shall have an external manual gear release. Spring-return actuators with more than 7 N·m (60 in.-lb) torque capacity shall have a manual crank.

19.2 Binary Temperature Devices.

19.2.1 Low-Voltage Space Thermostats. Low-voltage space thermostats shall be 24 V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed setpoint adjustment, 13°C-30°C (55°F-85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.

19.2.2 Line-Voltage Space Thermostats. Line-voltage space thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed setpoint adjustment, 13°C-30°C (55°F-85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.

- 19.2.3 Low-Limit Thermostats. Low-limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 6 m (20 ft) long. Element shall sense temperature in each 30 cm (1 ft) section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only.
- 19.3 Temperature Sensors
- 19.3.1 Type. Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor (10K).
- 19.3.2 Duct Sensors. Duct sensors shall be single point or averaging. Averaging sensors shall be a minimum of 1.5 m (5 ft) in length per 1 m² (10 ft²) of duct cross-section.
- 19.3.3 Immersion Sensors. Provide immersion sensors with a separable stainless steel well. Well pressure rating shall be consistent with system pressure it will be immersed in. Well shall withstand pipe design flow velocities.
- 19.3.4 Space Sensors. Space sensors shall have setpoint adjustment, override switch, display, and communication port.
- 19.3.5 Differential Sensors. Provide matched sensors for differential temperature measurement.
- 19.4 Humidity Sensors.
- 19.4.1 Differential Sensors. Provide matched sensors for differential temperature measurement.
- 19.4.2 Duct and room sensors shall have a sensing range of 20%-80%.
- 19.4.3 Duct sensors shall have a sampling chamber.
- 19.4.4 Outdoor air humidity sensors shall have a sensing range of 20%-95% RH and shall be suitable for ambient conditions of 40°C-75°C (40°F-170°F).
- 19.4.5 Humidity sensors shall not drift more than 1% of full scale annually.
- 19.5 Flow Switches. Flow-proving switches shall be paddle (water service only) or differential pressure type (air or water service). Switches shall be UL listed, SPDT snap-acting, and pilot duty rated (125 VA minimum).
- 19.5.1 Paddle switches shall have adjustable sensitivity and NEMA 1 enclosure unless otherwise specified.
- 19.5.2 Differential pressure switches shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.
- 19.6 Relays.
- 19.6.1 Control Relays. Control relays shall be plug-in type, UL listed, and shall have dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.
- 19.6.2 Time Delay Relays. Time delay relays shall be solid-state plug-in type, UL listed, and shall have adjustable time delay. Delay shall be adjustable $\pm 100\%$ from setpoint shown. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.
- 19.7 Override Timers.
- 19.7.1 Unless implemented in control software, override timers shall be spring-wound line voltage, UL Listed, with contact rating and configuration required by application. Provide 0-6 hour calibrated dial unless otherwise specified. Flush mount timer on local control panel face or where shown.

19.8 Current Transmitters.

19.8.1 AC current transmitters shall be self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4-20 mA two-wire output. Full-scale unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment. Unit accuracy shall be $\pm 1\%$ full-scale at 500 ohm maximum burden.

19.8.2 Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.

19.8.3 Unit shall be split-core type for clamp-on installation on existing wiring.

19.9 Current Transformers.

19.9.1 AC current transformers shall be UL/CSA recognized and shall be completely encased (except for terminals) in approved plastic material.

19.9.2 Transformers shall be available in various current ratios and shall be selected for $\pm 1\%$ accuracy at 5 A full-scale output.

19.9.3 Use fixed-core transformers for new wiring installation and split-core transformers for existing wiring installation.

19.10 Voltage Transmitters.

19.10.1 AC voltage transmitters shall be self-powered single-loop (two-wire) type, 4-20 mA output with zero and span adjustment.

19.10.2 Adjustable full-scale unit ranges shall be 100-130 Vac, 200-250 Vac, 250-330 Vac, and 400-600 Vac. Unit accuracy shall be $\pm 1\%$ full-scale at 500 ohm maximum burden.

19.10.3 Transmitters shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized at 600 Vac rating.

19.11 Voltage Transformers.

19.11.1 AC voltage transformers shall be UL/CSA recognized, 600 Vac rated, and shall have built-in fuse protection.

19.11.2 Transformers shall be suitable for ambient temperatures of 4°C-55°C (40°F-130°F) and shall provide $\pm 0.5\%$ accuracy at 24 Vac and 5 VA load.

19.11.3 Windings (except for terminals) shall be completely enclosed with metal or plastic.

19.12 Power Monitors.

19.12.1 Power monitors shall be three-phase type and shall have three-phase disconnect and shorting switch assembly, UL listed voltage transformers, and UL listed split-core current transformers.

19.12.2 Power monitors shall provide selectable output: rate pulse for kWh reading or 4-20 mA for kW reading. Power monitors shall operate with 5 A current inputs and maximum error of $\pm 2\%$ at 1.0 power factor or $\pm 2.5\%$ at 0.5 power factor.

19.13 Current Switches.

19.13.1 Current-operated switches shall be self-powered, solid-state with adjustable trip current. Select switches to match application current and DDC system output requirements.

19.14 Pressure Transducers.

- 19.14.1 Transducers shall have linear output signal and field-adjustable zero and span.
- 19.14.2 Continuous operating conditions of positive or negative pressure 50% greater than calibrated span shall not damage transducer sensing elements.
- 19.14.3 Water pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Transducer shall have 4-20 mA output, suitable mounting provisions, and block and bleed valves.
- 19.14.4 Water differential pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Over-range limit (differential pressure) and maximum static pressure shall be 2000 kPa (300 psi.) Transducer shall have 4-20 mA output, suitable mounting provisions, and 5-valve manifold.
- 19.15 Differential Pressure Switches. Differential pressure switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum) and shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.

20.0 NETWORKS

- 20.1 BAS contractor to coordinate with the City's IT department for the connections to the City's Network.
- 20.2 Design for the Network LAN (BC LAN) shall include the following provisions:
 - 20.2.1 Provide access to the BC LAN from a remote location, via the Intranet.
 - 20.2.2 The network LAN shall utilize BACnet/IP (ASHRAE standard SPC-135A-2004 - Annex L) for communication between BCs. Manufacturer specific proprietary protocols, gateways, or protocol converters are not acceptable for this project. The OWS shall communicate to the BCs utilizing standard Ethernet to IEEE 802.3 Standards.
 - 20.2.3 High-speed data transfer rates for alarm reporting, quick report generation from multiple controllers and upload/download efficiency between network devices.
 - 20.2.4 Detection and accommodation of single or multiple failures of workstations, controller panels and the network media. The network shall include provisions for automatically reconfiguring itself to allow all operational equipment to perform their designated functions as effectively as possible in the event of single or multiple failures.
 - 20.2.5 Message and alarm buffering to prevent information from being lost.
 - 20.2.6 Error detection, correction, and retransmission to guarantee data integrity.
 - 20.2.7 Default device definition to prevent loss of alarms or data, and ensure alarms are reported as quickly as possible in the event an operator device does not respond.
 - 20.2.8 Commonly available, multiple sourced, networking components shall be used to allow the system to coexist with other networking applications such as office automation. ETHERNET is the only acceptable technology.
 - 20.2.9 Synchronization of the real-time clocks in all BC panels shall be provided.
 - 20.2.10 The BC LAN shall be a 100 Megabits/sec Ethernet network supporting BACnet, Java, XML, HTTP, and CORBA IIOP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Building Controllers (BCs), user workstations and where specified, a local server. Local area network minimum physical and media access requirements:
 - 20.2.10.1 Ethernet; IEEE standard 802.3

- 20.2.10.2 Cable; 100 Base-T, UTP-8 wire, category5
- 20.2.10.3 Minimum throughput; 10 Mbps, with ability to increase to 100 Mbps

20.2.11 Provide access to the BC LAN via a Wireless Application Protocol (WAP) device as well. Through this connection the BC LAN will provide authorized staff with the ability to monitor and control the BAS from any location within the City network through a web browser, cellular phone, pager, WebPads, or PDA. (Pocket Computer).

21.0 SERVER FUNCTION

21.1 Local connections shall be via an Ethernet LAN.

21.2 It shall be possible to provide access to all Building Control Units (BC) via a single connection to the server. In this configuration, each Building Control Unit (BC) can be accessed from an Operator Workstation (OWS) using a standard Web browser by connecting to the BAS LAN. The server shall provide the following functions, as a minimum:

- 21.2.1 Global Data Access: The server shall provide complete access to distributed data defined anywhere in the system.
- 21.2.2 Distributed Control: The server shall provide the ability to execute global control strategies based on control and data objects in any Building Control Unit (BC) in the network, local or remote.
- 21.2.3 The server shall include a master clock service for its subsystems and provide time synchronization for all Building Control Units (BC).
- 21.2.4 The server shall accept time synchronization messages from trusted precision Atomic Clock Internet sites and update its master clock based on this data.
- 21.2.5 The server shall provide scheduling for all Building Control Units and their underlying field control devices.
- 21.2.6 The server shall provide demand limiting that operates across all Building Control Units. The server must be capable of multiple demand programs for sites with multiple meters and or multiple sources of energy. Each demand program shall be capable of supporting separate demand shedding lists for effective demand control.
- 21.2.7 The server shall implement the BACnet Command Prioritization scheme (16 levels) for safe and effective contention resolution of all commands issued to Building Control Units. Systems not employing this prioritization shall not be accepted.
- 21.2.8 Each Building Control Unit supported by the server shall have the ability to archive its log data, alarm data and database to the server, automatically. Archiving options shall be user-defined including archive time and archive frequency.
- 21.2.9 The server shall provide central alarm management for all Building Control Units supported by the server. Alarm management shall include:
 - 21.2.10 Routing of alarms to display, printer, email and pagers
 - 21.2.11 View and acknowledge alarms
 - 21.2.12 Query alarm logs based on user-defined parameters
- 21.2.13 The server shall provide central management of log data for all Network Control Units supported by the server. Log data shall include process logs, runtime and event counter logs, audit logs and error logs. Log data management shall include:
 - 21.2.14 Viewing and printing log data
 - 21.2.15 Exporting log data to other software applications
 - 21.2.16 Query log data based on user-defined parameters
- 21.2.17 Minimum BACnet features supported are
 - Standard BACnet Objects (Analog In/Out/Value, BinaryInput/Output/Value, Multi-State -- Input/Output/Value, Schedule(export), Calendar(export), Trend(Export), Device).
 - Segmented Capability (Segmented Request-Segmented Response).
 - Application Services (Read Property, Read Property Multiple, Write Property, Write Property Multiple, Confirmed Event, Notification, Acknowledge Alarm, Get Alarm Summary Who-has, I-have, Who-is, I-am, Subscribe COV, Confirmed COV notification, Unconfirmed COV notification).

-BACnet Broadcast Management

22.0 SCOPE OF WORK

- 22.1 The work covered by this specification and related sections consists of providing shop drawings, equipment, labour, materials, engineering, technical supervision, and transportation as required to furnish and install a fully operational BAS to monitor and control the facilities listed herein, and as required to provide the operation specified in strict accordance with these documents, and subject to the terms and conditions of the contract. The work in general consists of but is not limited to, the following:
- 22.1.1 The preparation of submittals and provision of all related services.
 - 22.1.2 Operator workstations located as listed in the specifications (OWS will be provided by the City's IT, SEE PART 2, SECTION 1.1.4).**
 - 22.1.3 Furnish and install all controllers to achieve system operation, any control devices, conduit and wiring, in the facility as required to provide the operation specified.
 - 22.1.4 Furnish and load all software required to implement a complete and operational BAS.
 - 22.1.5 Furnish complete operating and maintenance manuals and field training of operators, programmers, and maintenance personnel.
 - 22.1.6 Perform acceptance tests, commissioning or re-commissioning as indicated.
 - 22.1.7 Provide full documentation for all application software and equipment.
 - 22.1.8 Miscellaneous work as indicated in these specifications.

23.0 PERMITS, FEES AND CODES

- 23.1 Apply for, obtain and pay for all permits, licenses, inspections, examinations and fees required. Also submit, if required, information and other data that may be obtained from the Engineer. Should the authorities require the information on specific forms, fill in these forms by transcribing the information provided by the Engineer.
- 23.2 BAS contractor shall obtain and pay for the police clearance certificates if required for the project.
- 23.3 Arrange for inspection of all work by the authorities having jurisdiction over the Work. On completion of the Work, present to the Engineer the final unconditional certificate of approval of the inspecting authorities.
- 23.4 Comply with the requirements of the latest edition of the applicable ULC or CSA standards, the requirements of the Authorities, Federal, Provincial/Territorial and Municipal Codes, the applicable standards of ULC and all other authorities having jurisdiction. These Codes and Regulations constitute an integral part of these Specifications.
- 23.5 Where there is no alternative to supply equipment which is CSA certified, submit such equipment to the local electrical authority for special inspection and obtain approval before delivery of equipment to site.
- 23.6 In case of conflict, applicable Codes take precedence over the Contract Documents. In no instance reduce the standard or Scope of Work or intent established by the Drawings and Specifications by applying any of the Codes referred to herein.
- 23.7 Before starting any work, submit the required number of copies of documentation to the authorities for their approval and comments. Comply with any changes requested as part of the Contract, but notify the

Engineer immediately of such changes, for proper processing of these requirements. Prepare and furnish any additional drawings, details or information as may be required.

24.0 COORDINATION

- 24.1 All work shall be performed at times acceptable to the Engineer/Construction Manager. Provide work schedule at the start of the job for the approval of the Engineer/Construction Manager. Schedule shall show when all staff and sub-contractors shall be on-site.
- 24.2 Organize all sub-contractors and ensure that they maintain the schedule.
- 24.3 Full cooperation shall be shown with other sub-contractors to facilitate installations and to avoid delays in carrying out the work.
- 24.4 Notify Engineer/Construction Manager of any changes to the schedule. Send any schedule changes and weekly progress reports via fax to Engineer/Construction Manager.
- 24.5 Where, in the judgment of the Engineer/Construction Manager, the work could disrupt the normal operations in or around the building, contractor shall schedule work to eliminate or minimize interference, subject to owner's approval.
- 24.6 When connecting to the existing systems, advise the Engineer/Construction Manager and obtain permission to so. Perform work at a time acceptable to the Engineer/Construction Manager and Owner.

24.0 SUPERVISION OF PERSONNEL

- 24.1 Maintain at this building qualified personnel and supporting staff with proven experience in erecting, supervising, testing, and adjusting projects of comparable nature and complexity.
- 24.2 Supervisory personnel and their qualifications are subject to the approval of the Owner.
- 24.3 All personnel working on-site shall sign in as required by the Owner and shall wear company identification.
- 24.4 When requested and for whatever reason, remove personnel and/or support staff from project. Take immediate action. Contractors and subcontractors may require police clearance.

25.0 ELECTRICAL WORK AND SAFETY REQUIREMENTS

- 25.1 Control and interlock wiring and installation shall comply with national and local electrical codes, and manufacturer's recommendations.
- 25.2 CEC Class 1 (line voltage) wiring shall be UL listed in approved raceway as specified by CEC.
- 25.3 Low-voltage wiring shall meet CEC Class 2 requirements. Subfuse low-voltage power circuits as required to meet Class 2 current limit.
- 25.4 CEC Class 2 (current-limited) wires not in raceway but in concealed and accessible locations such as return air plenums shall be UL listed for the intended application.
- 25.5 Install wiring in raceway where subject to mechanical damage and at levels below 3 m (10ft) in mechanical, electrical, or service rooms.
- 25.6 Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).

- 25.7 Install Class 1 and Class 2 wiring in separate raceways. Boxes and panels containing high-voltage wiring and equipment shall not be used for low-voltage wiring except for the purpose of interfacing the two through relays and transformers.
- 25.8 Do not install wiring in raceway containing tubing.
- 25.9 Run exposed Class 2 wiring parallel to a surface or perpendicular to it and tie neatly at 3 m (10 ft) intervals.
- 25.10 Use structural members to support or anchor plenum cables without raceway. Do not use ductwork, electrical raceways, piping, or ceiling suspension systems to support or anchor cables.
- 25.11 Secure raceways with raceway clamps fastened to structure and spaced according to code requirements. Raceways and pull boxes shall not be hung on or attached to ductwork, electrical raceways, piping, or ceiling suspension systems.
- 25.12 Size raceway and select wire size and type in accordance with manufacturer's recommendations and CEC requirements.
- 25.13 Include one pull string in each raceway 2.5 cm (1 in.) or larger.
- 25.14 Use color-coded conductors throughout.
- 25.15 Locate control and status relays in designated enclosures only. Do not install control and status relays in packaged equipment control panel enclosures containing Class 1 starters.
- 25.16 Conceal raceways except within mechanical, electrical, or service rooms. Maintain minimum clearance of 15 cm (6 in.) between raceway and high-temperature equipment such as steam pipes or flues.
- 25.17 Install insulated bushings on raceway ends and enclosure openings. Seal top ends of vertical raceways.
- 25.18 Terminate control and interlock wiring related to the work of this section. Maintain at the job site updated (as-built) wiring diagrams that identify terminations.
- 25.19 Flexible metal raceways and liquid-tight flexible metal raceways shall not exceed 1 m (3 ft) in length and shall be supported at each end. Do not use flexible metal raceway less than ½ in. electrical trade size. Use liquid-tight flexible metal raceways in areas exposed to moisture including chiller and boiler rooms.
- 25.20 Install raceway rigidly, support adequately, ream at both ends, and leave clean and free of obstructions. Join raceway sections with couplings and according to code. Make terminations in boxes with fittings. Make terminations not in boxes with bushings.
- 25.21 All equipment and systems installed under this Contract shall be grounded, isolated, or conditioned as required to permit equipment to continue to function normally, without interruption, in the event of radio frequency interference (RFI), electromagnetic interference (EMI), power surges/dips or other electrical anomalies.
- 25.22 It shall be the responsibility of the Contractor or his Sub-contractor to ensure that any coring of holes through the walls or floors will not penetrate existing conduits, cables or mechanical equipment in or under the floor slabs or walls. He shall be responsible to take any and all action as deemed necessary by the Project Manager to correct any such penetrations at his cost. No coring shall be undertaken unless the Project Manager gives permission. Scan walls and floors prior to core drilling to identify hidden piping. Ensure that water does not flow into equipment and below floors. Waterproof and fire stop all penetrations.

26.0 COMMUNICATION WIRING

- 26.1 Communication wiring shall be low-voltage Class 2 wiring and shall comply with Article 25 (Electrical Work).
- 26.2 Install communication wiring in separate raceways and enclosures from other Class 2 wiring.

- 26.3 During installation do not exceed maximum cable pulling, tension, or bend radius specified by the cable manufacturer.
- 26.4 Verify entire network's integrity following cable installation using appropriate tests for each cable.
- 26.5 Install lightning arrestor according to manufacturer's recommendations between cable and ground where a cable enters or exits a building.
- 26.6 Each run of communication wiring shall be a continuous length without splices when that length is commercially available. Runs longer than commercially available lengths shall have as few splices as possible using commercially available lengths.
- 26.7 Label communication wiring to indicate origination and destination.
- 26.8 Ground coaxial cable according to OEC regulations article on "Communications Circuits, Cable, and Protector Grounding."

27.0 LOCKABLE PANELS

- 27.1 Indoor control panels shall be fully enclosed NEMA 1 construction with hinged door key-lock latch and removable sub-panels. A common key shall open each control panel and sub-panel.
- 27.2 Prewire internal and face-mounted device connections with color-coded stranded conductors tie-wrapped or neatly installed in plastic troughs. Field connection terminals shall be UL listed for 600 V service, individually identified per control and interlock drawings, with adequate clearance for field wiring.
- 27.3 Each local panel shall have a control power source power switch (on-off) with overcurrent protection.

28.0 WARNING LABELS

- 28.1 All Controller panels Affix permanent warning labels to equipment that can be automatically started by the control system.
 - 1. Labels shall use white lettering (12-point type or larger) on a red background.
 - 2. Warning labels shall read as follows.

CAUTION
This equipment is operating under automatic control and may start or stop at any time without warning. Switch disconnect to "Off" position before servicing.

- B. Affix permanent warning labels to motor starters and control panels that are connected to multiple power sources utilizing separate disconnects.
 - 1. Labels shall use white lettering (12-point type or larger) on a red background.
 - 2. Warning labels shall read as follows.

CAUTION
This equipment is fed from more than one power source with separate disconnects. Disconnect all power sources before servicing.

29.0 IDENTIFICATION OF HARDWARE AND WIRING

- 29.1 Label wiring and cabling, including that within factory-fabricated panels, with control system address or termination number at each end within 5 cm (2 in.) of termination.
- 29.2 Permanently label or code each point of field terminal strips to show instrument or item served.
- 29.3 Label control panels with minimum 1 cm (½ in.) letters on laminated plastic nameplates.
- 29.4 Label each control component with a permanent label. Label plug-in components such that label remains stationary during component replacement (lamacoids).
- 29.5 Label room sensors related to terminal boxes or valves with nameplates (lamacoids).
- 29.6 Manufacturers' nameplates and UL or CSA labels shall be visible and legible after equipment is installed.
- 29.7 Label identifiers shall match record documents.
- 29.8 Insert laminated points list in the control panel

30.0 PRELIMINARY DESIGN REVIEW

- 30.1 The BAS contractor shall submit a preliminary design document for review. This document shall contain the following information:
 - 30.1.1 Provide a description of the proposed system along with a system architecture diagram with the intention of showing the contractors solution to meet this specification.
 - 30.1.2 Provide product data sheets and a technical description of BC, AAC, ASC hardware required to meet specifications listed herein.
 - 30.1.3 Provide product brochures and a technical description of the Server, Operator Workstation, and Building Control Unit (BC) software required to meet this specification. Provide a description of software programs included.
 - 30.1.4 Open Protocols - For all hardware Building Controllers, Advanced Application Controllers (AAC) and Advanced Specific Controllers (ASC), provide BACnet Interoperability Building Blocks BIBBs certification. Provide complete description and documentation of any proprietary services and/or objects where used in the system.
 - 30.1.5 Provide a description and samples of Operator Workstation graphics and reports.
 - 30.1.6 Provide an overview of the BAS contractor's local/branch organization, local staff, recent related project experience with references, and local service capabilities.
 - 30.1.7 Provide information on the BAS contractors project team including project organization, project manager, project engineer, programmers, project team resumes, and location of staff.

31.0 DRAWING REQUIREMENTS

- 31.1.1 Within 45 days of award of contract and before start of construction, submit 3 hard copies and 1 soft copy of manufacturers information and shop drawings. Soft copy to be in AutoCAD or VISIO and WordPerfect or Word formats (latest versions) structured using menu format for easy loading and retrieval on the OWS.
- 31.1.2 Manufacturer's Data: Provide in completely coordinated and indexed package to assure full compliance with the contract requirements. Piecemeal submittal of data is not acceptable and such submittals will be returned without review. Information shall be submitted for all material and equipment the contractor proposes to furnish under terms of this contract work. Arrange the

submittals in the same sequence as these specifications and reference at the upper right-hand corner the particular specification provision for which each submittal is intended. Submittals for each manufactured item shall be manufacturer's descriptive literature (equipment specification), equipment drawings, diagrams, performance and characteristic curves, and catalog cuts, and shall include the manufacturer's name, trade name, catalog model or number, nameplate data, size layout dimension, capacity, specification reference, applicable specification references, and all other information necessary to establish contract compliance.

31.1.3 Shop drawings: Provide in completely coordinated and indexed package:

31.1.3.1Wiring and piping diagrams.

31.1.3.2Control schematics with narrative description and control descriptive logic fully showing and describing operation and/or manual procedures available to operating personnel to achieve proper operation of the building, including under complete failure of the BAS.

31.1.3.3Shop drawings for each input/output point showing all information associated with each particular point including sensing element type and location; details of associated field wiring schematics and schedules; point address; software and programming details (CDL's) associated with each point; and manufacturer's recommended installation instructions and procedures for each type of sensor and/or transmitter.

31.1.3.4Detailed system architecture showing all points associated with each controller, controller locations, and describing the **spare points capacity** at each controller and BAS LAN.

31.1.3.5Each BC shall contain a minimum of 20% spare resource capacity. The BC shall provide a throughput capable of transmitting all BAS LAN data connected to it within 10 seconds.

31.1.3.6Each AAC and ASC shall have a minimum of 10% spare capacity for each point type for future point connection. Provide all processors, power supplies and communication controllers complete so that the implementation of a point only requires the addition of the appropriate point input/output termination module and wiring. As a minimum, provide one of each type of point available on the controller.

31.1.3.7Specification sheets for each item including manufacturers descriptive literature, drawings, diagrams, performance and characteristic curves, manufacturer and model number, size, layout, dimensions, capacity, etc

31.1.3.8Colour graphic displays detailing hierarchical structure of facility, including floor plans, with multi-level penetration to equipment level.

32.0 START-UP AND CHECKOUT

City's BAS Project Manager shall be present during the Start-Up and Checkout- FOR FACILITIES MANAGEMENT PROJECTS ONLY, FOR OTHER DIVISIONS THIS IS OPTIONAL

32.1 This work shall include field testing and adjustment of the complete BAS, and on-site final operational acceptance test of the complete operational BAS. The Engineer shall be advised at least 14 days in advance of the dates of all tests and may attend at his discretion. If the Engineer witnesses the test, such tests shall be subject to his approval prior to the release of equipment. If the Engineer elects not to witness the tests, the contractor shall provide performance certification. Acceptance of tests by the Engineer and Project Manager shall not relieve the contractor of responsibility for the complete system meeting the requirements of these specifications after installation.

32.2 Static testing:

32.2.1 Static testing shall include point-by-point testing of the entire system and completion of Component Test Sheets. The contractor shall forward proposed Test Sheets at the shop drawing review stage. These Component Test Sheets shall be completed during the contractor's own testing and verification procedure that is done prior to the request for a final inspection. The completed Component Test Sheets shall then be returned to the Engineer for review and approval. The Engineer may repeat a random sampling of at least 50% of the tests during the Engineers commissioning procedure to corroborate their accuracy. The Contractor shall be on site with test equipment during this verification process. The test procedures shall include the following.

32.2.1.1 Digital input component testsheet:

- 32.2.1.1.1 DI status shall be verified at the POT and OWS for ON and OFF status.
- 32.2.1.1.2 All digital alarm inputs shall be proven using actual field conditions where possible or be jumpered at the field device for testing with the approval of the Engineer.

32.2.1.2 Digital output component testsheet:

- 32.2.1.2.1 Status to be verified at the equipment location. Verification at the OWS shall be completed for ON and OFF status, software DISABLE indicator and OVERRIDEN indicator

32.2.1.3 Analog input component testsheet:

- 32.2.1.3.1 All temperature sensors shall be calibrated using a hand held meter with equal or better accuracy.
- 32.2.1.3.2 Selected temperature sensors chosen by the Engineer shall be verified by spraying with a cold spray or other means to ensure response and to test the low temperature alarm condition.
- 32.2.1.3.3 All pressure sensing devices and analog output feedback shall be verified using a device with equal or better accuracy to ensure correct calibration.
- 32.2.1.3.4 All humidity sensing devices must be verified using a recently calibrated device with equal or better accuracy
- 32.2.1.3.5 All CTs shall be set to accurately reflect motor status, including removing belts on belt driven equipment
- 32.2.1.3.6 All other devices shall be verified using appropriate devices of equal or better accuracy
- 32.2.1.3.7 Adjust span on feedback devices so that input matches the end device

32.2.2 Analog output component testsheet:

32.2.2.1 AI points shall be tested by sending a command from the PWS or OWS to incrementally stroke the field device from full CLOSED to full OPEN and measuring the signal at the field device. The increments of the test shall be no larger than 10% of the output span.

32.2.2.2 The AO feedback requirement shall also be tested by failing the field device and verifying that the alarm registers

32.2.2.3 Each output shall be exercised over the full output capability of the panel

32.2.2.4 Field device hysteresis shall be measured at a minimum of three output levels for each direction of travel. Output increments shall not exceed 2% of span for this test

33.0 STANDARDS COMPLIANCE

33.1 Where materials or equipment are specified to conform to requirements of the standards of organizations, such as the Canadian Standards Association (CSA) that use a label or listing as method of indicating compliance, proof of such conformance shall be submitted and approved, indexed and cross-referenced with the specification. The label or listing of the specified organization will be acceptable evidence. In lieu of the label or listing, the contractor shall submit a certificate from a testing organization adequately equipped and competent to perform such services, and approved by the Engineer, stating that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's standard or code. For materials whose compliance with organizational standards or specifications is not regulated by an organization using its own listing or label as proof of compliance, a certificate from the manufacturer shall be furnished to the Engineer stating that the material complies with the applicable referenced standard or specification.

34.0 FINAL ACCEPTANCE

34.1 Final acceptance shall commence only after satisfactory completion of start-up, verification of performance and the 30-day test period described earlier. When the Contractor has satisfied himself as to proper system operation he shall advise the BAS Commissioning Engineer/Consultant to establish a date for Final Acceptance. This will involve a point-by-point check of all hardware and software items including graphics and displayed data, as well as performing tasks as directed.

34.2 Supply 2-way radios and all test equipment as previously specified. Have on-site technical personnel capable of re-calibrating all field hardware and modifying software.

34.3 Test each system independently and then in unison with other related systems. Test weather sensitive systems twice- once near winter design conditions and again near summer design conditions.

34.4 Optimize operation and performance of each system. Test full-scale emergency operation and integrity of smoke management and other life safety systems.

34.5 Demonstrate to the Engineer the operation of each system including sequence of operations in regular and emergency modes, under all normal and emergency conditions, start-up, shut-down, interlocks, and lock-outs.

34.6 Upon completion of the testing submit a report to the Engineer to summarize all testing.

35.0 DOCUMENTATION

35.1 Documentation shall consist of 4 hard copies and one soft copy for all information described below

35.2 The final documentation package shall include:

35.2.1 Hard and soft copies of all control drawings (As-Builts).

35.2.2 Manufacturer's technical data sheets for all hardware and software

35.2.3 Factory operating and maintenance manuals with any customization required

35.2.4 Soft copies of programming and front-end software and each controller's database. Hard copy output of programming is not necessary

- 35.2.5 Provide clear, concise, typewritten and soft copy descriptions of all control sequences in the working language.
- 35.2.6 Soft copy text files shall be in MS-Word.
- 35.3 Each instruction and reference manual shall be bound in hardback, 3 ring, binders or an approved equivalent shall be provided to the Engineer. Binders to be no more than 2/3 full. Each binder to contain index to full volume. One complete set of manuals shall be furnished prior to the time that the system or equipment tests are performed, and the remaining manuals shall be furnished at acceptance. The identification of each manual's contents shall be inscribed on the cover and spine. The manuals shall include the names, addresses and telephone numbers of each subcontractor installing equipment systems and of the local representatives for each item of equipment and each system. The manuals shall have a table of contents and be assembled to conform to the table of contents with the tab sheets placed before instructions covering the subject. Additionally, each manual shall contain a comprehensive index of all manuals submitted in accordance with this paragraph. Manuals and specifications shall be furnished which provide full and complete coverage of the following subjects:
- 35.4 Operational Requirements: This document shall describe in concise terms, all the functional and operational requirements for the system and its functions that have been implemented. It shall be written using common terminology for building operation staff and shall not presume knowledge of digital computers, electronics or in-depth control theory.
- 35.5 System Operation: Complete step by step procedures for operation of the system, including required actions at each operator station; operation of computer peripherals; input and output formats; and emergency, alarm and failure recovery. Step-by-step instructions for system startup, back-up equipment operation, and execution of all system functions and operating modes shall be provided.
- 35.6 Maintenance: Documentation of all maintenance procedures for all system components including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective module. This shall include calibration, maintenance, and repair or replacement of all system hardware.
- 35.7 Test Procedures and Reports: The test implementation shall be recorded with a description of the test exercise script of events and documented as test procedures. A provision for the measurement or observation of results, based on the previously published test specification, forms the test reports. The procedures record and the results of these exercises shall be conveniently bound and documented together.
- 35.8 Configuration Control: Documentation of the basic system design and configuration with provisions and procedures for planning, implementing, and recording any hardware or software modifications required during the installation, test, and operating lifetime of the system. This shall include all information required to ensure necessary coordination of hardware and software changes, data link or message format/content changes, and sensor or control changes in the event system modification are required, and to fully document such new system configurations.

36.0 TRAINING

- 36.1 The Contractor shall provide the services of competent instructors who will provide instruction to designated personnel in the adjustment, operation and maintenance, including pertinent safety requirements, of the equipment and system specified. The training shall be oriented towards the system installed rather than being a general "canned" training course. Instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach. The number of person-days (eight hours) of instruction furnished shall be as specified below as a minimum. A training manual shall be provided for each trainee that describes in detail the data included in each training program.
- 36.2 All equipment and material required for classroom training shall be provided by the contractor. A person-week shall be considered as 37.5 hours, 8:00 am to 12:00 noon, and 12:30 pm to 4:30 pm Monday through Friday. Provide 5 days of training as specified herein.

36.3 Training shall enable operators to accomplish the following objectives:

- 36.3.1 Proficiently operate system
- 36.3.2 Understand control system design and configuration
- 36.3.3 Create and change system graphics
- 36.3.4 Create, delete, and modify alarms, including configuring alarm reactions
- 36.3.5 Configure and run reports
- 36.3.6 Add, remove, and modify system's physical points
- 36.3.7 Create, modify, and delete application programming
- 36.3.8 Add a new controller to system
- 36.3.9 Download firmware and advanced applications programming to a controller
- 36.3.10 Configure and calibrate I/O points
- 36.3.11 Maintain software and prepare backups
- 36.3.12 Understand DDC system components
- 36.3.13 Understand system operation, including DDC system control and optimizing routines (algorithms)
- 36.3.14 Operate workstation and peripherals
- 36.3.15 Log on and off system
- 36.3.16 Access graphics, point reports, and logs
- 36.3.17 Adjust and change system setpoints, time schedules, and holiday schedules
- 36.3.18 Recognize common HVAC system malfunctions by observing system graphics, trend graphs, and other system tools
- 36.3.19 Access data from DDC controllers
- 36.3.20 Add new users and understand password security procedures

37.0 WARRANTY

- 37.1 Provide warranty certificates showing the name of the firm giving the warranty, dated from the issuance of the Certificate of Substantial Performance and acknowledged on specific equipment and systems.
- 37.2 Include these certificates with the Operation and Maintenance Manual in the appropriate sections.
- 37.3 Contractor shall give a minimum two-year warranty for parts and labor on all equipment and materials installed and shall select materials and equipment where the Manufacturer gives the same warranty arrangements. Warranty shall commence on the date of the Engineers issuance of the Certificate of Substantial Completion.
- 37.4 Provide a warranty as indicated in 38.0 - Maintenance/Service.

37.5 The Contractor shall agree to make good at his own expense any equipment that fails to operate due to poor workmanship, manufacturing defect or improper installation. Any repairs shall be made at the convenience of the Engineer during normal working hours, unless deemed an emergency.

37.6 Provide upgrades to all software or all panel firmware issued during the warranty period at no charge to Owner.

38.0 MAINTENANCE/SERVICE

*BAS contractor to show the price of service contract as separate line item.
Applicable to New System Installations OR Major overhaul of existing BAS system/s*

38.1 Provide warranty in accordance with the warranty section of this specification. In addition provide scheduled maintenance and service during the warranty period on all control system apparatus including but not limited to valves, dampers, linkages, control panels, interfaces, direct digital control systems, OWS, Server, BC, AAC, ASC, Software and application programs.

38.2 Scheduled preventive maintenance inspections will provide those services required to maintain the system at maximum performance and reliability levels and may include the following:

38.3 Analyze, adjust, calibrate the applicable temperature sensors, humidity sensors, diagnostic LEDs, printers, power supplies, work stations, controllers, modems, input/output points, communication cabling, transmitters, transducers, UPS for the BAS system.

38.4 Conduct inspections and thorough preventive maintenance routine on each piece of covered equipment. In addition, make tests and adjustments to ensure efficient and reliable operation of other major components.

38.5 Examine, clean and calibrate as required sensors, thermostats, humidity controls, temperature controls, pressure controls, relays, damper actuators, instrumentation and accessories directly pertaining to the Building Automation System.

38.6 Check and confirm control system sequence of operation to insure optimum system efficiency and economy.

38.7 A log of each loop tested and each control sequence verified shall be reviewed with the owner.

38.8 All components of the Pneumatics Control System will be serviced according to manufacturer's recommendations during each year of the contract. This will include (but not be limited to) all lubricant changes, filter changes, adjustments, calibrations and cleaning.

38.9 The system includes, but is not limited to, the air compressor, air receiver, pressure reducing valves, air dryers and all sensors, controllers, transducers, damper and valve operators, thermostats, pilot positioners, electro-pneumatic switches, linkages and any other pneumatic and electronic devices used to maintain the environmental comfort in the building.

38.10 The Contractor will provide preventative maintenance and diagnostic inspections to all electronic system components on a frequency established by manufacturer's recommendations, component age and condition and discussion with the Supervisor of Operations responsible for the site.

38.11 Provide a fully trained BAS service technician and a Pneumatic fitter (Required for Pneumatic/DDC system) a minimum of one day per month (8 hours for DDC technician and 8 hours for pneumatic fitter) during the warranty period to provide the preventive maintenance and service described above. Provide

written reports to the owner outlining the work performed. Allow for 12 annual visits of one day each (24 days total for 2 years) during the warranty period to provide required service. (This may change in accordance with the size of the project).

- 38.12 Provide emergency service for parts and labor on an as needed basis. Response to an emergency call shall be 2 hours maximum on Mon.-Fri. including on holidays and weekends.
- 38.13 Provide remote service diagnostic monitoring from the local office. At the request of the owner, a service diagnostic call will be made to troubleshoot and resolve (if possible) any reported system complaints.
- 38.14 Provide a price for a three-year service agreement based on the above requirements to come in to effect upon the completion of the warranty period. Show this price as OPTION: Service Agreement.



**DIVISION 26 – GENERAL ELECTRICAL
SPECIFICATIONS
FOR THE
METRO HALL DAYCARE
55 JOHN STREET, TORONTO, ON**

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Our Project No. 2021-0245

**January 26, 2024
Issued for Tender**

SEAL:

DISCIPLINES MECHANICAL
ELECTRICAL
PLUMBING
LIGHTING DESIGN
COMMUNICATIONS
SECURITY & RISK
COMMISSIONING
ENERGY SERVICES

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Project No.: 2021-0245
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Date: January 26, 2024

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Section 26 50 00 Lighting

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Project No.: 2021-0245
Section Name: **Common Work Results for Electrical**
Section No.: **26 05 01**
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1 **GENERAL**

1.1 GENERAL

1.1.1 This Section covers items common to Sections of Division 26. This section supplements requirements of Division 1.

1.1.2 Comply with General and Supplementary Conditions of Contract.

1.1.3 Conditions and Division 01 General Requirements. This Section covers items common to Sections of Division 26.

1.1.4 Where conflict occurs between Codes, Specification and Drawings, plan and riser, the maximum condition is to govern, and the Tender is to be based on whichever indicates the greater cost.

1.1.5 Provide all materials, equipment, labor and services to complete the installation, wiring, testing and commissioning of the complete and functioning electrical systems, including but not limited to the scope of work specified in this section.

1.2 INTENT

1.2.1 The General Requirements apply to all Sections of this Division.

1.2.2 The extent of the work shall comprise the whole management, programming, labour and materials required to form a complete installation, together with such tests, adjustments and commissioning as prescribed in subsequent clauses and otherwise as may be required in order to provide an effective working installation to the satisfaction of the Engineer.

1.2.3 This specification covers the design of details, supply, installation and testing of all necessary equipment required for the complete Electrical Engineering Services as described in the Contract Documents and incorporates standard descriptions for equipment and the installation to be provided under this Contract. The clauses shall be read in conjunction with all other Contract Documents.

1.2.4 Provide all items, articles, materials, operations and methods listed, mentioned and scheduled in the contract documents. Include all labour, equipment, tools, scaffolds and other incidentals necessary and required for the complete installation.

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1.2.5 Consider the specifications as an integral part of the drawings which accompany them. Do not use the drawings or the specifications alone. Consider any item or subject omitted from one, mentioned or reasonably implied in the other, as properly and sufficiently specified and provides same under the work of this division.

1.2.6 Each Contractor is considered to be an expert in their field.

1.3 WORK INCLUDED

1.3.1 Work to be done under this section to include furnishing of labour, materials and equipment required for installation, testing and putting into proper operation complete Electrical systems as shown, as specified, as intended, and as otherwise required. Complete systems to be left ready for continuous and efficient satisfactory operation.

1.4 CODES, PERMITS, FEEDS, AND INSPECTION

1.4.1 All work shall meet or exceed the latest requirements of the Ontario Electrical Safety Code and its supplement, local inspection bulletins, and all authorities having jurisdiction.

1.4.2 Obtain all permits and arrange for inspection of all work and pay all fees in this regard. On completion of the work, deliver the final unconditional "Certificate of Approval of the Electrical Inspection Authority" to the Consultant.

1.4.3 Before proceeding with any work, submit the required number of sets of plans and specifications to the Electrical Inspection Authority for approval and pay all costs in this regard. Bring any additional requirements or changes required by the Electrical Inspection Authority to the attention of the Consultant immediately.

1.4.4 It is hereby agreed that all requirements have been examined and checked with the Electrical Inspection Authority and CSA, and a complete installation in accordance with these requirements will be provided at the Tender Price.

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- 1.4.5 Keep a permanent record of each inspection made by the Electrical Inspection Authority showing the date, inspector's name, scope of the inspection, and statement of special decisions or permissions granted. Make these records available to the Consultant at any time, and turn them over to them after the completion of the work.
- 1.4.6 Provide partial inspection and approval reports as required to suit phasing and partial occupancy requirements.
- 1.4.7 Abbreviations for electrical terms shall be as per CSA Z85-1983.
- 1.5 **SCOPE OF WORK**
- 1.5.1 The scope of the contract works shall include but not limited to the supply, delivery, off-loading, erection, setting-to-work, testing and commissioning and handing over of the electrical building services installation outlined below and described in more detail elsewhere in the specification and indicated on the drawings all in accordance with the contract documentation.
- 1.5.2 The Contractor shall be responsible to review and fully understand the specification and the scope of work. Furthermore, the Contractor shall be responsible to provide all conduit, wiring, power supply, accessories and supplementary component, necessary for the safe and proper operation of the various systems.
- 1.5.3 The Contractor shall be responsible as follows:
 - 1.5.3.1 Visit the site to familiarize themselves with the scope of work.
 - 1.5.3.2 Preparation of shop drawings and obtaining approval from the various authorities prior to execution of work.
 - 1.5.3.3 Obtaining all materials and work approval during execution and on completion of works.
 - 1.5.3.4 All costs and charges required by the various local authorities and any related to the connection of permanent power supply and kWh meters including the provision of the tenants kWh meters shall be included in the scope of work except the power connection charges which shall be paid by the Client.
- 1.5.4 High Voltage Installation:

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- 1.5.4.1 Liaise and coordinate with the Local Authority Distribution Company and provide all assistance to facilitate the installation of all Local Authority Distribution Company supplied, installed and commissioned Transformers.
- 1.5.4.2 Provide transformer grounding system.
- 1.5.4.3 Include for lay in duct bank and termination of the interconnecting cabling from the secondary side of the transformers to the LV switchgear.
- 1.5.5 Low Voltage Installation:
 - 1.5.5.1 Supply and installation of all switchboards, distribution panels, and panelboards, and power factor correction as identified in Construction Documents.
 - 1.5.5.2 Generator, low voltage life safety switchboard, Automatic Transfer Switches (ATS), including outgoing LV cabling to essential and life safety services, and integral phase failure relays.
 - 1.5.5.3 Busbars with fully rated neutral and earth integral and MCCB tap off units where indicated.
 - 1.5.5.4 Main and sub-main distribution cables and system wiring.
 - 1.5.5.5 Emergency power off system and trip facilities including battery-tripping units.
 - 1.5.5.6 Motor Control Centres.
 - 1.5.5.7 ACB/MCCB protection settings.
 - 1.5.5.8 Energy meters on plant.
 - 1.5.5.9 UPS for critical services including UPS module, batteries and switchgear requirements.
 - 1.5.5.10 All containment systems required to facilitate the above services.
 - 1.5.5.11 Leak detection system;
 - 1.5.5.12 All associated noise and vibration control measures including attenuators and anti-vibration mounts;
- 1.5.6 Grounding and Bonding:

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- 1.5.6.1 Supply and installation of all main and supplementary earth bars in all plant rooms and risers as indicated in the tender drawings.
- 1.5.6.2 Equipment bonding.
- 1.5.6.3 Circuit protective conductors.
- 1.5.6.4 Cableways and interconnecting cabling for the above.
- 1.5.7 Lighting Installation:
 - 1.5.7.1 The Electrical Contractor shall be responsible for the supply and installation of all luminaires as indicated on the tender drawings and described in this specification. The complete lighting installation shall include but not be limited to:
 - 1.5.7.1.1 All luminaires as specified on the drawings and in the contract documentation, which shall include both Electrical Consultant specification and specialist lighting designer's specifications.
 - 1.5.7.1.2 All luminaire fixings.
 - 1.5.7.1.3 Power supplies, cabling and containment.
 - 1.5.7.1.4 Lighting control system as described and detailed on the drawings and later in this specification.
- 1.5.8 Small Power Installation:
 - 1.5.8.1 The Electrical Contractor shall be responsible for the supply and installation of the small power services as detailed on the tender drawings. This shall include but not be limited to the following:
 - 1.5.8.1.1 General purpose socket outlets in all areas.
 - 1.5.8.1.2 Single phase and three phase power points for laboratory equipment as indicated on the tender drawings.
 - 1.5.8.1.3 Power supplies to power assisted doors.
 - 1.5.8.1.4 Power supplies to automatic openable windows.
 - 1.5.8.1.5 Power supplies entrance doors.
 - 1.5.8.1.6 Power supplies to motorised dampers.
 - 1.5.8.1.7 Power supplies to fan coil units.

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- 1.5.8.1.8 Power supplies to Kitchen equipment.
- 1.5.8.1.9 Power supplies to meeting room equipment.
- 1.5.8.1.10 Power supplies to Public Address System.
- 1.5.8.1.11 Advertisement power and control system.
- 1.5.9 Kitchen and Laundry:
 - 1.5.9.1 The Electrical Contractor shall be responsible for the supply and installation of kitchen and laundry services as detailed on the tender drawings and as described in this specification. The extent of the works shall generally be to a consolidation point where the Electrical Contractor's scope of works ends and the kitchen electrical contractors (KEC) scope begins. The Electrical Contractors scope of works shall include but not be limited to the following:
 - 1.5.9.1.1 Supply and installation of all sub main and final circuit distribution boards.
 - 1.5.9.1.2 All combination of outlets, switch units, fused connection units, flex outlets, commando sockets, isolators and junction points for specialist equipment's as detailed on the tender drawings.
 - 1.5.9.1.3 All cable tails to service distribution points as detailed.
 - 1.5.9.1.4 Wiring and raceways to facilitate the above installation.
 - 1.5.10 Fire Detection, Alarm System and Voice Evacuation System:
 - 1.5.10.1 An analogue addressable main fire alarm control panel and distributed fire alarm panels.
 - 1.5.10.2 Provision of automatic fire detectors and manual call points;
 - 1.5.10.3 Full Voice alarm system including audio control unit and distributed amplifier units.
 - 1.5.10.4 Fire alarm system repeater panels.
 - 1.5.10.5 The firefighter's override smoke and extract systems panel.
 - 1.5.10.6 Fire priority telephone panel, sprinkler/wet riser systems status panel, firefighter's override panel.

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- 1.5.10.7 Field wiring and cable management system.
- 1.5.10.8 Fire priority telephone system and disabled refuge alarm system.
- 1.5.10.9 The firefighter's override panel, providing control of smoke pressurization, mains power supply, motorised doors/louvers/windows for the purpose of smoke control.
- 1.5.10.10 Sprinkler status monitoring panel and interconnecting cabling to facilitate monitoring of all isolating valves and tamper switches.
- 1.5.10.11 Firefighting lift mimic panels;
- 1.5.10.12 Interface to smoke extract plant including control of dampers etc. as necessary;
- 1.5.10.13 Fire alarm interface units to other systems such as mechanical plant, lifts and security system.
- 1.5.10.14 Serial communications interface to BMS.
- 1.5.10.15 Interface to access control system
- 1.5.10.16 Interface to background music system
- 1.5.10.17 Link to existing/site wide fire alarm systems;
- 1.5.10.18 All associated cabling and containment with the above.
- 1.5.11 Lightning Protection Installation:
 - 1.5.11.1 Air termination network, including bonding to all roof exposed metalwork/plant;
 - 1.5.11.2 Down conductors utilising selected re-enforced concrete columns
 - 1.5.11.3 Earth electrodes
 - 1.5.11.4 Surge protection devices to all sub main and final circuit distribution panels at roof level serving equipment susceptible to lightning strike.
 - 1.5.11.5 Surge protection devices to all Main Switchboard and Distribution Panels.
- 1.6 RELATION TO WORK OF OTHER DIVISIONS
 - 1.6.1 Examine the Work of other Divisions upon which the Work of this

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Division depends for proper completion. Contractor shall report any defect or variance to the Engineer. Do not commence work under this Division until such defects have been resolved.

- 1.6.2 Coordinate the work of the Electrical Division with the Work of the other Divisions in such a manner that there is no interference and conflicts. In areas where conduits and equipment called for in the Electrical Division will be installed in conjunction with pipes, ductwork and equipment called for in other Divisions, Contractor shall coordinate the work to ensure proper installation, clearances, access, and the best use of the space.
- 1.6.3 Coordinate with other Divisions excavation, backfilling, form work, shoring and concrete work for maintenance holes, cable pits, equipment bases, concrete pads, earth wells and pits, lighting pole bases and all other work of this Division, to be carried out under the appropriate Divisions of this Specification.
- 1.6.4 Verify in the field all dimensions, locations and clearances affecting the work of this Division.
- 1.7 CONTRACT DOCUMENTS
- 1.7.1 The drawings for the electrical work are performance drawings and diagrammatic, intended to convey the scope of the work and indicate general arrangement and approximate location of apparatus, fixtures and conduit runs. The drawings do not intend to show architectural and structural details.
- 1.7.2 Do not scale drawings. Obtain information involving accurate dimensions shown on architectural and structural drawings, or by site measurements. Consult general construction drawings, as well as detail drawings to become familiar with all conditions affecting work, and verify spaces in which the work will be installed.
- 1.7.3 Make, at no additional cost, any changes or additions to materials and/or equipment necessary to accommodate structural conditions (runs around beams, columns, etc.).
- 1.7.4 Alter, at no additional cost, the location of materials and/or equipment as directed, provided that the changes are made before installation and any such outlet is not relocated in excess of 3m (10') in any direction.
- 1.7.5 Install all ceiling mounted components (luminaires, speakers, bells, etc.) in accordance with reflected ceiling drawings, approved by the

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- 1.7.6 Leave space clear and install all work to accommodate future materials and/or equipment as indicated, and to accommodate equipment and/or material supplied by another division of work or contract. Verify spaces in which work is to be installed. Install all conduit runs, etc., to maintain headroom and clearances and to conserve space in shafts and ceiling spaces.
- 1.7.7 Confirm on the site the exact location of outlets for equipment supplied under other divisions of work or contracts.
- 1.7.8 Confer with all trades installing equipment which may affect the work of this division, and arrange equipment in proper relation to equipment installed under all divisions of the contract.
- 1.7.9 Timeously furnish all items to be built in, complete with all pertinent information, commensurate with the progress of the work.
- 1.7.10 Store materials neatly and out of the way and clean up daily all refuse caused by the work.
- 1.7.11 Relocate equipment and/or material installed, but not coordinated with the work of other divisions, as directed by the Consultant at no extra cost.
- 1.7.12 Where discrepancies are found within the Contract Documents, the maximum conditions will govern.
- 1.7.13 Refer to the Base Building Vendors List for Metro Hall in Part 3 of the City of Toronto's General Specifications.

2 **PRODUCTS**

2.1 MATERIALS

- 2.1.1 Contactor shall arrange and format the submittals for the materials and related drawings to the Engineer for approval and to include the necessary details as requested by the Engineer.
- 2.1.2 The contractor shall specify items/materials from the list of approved suppliers/manufacturers or equal and approved. However this shall be limited to a single alternative and should this be rejected the contractor is obliged to revert to the list of approved suppliers/manufacturers
- 2.1.3 Materials and equipment shall be:

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- 2.1.3.1 New and free of all defects,
- 2.1.3.2 Designed, manufactured and tested in accordance with the latest issues of all applicable CSA and other applicable industry standards,
- 2.1.3.3 Certified by CSA or acceptable to the authorities having jurisdiction, including special inspection if required.
- 2.1.3.4 All electrical equipment shall be designed for operating in a 50°C ambient temperature with 100% relative humidity. Copies of test certificates shall be provided prior to ordering equipment.
- 2.1.3.5 Equipment or material used in hazardous classified areas such as battery rooms shall be certified for use in such locations from recognized authorities such as Bassefd, PTB etc.
- 2.1.3.6 Provide samples properly labeled of each material specified in this specification or requested by the Engineer. Such samples shall be submitted to the Engineer for their approval at their offices or elsewhere as directed with all parts left loose, so that they may be taken apart for internal inspection by hand without the necessity of using spanners, screw drivers or wrenches.
- 2.1.3.7 Where more than one of any item is required, all shall be of the same type and manufacture.
- 2.1.3.8 The products of the specified manufacturers are acceptable only when these products comply with or are modified as necessary to comply with the requirements of the contract documents.
- 2.1.3.9 Items of equipment or material, which are not specifically defined herein, shall conform to the general standard of quality established herein.

3 **EXECUTION**

3.1 GENERAL

- 3.1.1 Contractor shall submit detailed method statement for installation of each system to the engineer approval. Execution of work shall be carried out strictly in accordance with the engineer approved shop drawings and method statements.

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3.1.3 All systems shall be segregated from each other. Contractor shall provide narrative and schematics on methods and procedures for system segregation. Narrative shall include bundling, separation, color coding, and installation of each system installed by the electrical Contractor. Narrative shall be approved by the Engineer and owner prior to commencement of work.

3.2 ACCESS PANELS AND DOORS

3.2.1 Provide all access panels and/or doors to facilitate the maintenance and/or servicing of all electrical equipment installed in concealed spaces.

3.2.2 Indicate on the "as-built" drawings the location of these panels and doors.

3.2.3 Doors and panels in fire rated enclosures shall be ULC listed sandwich doors and shall have the same rating as the enclosure.

3.2.3.1 Doors shall have concealed hinges and screwdriver operated lock. Doors shall be as follows:

3.2.3.2 Concrete Block and Drywall: 12 gauge prime painted steel door.

3.2.3.3 Plaster and Acoustic Tile: recessed dish shaped door to accept ceiling tile or welded metal lath for plaster.

3.2.4 All access doors and locations shall be to the Consultant's approval.

3.3 CARE, OPERATION AND START-UP

3.3.1 Instruct Consultant and operating personnel in the operation, care and maintenance of equipment.

3.3.2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components.

3.3.3 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 all aspects of its care and operation.

3.4 COMPLETION

3.4.1 Clean all fixtures and equipment. Polish all plated surfaces.

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- 3.4.2 Set all relays to operating condition.
- 3.4.3 Remove all temporary protection and covers.
- 3.4.4 Vacuum clean the inside of switchgear, panelboards, motor control centre, and fire alarm control panel and annunciators. Ensure that they are free from debris and dust.
- 3.4.5 Change all lamps. All lamps are to be new at time of system acceptance.
- 3.4.6 Leave electrical work in as-new working order.
- 3.5 CONSTRUCTION AND INTERFERENCE DRAWINGS
- 3.5.1 Prepare fully dimensioned drawings showing sleeves and openings through structure. Indicate locations and weights on all load points.
- 3.5.2 Prepare drawings of pits, curbs, sills, equipment bases, anchors, inertia slabs, etc.
- 3.5.3 Prepare fully dimensioned construction drawings of Products and services in electrical rooms, service and ceiling spaces, and all other critical locations. Co-ordinate the Work with all other Divisions. Base drawings on reviewed shop drawings and indicate all details pertaining to access, clearances, cleanouts, sleeves, electrical connections, drain locations and elevations of pipes, ducts and conduits.
- 3.5.4 Submit construction/interference drawings prior to commencement of work.
- 3.5.5 Provide AutoCAD files indicating all electrical equipment mounted on or above the ceilings or at ceiling level in areas without ceilings to the mechanical contractor for preparation of interference drawings. Items to be coordinated include all electrical equipment that may interfere with installation of the work of other trades including outlet box locations, hangers and supports, cable trays, luminaires, etc. Indicate depths of luminaires or other recessed electrical equipment to assist in the coordination of services
- 3.5.6 Submit drawings coordinated and approved by all trades, to the Consultant and include one complete set in each operating and maintenance manual.
- 3.5.7 Construction drawings are prepared for construction and record

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purposes only and are not part of the contract documents or shop drawings.

3.6 CUTTING AND PATCHING

- 3.6.1 Do all cutting and patching required for the installation of new equipment and surface restoration after the removal of existing equipment. Work will be carried out by others at this Contractor's cost. For patching use materials equal to those comprising the surrounding area.
- 3.6.2 Inform other Division Contractors in sufficient time with regard to required openings. Where this requirement is not met, bear the cost of all cutting and patching.
- 3.6.3 In existing work and work already finished, cutting and patching will be carried out by the General Contractor at the Electrical Contractors' expense.
- 3.6.4 Be aware of fire rated partitions, minimize the area affected by the work, and return all surfaces to a condition encountered before the work. Acceptance of the finished work is at the sole discretion of the Consultant.
- 3.6.5 Painting of finished surfaces will be by the General Contractor to match adjacent surfaces.

3.7 DEMOLITION

- 3.7.1 Make safe and disconnect all power and systems, as and when, and to the extent required to facilitate with the demolition.
- 3.7.2 Ensure that all electrical, life safety services, and services for existing equipment, in areas outside the areas of this work, that are required to remain in service, shall do so.
- 3.7.3 Relocate any electrical feeders or equipment that are required to remain in service, that are secured to existing walls, floors or ceilings to be demolished or that are buried and required to be excavated for new work.
- 3.7.4 Remove and replace any electrical equipment on walls or ceilings that will be demolished and rebuilt.
- 3.7.5 When deleting and/or making safe existing electrical work, ensure that it includes all wiring back to the associated panelboard or control panel.

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- 3.7.6 Disconnect and remove existing light fixtures, devices, outlets, etc. which are not to be reused. Such items shall be cartoned and turned over to the Owner at a place designated by the Owner. Cut back and cap unused raceway and outlets and remove unused wiring back to panelboard in an approved manner.
- 3.7.7 Ensure that all existing equipment which is to be reused and/or relocated is thoroughly inspected and refurbished to ensure correct operation when put back into service.
- 3.7.8 All existing electrical equipment which is no longer required shall be removed and disposed of, off site.
- 3.7.9 Be responsible and pay for any damage to the base building incurred by work of this Division, or repair to the satisfaction of the Consultant.
- 3.7.10 Carry out the work with a minimum of noise, dust and disturbance.
- 3.7.11 Provide tools and clean up equipment. Obtain the Owner's permission for the use of electrical, plumbing or drainage outlets.
- 3.7.12 Provide daily clean-up and proper disposal of debris generated by daily operations. On completion of the work, all tools, surplus materials and waste materials shall be removed and the premises left in a clean, perfect condition.
- 3.8 EQUIPMENT SUPPORTS, ANCHORS AND HANGERS
- 3.8.1 Provide all supports required for the erection and support of the electrical work.
- 3.8.2 Support all suspended equipment from the bottom.
- 3.8.3 Provide all lintels where required.
- 3.8.4 Suspend all hangers directly from the structure using approved inserts or beam clamps.
- 3.8.5 Do not use pipe hooks or perforated straps.
- 3.8.6 Hangers shall be spaced such that there is a hanger within 610mm (24") of every bend and that the maximum spacing does not exceed the limits as per the local standard requirement.
- 3.8.7 Vertical pipes shall be supported at each floor slab and at the top and bottom of each riser.

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3.8.8 Support all conduit or cable at equipment mounted on spring isolators, with spring hangers for at least 4572mm (15').

3.8.9 Do not support any conduits from ductwork, pipes etc.

3.9 EXCAVATION AND BACKFILL

3.9.1 All excavation and backfilling will be carried out by Division 02.

3.9.2 Conform to the performance standards of Division 02.

3.9.3 All rough excavation, i.e., excavation to within 152mm (6") of final elevation, will be done by Division 02.

3.9.4 All final backfilling, i.e., backfilling from a location 305mm (12") above the electrical equipment or service, to grade, will be done by Division 02.

3.9.5 Do all final excavation, i.e., excavation of the last 152mm (6") to final elevation, and all initial backfilling, i.e., backfilling of the first 305mm (12") above the electrical equipment or service.

3.9.6 Conform to the performance standards of Division 02 with respect to all excavation and backfilling.

3.9.7 Obtain approval from the Consultant before backfilling.

3.9.8 After backfilling and compaction, return the surface to match the original condition, or as directed by the Consultant.

3.10 EXPANSION JOINTS AND LOOPS

3.10.1 Supply and install expansion joints or loops in conduits crossing expansion joints in the structure without imposing undue stress on structure, apparatus or conduit.

3.11 EXISTING CONDITIONS

3.11.1 Visit the site and examine the existing conditions affecting the work of this Division.

3.11.2 No claim for extra payment shall be made for extra work made necessary by circumstances encountered due to conditions which were visible upon, or reasonably inferable from an examination of the site prior to submission of the Bid.

3.12 EXPEDITING

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- 3.12.1 Continuously check and expedite delivery of equipment and materials.
- 3.12.2 As required, inspect equipment, etc. at the source of manufacture.
- 3.12.3 Continuously check and expedite the flow of necessary information to and from all parties involved.
- 3.12.4 Immediately inform the Construction Manager and the Consultant where information is required from them, and attend to any request for information, details, dimensions, etc. from them.
- 3.13 FIELD QUALITY CONTROL
- 3.13.1 Carefully check each piece of apparatus for completeness of connections, accessories, wiring and controls and place in operation, test and adjust.
- 3.13.2 Obtain written permission to start and test permanent equipment and systems.
- 3.13.3 Operate each piece of equipment, including motors and controls, continuously for minimum 2 hours in the presence of the Engineer.
- 3.13.4 Correct defects; repeat tests until no defects are disclosed; leave equipment clean and ready for use.
- 3.13.5 After completion of initial trial test, execute Reliability Tests for plant and equipment. Give Engineer 7 days' notice before commencing tests.
- 3.13.6 Each reliability test shall last for 30 consecutive days during which time the whole of the plant being tested shall operate continuously without adjustment or repair.
- 3.13.7 Repeat reliability test after repairs and adjustments (other than normal running adjustments) have been carried out, until system runs as intended.
- 3.13.8 Run systems under full summer and winter load conditions.
- 3.13.9 The Electrical Contractor is responsible for the following tests:
 - 3.13.9.1 Power distribution system including phasing, voltage, grounding and load balancing.
 - 3.13.9.2 Circuits originating from branch distribution panels.

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- 3.13.9.3 Lighting and its control.
- 3.13.9.4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
- 3.13.9.5 Systems: fire alarm system, communications.
- 3.13.9.6 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- 3.13.9.7 Insulation resistance testing.
- 3.13.9.8 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
- 3.13.9.9 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
- 3.13.9.10 Check resistance to ground before energizing.
- 3.13.9.11 Any tests and commissioning work identified in the individual sections of this Electrical Specifications.
- 3.13.10 Carry out tests in presence of Consultant.
- 3.13.11 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- 3.13.12 Submit test results for Consultant's review.
- 3.14 FIELD REVIEW
- 3.14.1 The Consultants will make periodic visits to the site during construction to ascertain reasonable conformity to plans and specifications. The Consultant is not responsible for quality control. The Contractor shall maintain their own quality control and will be responsible for the execution of their work in conformity with the contract documents and the requirements of the Authorities.
- 3.14.2 The Owner and Consultant shall have access to the site at all times for periodic inspections. Maintain a complete set of contract documents on site for field reference by the Consultant.
- 3.14.3 Provide all gauges, instruments, and other equipment necessary for field review by the Consultant.

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- 3.14.4 Application for final review will be considered when the Work has been completed and written declarations submitted that all commissioning, adjustment, set up and documentation is complete. Final review will be completed when:
 - 3.14.4.1 All reported deficiencies have been corrected.
 - 3.14.4.2 All systems have been tested, commissioned and are operational.
 - 3.14.4.3 The Owner has been instructed in the operation and maintenance of all equipment.
 - 3.14.4.4 All reports have been submitted and reviewed.
 - 3.14.4.5 All instruction manuals have been submitted and reviewed.
 - 3.14.4.6 All directories and nameplates are in place.
 - 3.14.4.7 Cleaning up is finished in all respects.
- 3.14.5 All spare parts and replacement parts specified have been provided.
- 3.14.6 All record drawings have been submitted and reviewed.
- 3.15 FINISHES
 - 3.15.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - 3.15.2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
 - 3.15.3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.
- 3.16 FIRE RATING
 - 3.16.1 All feeder conduits for the following systems shall be 2 (two) hours fire rated MI cable:
 - 3.16.1.1 Emergency Distribution and Lighting Panels
 - 3.16.1.2 Fire Alarm System
 - 3.16.1.3 All life safety systems

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- 3.16.1.4 Elevators
- 3.16.1.5 Diesel Oil Pumps
- 3.16.1.6 Fire Pumps
- 3.16.1.7 Emergency Motor Starters and MCC's
- 3.16.1.8 Branch and control circuits for smoke control and dampers.
- 3.17 **FIRE SEALS**
- 3.17.1 Where cables, bus ducts, cable tray, or conduits pass through non-fire rated floors, walls or roof, provide internal and external sealing thereto.
- 3.17.2 For non-fire rated locations, sealant shall be silicone.
- 3.17.3 For fire rated locations, the sealant shall be fire stop and shall meet the requirements of authorities and to U.L, and CSA standards with regard to the type of assembly and fire separation.
- 3.17.4 Refer to articles on fire seals and firestopping submittals and project coordination in Division 01
- 3.18 **GROUNDING AND BONDING**
- 3.18.1 The whole of the installation covered by this specification shall be efficiently bonded back to the main switchboards through the metal sheathing of cables or thru a separate earthing conductor as indicated on drawings. The steel conduit, the trunking system and earth wires, all in accordance with the OESC and IEEE recommended practices. All prices shall be inclusive of the cost of this bonding.
- 3.18.2 All grounding installations, size of grounding conductors and bonding shall be in accordance with the OESC.
- 3.18.3 The grounding continuity of each metal sheathed cable shall be maintained by efficient bonding between the cable sheath, the gland and the metal case of switchgear or other metal-clad accessory or appliance at which the cable terminates.
- 3.18.4 All wires and cables shall be protected against mechanical stresses and corrosion.
- 3.18.5 All joints between wires and earthing metalwork shall be

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mechanically sound before soldering.

- 3.18.6 Where separate pieces of apparatus connected to different phase are, of necessity erected or positioned less than two meters apart, an equipotential bonding strip 2.5mm x 35mm tinned copper tape shall be installed between such pieces of apparatus.
- 3.18.7 The main earth electrode resistance shall be less than one ohm. If this value cannot be obtained by driving copper clad steel rods, the Contractor shall provide bore holes until the damp soil is reached for installation of rods. Provide additional Earthing electrodes to meet code requirements.
- 3.19 HOISTING AND MOVING
- 3.19.1 Carefully study the architectural and structural drawings with particular reference to the portions of the structure which are reinforced to withstand the forces applied during the transporting of heavy equipment across that structure.
- 3.19.2 Devise methods and schedules for the hoisting and transportation of equipment from grade to roof and then into the building, to ensure that no damage occurs to the structure, finish, or any other part of the building. Ensure that the schedule meets with the approval of the Construction Manager.
- 3.20 INSERTS, SLEEVES, AND ESCUTCHEONS
- 3.20.1 Supply, locate and set all inserts, anchor bolts and sleeves in time when walls, floors and roof are erected.
- 3.20.2 Use only factory made threaded or toggle type inserts, properly sized for the load to be carried.
- 3.20.3 Provide a dimensioned sleeving layout to the Construction Superintendent indicating sizes of sleeves and other structural openings.
- 3.20.4 Do all drilling for hangers, rods and inserts, etc., not placed at time of building erection. Do not use powder actuated tools, except on written permission by the Consultant.
- 3.20.5 Pipe sleeves shall be standard weight steel pipes, machine cut flush with finished structure.
- 3.20.6 Sleeves in waterproof floors shall extend in 102mm (4") above the floor (mechanical rooms, kitchens, etc.).

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- 3.20.7 Cover exposed sleeves in finished areas with satin finished chrome or stainless steel escutcheon plates with set screws.
- 3.20.8 Provide sleeves in below grade wall with waterproofing flange.
- 3.20.9 In mechanical rooms and on top of shafts the concrete division shall provide 102mm (4") high (minimum) concrete curbs.
- 3.20.10 Seal all unused sleeves and openings around conduits and ducts with resilient non combustible material. In waterproof sleeves provide additional silicon base seal.
- 3.20.11 Provide and install steel bumper guards around all piping, ductwork, etc., susceptible to being damaged.
- 3.20.12 All conduits, etc., which pierce quarry tile and/or ceramic tile must be sealed and made watertight.
- 3.21 INSTALLATIONS
- 3.21.1 All electrical wiring and cables shall be installed in conduit or approved electrical raceways in compliance with the OESC.
- 3.21.2 All work shall be executed in a professional manner and shall conform to the highest standards applicable.
- 3.21.3 Install equipment in accordance with the general arrangement drawings. Unless actual dimensions are indicated, take such dimensions from final reviewed shop drawings and at the site.
- 3.21.4 Coordinate with the type of concrete floors/slab construction including the finish concrete surface. Ensure co-ordination with relevant divisions for the installation of all electrical equipment to be installed under this Division is installed prior to the casting of concrete slabs.
- 3.21.5 Line up exposed conduit parallel or at right angles to building lines. Set, plumb and level equipment accurately, install hanger rods plumb and without offsets, install rows of fixtures accurately in line and level.
- 3.21.6 Flush-mount boxes, panels, cabinets and electrical devices in finished areas and provide suitable flush trims and doors or covers, unless specifically noted otherwise.
- 3.21.7 All areas shall be considered finished areas except the pump rooms, mechanical rooms, chiller yard, energy transfer station and

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areas exposed to weather.

3.21.8 The locations of switches, outlets and control devices are shown diagrammatically only. Mount switches and other controls as close to doorjambes and other openings as possible, maintaining a minimum of 100mm from trims of doors except where installed in doorframes of metal partitions. Ensure that these locations meet with the approval of the Engineer. Check all door swings and install switches on strike side of door. Mount to code requirements.

3.21.9 Where the location of any item is shown on the architectural details or elevations, this location shall govern. No change to the contract sum shall be allowed for the relocation of any equipment improperly installed because of the failure to check all such details prior to the installation of the equipment. Notify the Engineer where details differ.

3.22 MATERIALS, WORK AND SUPERVISION

3.22.1 It is a requirement of the specification that the finished appearance of the project in public areas is of a high architectural standard but not limited to all panels, covers, trim panels, finishes and the like shall be included to provide this required appearance to the satisfaction of the Engineer.

3.22.2 The whole of the equipment supplied shall be of proven design and of high class durable finish and suitable for installation in a modern building which will be subjected to excessively heavy usage.

3.22.3 The Contractor shall be responsible for ensuring that the components of each system are mutually compatible and integrated to form fully efficient systems complying with the Drawings and specifications.

3.22.4 All articles and materials specified to conform to CSA Standards shall be clearly and indelibly marked and stamped with the CSA Standard number specified and other details required by the regulations, except where marking is impracticable when the relevant advice/delivery notes shall include the CSA Standard number with which they are to comply.

3.22.5 All materials and work shall be to the satisfaction of the Engineer, particular attention shall be paid to a neat orderly well-arranged installation, carried out in a methodical competent manner.

3.22.6 The Contractor shall produce dimensional layout showing the exact

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location and elevation for the various outlets and shall be responsible to submit drawings/ proposed material in a format to the Engineer's instruction.

3.22.7 The Contractor shall maintain a competent supervising Engineer for the work on site throughout the whole of the time for the completion of the Contract. The Engineer shall give prior approval to the appointment of this supervising Engineer and shall have the authority to withdraw this approval at any time.

3.22.8 No person shall be allowed to execute any type of work, which is normally carried out by a skilled tradesperson unless he is thoroughly experienced and proficient in the trade concerned. The Engineer shall have the option to require a tradesperson to demonstrate their proficiency to the satisfaction of the Engineer.

3.23 TESTING AND COMMISSIONING ON SITE

3.23.1 Upon completion of the installation or part of the installation, the Contractor shall carry out and be responsible for the testing and commissioning all equipment and integral systems, in stages if required, to ensure that it is in proper working order and capable of performing all of its functions in accordance with the specification and to the satisfaction of the Engineer. Site Acceptance Testing inclusive of Individual System Testing, and Factory Acceptance Testing to the satisfaction of the commissioning authority and jurisdiction authority, shall be provided.

3.23.2 The Contractor shall be fully responsible for all equipment until each item of equipment or system or part thereof has been tested, commissioned and accepted by the Engineer.

3.23.3 Any equipment damaged in commissioning shall be replaced with new equipment by the Contractor at their own expense and the equipment or system concerned shall be re-tested and commissioned. No instruction or action of the Engineer shall relieve the Contractor of this responsibility.

3.23.4 The Contractor shall give to the Engineer in writing at least ten days' notice of the date after which he will be ready to make the specified tests on completion of installation. Unless otherwise agreed the tests shall take place within seven days after the said date on such day or days as the Engineer shall in writing notify the Contractor. The tests shall as far as possible be carried out under normal working conditions to the satisfaction of the Engineer and shall extend over such periods as he may direct.

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- 3.23.5 The Contractor shall provide all skilled labor, supervision, apparatus and instruments required for commissioning and testing and within a reasonable time thereafter furnish to the Engineer six certificates of all tests performed and accepted, signed by the Engineer, the Contractor and an authorized person acting on behalf of Local Authority Distribution Company, as prescribed in the appropriate Regulations and Specifications.
- 3.23.6 If any part of the equipment fails to pass the specified tests, further tests shall, if required by the Engineer, be repeated. The Contractor shall, without delay, put in hand such modifications as are necessary to meet the requirements as described in the Contract and any expense which the Employer may have incurred by reason of such further tests may be deducted from the Contract Price.
- 3.23.7 The Contractor shall include for submission of working drawings for the electrical installation to the Local Authority Distribution Company for approval and shall allow for the procurement of the Local Authority Distribution Company test certificate upon completion of the building following inspection of the electrical installation by Local Authority Distribution Company. Acceptance shall not in any way absolve the Contractor of their responsibility for the performance of the equipment after erection as a complete working system in all respects.
- 3.24 LOAD BALANCE
- 3.24.1 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.
- 3.24.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- 3.24.3 Submit, at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers and motor control centers, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.
- 3.25 LOCATION OF OUTLETS
- 3.25.1 Locate outlets in accordance with Division 01.
- 3.25.2 Do not install outlets back-to-back in wall; allow minimum 6"

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horizontal clearance between boxes.

3.25.3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3600mm (12'), and information is given before installation.

3.25.4 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.26 MANUFACTURERS AND CSA LABELS

3.26.1 Visible and legible after equipment is installed.

3.27 MECHANICAL EQUIPMENT AND WORK

3.27.1 Read together with Divisions 21, 22, 23, & 25 Mechanical and adhere to its requirements. Supply and install all electrical apparatus which is required and is not covered by Divisions 21, 22, 23, & 25 Mechanical.

3.27.2 Motors:

3.27.2.1 Supply and installation of all motors for electrical equipment will be by the Mechanical Contractor.

3.27.3 Except where noted otherwise, all motors will have the following characteristics:

3.27.3.1 1/2 HP and smaller, 120V, 1 PH, 60 Hz

3.27.3.2 1 HP and larger, 600V, 3 PH, 60 Hz

3.27.3.3 The Mechanical Contractor will submit an accurate schedule of all motors. Include for each motor, the HP, rpm, nameplate current, voltage, phase, equipment served, location, electrical characteristics and identification number. Schedule to be reviewed by Division 26 and the Consultant.

3.27.4 Contactors and Control Devices:

3.27.4.1 Supply and installation of all automatic devices controlling mechanical equipment supplied under the Mechanical Division will be by the Mechanical Contractor.

3.27.4.2 Mechanical Contractor shall provide all starters, contactors, MCC's etc., for all equipment supplied by Division 25 such as chillers,

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boilers, rooftop air conditioning, fans, pumps and heating units, electric reheat coils, etc., as specified in the respective section (See Motor Control Schedule). Division 26 Electrical shall provide disconnect switches for this equipment as required by code. Weatherproof switches shall be provided for all outdoor units.

3.28 MOTOR AND EQUIPMENT WIRING

3.28.1 Provide power wiring connection and, fittings external to all motors, machines, starters, control panels, etc., supplied under this and all other contracts except as noted herein. All line and load side wiring shall be by the Electrical Contractor.

3.28.2 Power wiring will include but not be limited to all raceways, conduits, lugs, fittings, disconnect switches, auxiliary devices for 3 phase 600 V, and 3 phase 208 V motors and 1 phase 240 V, 1 phase 208 V, and 1 phase 120 V motors. All wiring to be in accordance with the manufacturer's instructions.

3.28.3 All starters, motor control centres, etc., along with line and load side power wiring will be by the mechanical division. This also applied to the packaged units.

3.28.4 Packaged units will have integral starters and only power feeders need be provided. The packaged unit starters will be by Mechanical Contractor. The main disconnect switch will be provided by this contractor.

3.28.5 The equipment of the mechanical contract shall generally have all control wiring provided by that contract in accordance with the methods and materials specified under Division 216. Exceptions to this include equipment provided by this contract which must interface into the mechanical contract control circuit. This contract shall wire devices into the mechanical contract control circuit and co operate with Mechanical Contractor regarding testing, locations, etc. Examples of this interface include fire alarm systems interconnection, low voltage switching system interconnection, security system interconnection, etc.

3.28.6 Where control devices are line voltage, receive these devices from the Contractor providing that system, install all power wiring to the devices and install the devices.

3.28.7 The use of "lock off stop" devices will not be permitted. Provide disconnect switches for all motors that are 30' (9 m) or greater away from the motor starter or if the distance is less, provide

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disconnect switches for the motors where the motor starter is not visible.

3.28.8 All two (2) speed and delta wye motors shall have an adequate number of properly sized feeders between the starters and motors to allow for operation. Note that all remote disconnect switches located adjacent to 2 speed motors and delta wye shall be 6 pole with an auxiliary contact.

3.28.9 Control wiring shall be provided by this contract for the work of all contracts other than Division 15 contracts as noted on the drawings and called for herein. Control wiring includes the wiring of all control devices that are connected into control circuits of motor starters and into motor power feeders. Wiring shall be in accordance with manufacturers wiring diagrams and instructions. This includes production equipment, computer equipment, overhead doors, dock levelers, elevating docks, security systems, ASRS door controls, C.I.M. systems, etc.

3.28.10 Load side wiring for remote VFD and soft-start drives shall be provided by the Mechanical Contractor. Load side wiring for VFD's shall be drive RX type cable appropriately sized. Any disconnects provided on the load side of VFDs shall have auxiliary contacts interlocked with shunt trip of VFD.

3.28.11 Power for building automation or like control system panels shall be provided by this contractor. The drawing package will indicate a branch circuit and junction box in each mechanical area. This contractor shall provide wiring to the respective control panel locations as located by the controls contractor. Final connections are not indicated on the electrical drawings, however remain part of this contract.

3.29 MOUNTING HEIGHTS

3.29.1 Mounting height of equipment is from finished floor to centerline of equipment unless specified or indicated otherwise.

3.29.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

3.29.3 Refer to architectural drawings for mounting height of devices and equipment. Should there be a discrepancy between the mounting height noted in electrical and architectural construction documents, obtain clarification from the consultants prior to proceeding with the rough-ins.

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- 3.29.4 Mounting height of the control devices (ie. switches, thermostats, intercom, etc.) located in designated barrier-free spaces or the barrier-free path of travel shall conform to the requirement of OBC article 3.8.1.5 (1).
- 3.29.5 Install electrical equipment at following heights unless indicated otherwise:
 - 3.29.5.1 Local switches: 1,100 mm.
 - 3.29.6 Wall receptacles:
 - 3.29.6.1 General: 300mm.
 - 3.29.6.2 Above top of continuous baseboard heater: 150mm.
 - 3.29.6.3 Above top of counters or counter splash backs: 150mm.
 - 3.29.6.4 In mechanical rooms: 1200mm.
 - 3.29.6.5 Panelboards: as required by Code or as indicated.
 - 3.29.6.6 Telephone and interphone outlets: 300mm.
 - 3.29.6.7 Wall mounted telephone and interphone outlets: 1100mm.
 - 3.29.6.8 Television outlets: 305mm.
 - 3.29.6.9 Wall mounted speakers: 2100mm.
 - 3.29.6.10 Doorbell pushbuttons: 1100mm.
 - 3.29.7 Fire Alarm Devices:
 - 3.29.7.1 Mounting height of the fire alarm devices shall conform to the latest requirement of CAN/ULC-S524.
 - 3.29.7.2 Fire alarm manual pull stations: 1200mm and maximum 600mm from door latch.
 - 3.29.7.3 Wall mounted fire alarm speakers: Minimum 2300mm above the finished floor and at least 150mm below the ceiling.
 - 3.29.7.4 Wall mounted visual strobe lights: Mounted at not less than 2000mm and not more than 2400mm above the finished floor.
- 3.30 OCCUPANCY REQUIREMENTS FOR FINA: FULL AND PARTIAL OCCUPANCY OF AREAS

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- 3.30.1 The following are the Occupancy requirements for full and partial occupancy of areas.
- 3.30.2 Partial occupancy and occupancy will be provided as requirement for turnover of each phase or partial phase of work that has been completed and areas as required by the Owner in order to maintain function of the building and there operations. Warranties will be as per the signed contract.
- 3.30.3 The requirements below shall be completed two weeks prior to the scheduled turn over date and all required documentation shall be submitted to the Owner and the Consultant for review and comments. At a minimum the above must be submitted two week prior to the scheduled turn-over date.
- 3.30.4 Provide a copy of the ESA Hydro Completion and Final Clearance Certificate.
- 3.30.5 Provide a letter confirming that fire proofing has been installed in area(s) that are to be occupied.
- 3.30.6 Distribution Equipment labelling has been completed.
- 3.30.7 Staff trainings as well as required Practical Training have been completed to the Owners and that of the Consultants' requirements and satisfaction. Provide a list of Names of the Attendees.
- 3.30.8 Provide a letter confirming that the Labelling of Emergency Power Light Fixtures has been completed.
- 3.30.9 Submission of the Project Field Working and Record Drawings for the area(s) to be occupied has been completed and they have been reviewed and accepted.
- 3.30.10 Recording and provision of Fire Alarm System Hex address for the fire alarm system are shown on the Record Drawings and installed within the panels.
- 3.30.11 Provide a letter Panel schedules are typed confirming that the Emergency lighting has been tested and the light levels that are present meet Building Code Requirements.
- 3.30.12 Infrared Thermo Scan has been completed and test reports submitted for review – for modified or new electrical distribution equipment.

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- 3.30.13 Provision of Record Single Distribution Diagram(s) in main electrical and secondary electrical rooms that reflect the modifications to the Normal and Emergency Power distribution systems.
- 3.30.14 Short Circuit Protection & Coordination and Arc Flash Studies have been completed and submitted and been reviewed by the Electrical Consultant.
- 3.30.15 Provide a letter confirming that the power distribution for both Normal and Emergency - protection equipment has been adjusted to the setting as recommended in the coordination study for the normal and emergency distribution systems.
- 3.30.16 Provide a letter confirming that the Arc Flash Labelling has been installed on the Electrical Distribution Systems.
- 3.30.17 Lighting test reports for Emergency Lighting (including areas covered by Battery Units) have been submitted and meet Building Code Requirements.
- 3.30.18 Provide a completed Fire alarm verification report with no deficiencies. Should the Fire Alarm Vendor have recommendations regarding the system that do not affect the verification document this is to be submitted for review by means of a separate letter.
- 3.30.19 Conduct Audibility Test's for the fire alarm system and provide separate letter that audibility requirements have been met as per the Building Code Requirements.
- 3.30.20 Provide a letter confirming interface of fire alarm system to Security system completed and tested and is operating as per design and code requirements.
- 3.30.21 Provide a letter confirming interface of the fire alarm system to Mechanical equipment has been completed and tested and is operating as per the design and code requirements.
- 3.30.22 The Fire Alarm Graphic – Has been Reviewed by Local Fire Department and Accepted.
- 3.30.23 Provision of Temporary Fire Alarm Graphic as required to meeting the Phasing requirements of the Project.
- 3.30.24 Removal all temporary wiring.

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3.31 OPERATION AND MAINTENANCE MANUALS

- 3.31.1 Submit operation and maintenance manuals in accordance with Division 01.
- 3.31.2 Include the following information in the Operation and Maintenance manuals:
 - 3.31.2.1 Names and address of local suppliers for the items included.
 - 3.31.2.2 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 the installation.
 - 3.31.2.3 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.
 - 3.31.2.4 Review information provided in the maintenance instructions and manuals with the Owners' operating personnel to ensure a complete understanding of the electrical equipment and systems and their operation.

3.32 PERMITS, FEES, AND INSPECTION

- 3.32.1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- 3.32.2 Pay associated fees.
- 3.32.3 Consultant will provide drawings and specifications required by Electrical Inspection Department and Supply Authority at no cost. Drawings are to be submitted by the Electrical Contractor.
- 3.32.4 Notify Consultant of changes required by Electrical Inspection Department prior to making changes.
- 3.32.5 Furnish Certificates of Acceptance from Electrical Inspection Department authorities having jurisdiction on completion of work to Consultant.

3.33 PLYWOOD

- 3.33.1 Supply and install all plywood backboards required for the work of

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this Division. Plywood to be highest quality fire retardant fir, 1219mm (4'-0") wide x 2438mm (8'-0") high, 19mm (¾") thick unless otherwise specified. Prime and paint backboards on both sides with fire retardant paint, equal to CGSB Spec. #1-GP-151M, of a colour to match the equipment and services mounted thereon as defined in "Finishes" above.

3.34 PROGRESS PAYMENTS

- 3.34.1 Submit a complete breakdown of the Contract with each progress billing, indicating percentage of work complete, in a form acceptable to the Owner/Consultant.
- 3.34.2 The contractor shall provide a work breakdown structure to include an itemized list of work and associated cost structure for consultant review prior to the first billing.
- 3.34.3 The work breakdown separate supply and installation where material cost exceeds \$30,000.
- 3.34.4 Progress draw breakdowns shall include both dollar value and percentage value for the following: Contract Value, current billing, previous billing, and complete to date categories.
- 3.34.5 The contractor may claim a maximum of 95% against the supply category until such time as the system is installed and is fully functional.
- 3.34.6 Where indicated as a separate category, any systems requiring programming or manufacturer start-up shall be subject to a minimum 10% hold in addition to the above, until such time as the system is fully functional.
- 3.34.7 Where not indicated as a separate category, any systems requiring testing or test results shall be subject to a minimum 10% hold in addition to the above, until such time as the system is fully functional.

3.35 PROTECTION

- 3.35.1 Protect building and structure from damage due to carrying out this work.
- 3.35.2 Protect all electrical work from damage. Keep all equipment dry and clean at all times.
- 3.35.3 Cover all opening in equipment and materials.

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3.35.4 Be responsible for and make good any damage caused directly or indirectly to any walls, floors, ceilings, woodwork, brickwork, finishes, etc.

3.36 RECORD OF DRAWINGS

3.36.1 The Consultant will provide the Contractor with one (1) disk containing all drawings relating to the work of this Contract in AutoCAD format. The contractor shall clearly mark, as the job progresses, all changes and deviations from that shown on contract drawings. Drawings shall be kept up-to-date during construction and in addition to field measurements shall include variation orders, field instructions and all other changes. After inspection and approval of service lines in trenches, the contractor shall take as-built measurements, including all depths, prior to backfilling operations. It will not be sufficient to check off line locations. Definite measurements shall be taken for each service line. The location of buried duct banks, etc. shall be shown on the drawings from fixed points. On completion of the building, the contractor shall forward to the Consultant the two sets of drawings indicating all such changes and deviations for review. Include in the tender price, the cost for the production of CAD diskette record drawings by the Consultant's staff.

3.37 SHOP DRAWINGS

3.37.1 Refer to article on shop drawings in Division 01.

3.37.2 Shop drawings shall indicate clearly the materials and/or equipment actually being supplied, all details of construction, accurate dimensions, capacity, operating characteristics and performance. Each shop drawing shall give the identifying number of the specific piece of equipment etc. for which it was prepared (e.g. panel #2A).

3.37.3 Each shop drawing for non-catalogue items shall be prepared specifically for this project. Shop drawings and brochures for catalogue items shall be marked clearly to show the items being supplied.

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3.37.4 Each shop drawing or catalogue sheet shall be stamped and signed by the contractor to indicate that he has checked the drawing for conformance with all requirements of the drawings and specifications, that he has coordinated this equipment with other equipment to which it is attached and/or connected thereto and that he has verified all dimensions to ensure the proper installation of equipment within the available space and without interference with the work of other trades. Ensure that mechanical coordination is complete before submitting drawings for review.

3.37.5 Installation of any equipment shall not start until after final review of shop drawings has been obtained.

3.37.6 When requested, shop drawings shall be supplemented by data explaining the theory of operation.

3.37.7 The General Requirements Division shall apply except as amended above.

3.38 SINGLE LINE ELECTRICAL DIAGRAMS

3.38.1 Provide single line electrical diagrams under plexiglass as follows:

3.38.1.1 Electrical distribution system: locate in main electrical room.

3.38.1.2 Electrical power generation and distribution systems: locate in power plant rooms.

3.38.1.3 Provide fire alarm riser diagram, plan and zoning of building under plexiglass at fire alarm control panel and annunciator.

3.38.1.4 Drawings: 610mm x 610mm (2' x 2') minimum size.

3.39 TEMPORARY SERVICES

3.39.1 Temporary electrical service shall be provided by Division 26 unless otherwise noted. Coordinate with General Contractor for further detail.

3.39.2 Do not use any of the permanent electrical systems during construction, unless specific written approval is obtained from the Consultant or unless allowed elsewhere in the contract documents.

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3.39.4 The use of permanent facilities for temporary construction service shall not affect in any way the commencement period in which correction after completion is the Contractor's responsibility. Such period will commence only when the overall project is completed and certificates are issued.

3.40 VALUATION OF CHANGES

3.40.1 Refer to and conform to the requirements set out in Division 01 and Electrical Tender Form.

3.40.2 Submissions will be scrutinized by the Consultant and therefore require complete detailed itemization of all material, labour, unit prices and overhead and profit mark-ups.

3.41 WORK ASSOCIATED WITH OTHER TRADES OR PARTIES

3.41.1 Some works and/or provisions associated with the Electrical Services shall be performed by other trades or parties. Liaise and co-ordinate with other trades to ensure that all requirements are provided as required for the completeness and proper operation of the equipment or system.

3.42 TAGS AND DIRECTORY

3.42.1 After finished painting is completed, identify each main feeder cable and conduit service. Locate identification:

3.42.1.1 Behind each access door.

3.42.1.2 At each change of direction and at junction boxes.

3.42.1.3 At not more than 12 meters (40') apart in straight runs of exposed conduit, but on both sides of sleeves.

3.42.1.4 At not more than 12 meters (40') apart in straight runs of conduit behind removable enclosures such as lay in type ceiling, cut on both sides of sleeves.

3.42.1.5 Use stencils and stencil paint or use lamacoid plates on all conduit and ductwork.

3.42.1.6 Use letters of minimum 25mm (1") high.

3.42.1.7 The identification shall describe system voltage and services; e.g. "120/208 Volt lighting fed from panel 2A".

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- 3.42.2 Conduits and outlet boxes for the various systems shall be identified by the use of distinctive colour paints. Identification of raceways shall consist of painted junction box covers and pointed conduit couplings. The following colours shall be used:
 - 3.42.2.1 120/208 Volt System – Orange
 - 3.42.2.2 600 Volt System – Blue
 - 3.42.2.3 Telephone Conduit System – Green
 - 3.42.2.4 Intercom and Low Voltage Signal Systems – Black
 - 3.42.2.5 Emergency System – Yellow
 - 3.42.2.6 Fire Alarm System – Red
- 3.42.3 All high voltage raceways shall be labelled "DANGER 13.8 kV" in accordance with OESC, at 3' (3 m) intervals along raceway.
- 3.42.4 Have the manufacturers nameplate affixed to each item of all equipment showing the size, name of equipment, serial number and all information usually provided, including voltage, frequency, # of phases, horsepower, etc., and the name of the manufacturer and their address. Ensure that all stamped, etched and engraved lettering on plates is perfectly legible. Ensure that nameplates are not painted over. Where apparatus is to be concealed, attach the nameplate in an approved location on the equipment support or frame.
- 3.42.5 Identify all equipment with the corresponding remote controls.
- 3.42.6 Ensure that panels and other apparatus which have exposed faces in finished areas do not have any visible trademarks or other identifying symbols. Mount nameplates behind doors.
- 3.42.7 All outlet boxes provided in the ceiling space for future lighting and/or power connections shall be identified on the box cover with brady self-sticking markers indicating circuits contained in the box.
- 3.43 TRIAL USAGE AND INSTRUCTION TO OWNER
 - 3.43.1 The Owner has the privilege of the trial usage of electrical systems or parts thereof for the purpose of testing and learning the operational procedures.
 - 3.43.2 Carry out the trial usage over a length of time as deemed

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reasonable by the Consultant at no extra cost.

- 3.43.3 Carry out the operations only with the express knowledge and under supervision of the construction manager who shall not waive any responsibility because of the trial usage.
- 3.43.4 Trial usage shall not be construed as acceptance by the Owner.
- 3.43.5 Instruct the Owner's representative in all aspects of the operation of systems and equipment.
- 3.43.6 Arrange for and pay for services of service engineers and other manufacturer's representatives required for instruction on specialized portions of the installation.
- 3.43.7 Submit to the Consultant at the time of final inspection, a complete list of systems stating for each system.
- 3.43.8 Date instructions were given to the Owner's staff.
- 3.43.9 Duration of instruction.
- 3.43.10 Name of persons instructed.
- 3.43.11 Other parties present (manufacturer's representative, Consultants, etc.).
- 3.43.12 Signature of the Owner's representatives stating that they properly understood the system installation, operating and maintenance requirements.

3.44 VIBRATION ISOLATION

- 3.44.1 Provide vibration isolation control as necessary so as to prevent transmission of objectionable vibration to the building structure, and from one area to another.
- 3.44.2 Provide all steel bases and concrete inertia pads. Install all bases to clear the sub-base (housekeeping pads) by minimum 25mm (1") for steel bases, and 50mm (2") for concrete bases.
- 3.44.3 All floor mounted equipment shall be erected on 102mm (4") high reinforced concrete pads. Concrete pads shall be of similar dimensions to that of the foot print of the equipment. Wherever vibrations eliminating devices and/or concrete inertia blocks are specified, these items shall, in all cases, be mounted upon the 102mm (4") high reinforced concrete pads; unless specified to the

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contrary.

3.44.4 All concrete foundations and supports shall be provided by this division. This contractor shall provide dimensioned drawings and details of all such work required and shall submit same to the Consultant for approval.

3.45 FLASHING

3.45.1 Provide galvanized or aluminum sleeves for piping through roof.

3.45.2 Ensure that the flashing suits roof and extends minimum 450mm (18") on all sides. Leave flashing as directed by the Contractor, to be built into roofing, rendering a watertight connection.

3.45.3 Provide counter flashing on diesel and boiler exhaust stacks, ducts, and pipes passing through roofs to fit over flashing or curb. Coordinate with Roofing Contractor.

3.46 WARNING SIGNS

3.46.1 As specified and to meet requirements of Electrical Inspection Department, Local Authority and Consultant.

3.46.2 Decal signs, minimum size 175mm x 250mm (8" x 10").

3.47 VOLTAGE RATINGS

3.47.1 Operating voltages: to CAN3-C235-83.

3.47.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment

3.48 WORK

3.48.1 Install conduits and pipes parallel and perpendicular to the building planes and concealed in chases, behind furring or above ceiling, except in unfinished areas. Install all exposed systems neatly and grouped together, to present a neat appearance.

3.48.2 Install meters and switches to permit easy reading.

3.48.3 Install all equipment and apparatus requiring maintenance, adjustment or replacement with sufficient clearance for servicing.

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- 3.48.4 Install control devices to guarantee proper sensing. Shield element from direct radiation and avoid placing them behind any obstruction.
- 3.48.5 Include in the work all requirements of the manufacturer and as shown on the shop drawings.
- 3.48.6 Replace any work unsatisfactory to the Consultant/Owner without extra cost.

END OF SECTION

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Section Name: **Backboards**
Section No.: **26 05 15**
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1 **GENERAL**

1.1 GENERAL

1.1.1 Provide plywood backboards for mounting of all electrical, telecommunications, and security equipment unless noted otherwise on the drawings.

2 **PRODUCTS**

2.1 BACKBOARDS

2.1.1 Construct plywood backboards from 19mm thick fir plywood, good one (1) side.

2.1.2 Use fire retardant backboards, pressure impregnated with fire retardant chemicals, and stamp.

2.1.3 Conform to CSA 080.

3 **EXECUTION**

3.1 INSTALLATION

3.1.1 Construct each backboard in a rectangular shape of the size as indicated. Where no size is indicated, provide a backboard minimum 100mm wider and 100mm higher than the equipment. Where more than one (1) 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.

3.1.2 Fastenings:

3.1.3 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.

3.1.4 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.

3.1.5 Install fastenings a maximum 500mm apart in both the vertical and horizontal directions.

3.1.6 When installing equipment heavier than 50kg, fasten the

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equipment through the backboard directly to the wall or support structure.

END OF SECTION

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Section No.: **26 05 19**
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1 **GENERAL**

1.1 REFERENCE

1.1.1 Comply with the requirements of Section 26 05 01 Common Work Results – Electrical.

1.1.2 Section 26 05 24 – Wiring Methods.

1.1.3 Conform to relevant sections of specifications for this and other Divisions.

1.2 PRODUCT DATA

1.2.1 Submit product data in accordance with Section 26 05 01 Common Work Results – Electrical.

1.3 STANDARDS

1.3.1 TECK 90 cables to CSA Standard C22.2 No.131-M89.

1.3.2 Thermostat Insulated Wires and Cables to CSA Standard C22.2 No. 38-M1986.

1.3.3 Armoured Cable to CAN/CSA-C22.2 No. 51-M89.

1.3.4 Thermoplastic Insulated Wires and Cables to CSA Standard C22.2 No. 75- M1983 (R1992).

1.3.5 All cables installed in areas requiring fire rating shall conform to test FT-4.

1.3.6 All cables installed in spaces designated as a return air plenum shall conform to test FT 6 or be installed in continuous conduit system.

2 **PRODUCTS**

2.1 BUILDING WIRES

2.1.1 Conductors

2.1.1.1 Copper conductors, of the size as indicated, having a minimum conductivity of 98 percent.

2.1.1.2 Stranded copper conductors shall be provided for all wires sizes with ampacity greater than #8 AWG.

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- 2.1.1.3 The minimum wiring size that shall be permitted for this project is No. 12 AWG.
- 2.1.1.4 Conductors shall be minimum No. 12 AWG, size conductor for maximum 2% voltage drop to the furthest outlet on a fully loaded branch circuit.
- 2.1.1.5 The following shall be used with respect to branch circuit wire sizing for voltage drop from the circuits associated panel board:
 - 2.1.1.5.1 Conductors shall be minimum No. 12 AWG for maximum 2% voltage drop to the furthest outlet/load on a fully loaded branch circuit, where circuit is 20m in length.
 - 2.1.1.5.2 Conductors shall be minimum No. 10 AWG for maximum 2% voltage drop to the furthest outlet/load on a fully loaded branch circuit, where the circuit is less than 30m in length but more than or equal to 20m in length.
 - 2.1.1.5.3 Conductors shall be minimum No. 8 AWG for maximum 2% voltage drop to the furthest outlet/load on a fully loaded branch circuit, where the circuit is less than 45m in length but more than or equal to 30m in length.
 - 2.1.1.5.4 Conductors shall be minimum No. 6 AWG for maximum 2% voltage drop to the furthest outlet/load on a fully loaded branch circuit, where the circuit is less than 60m in length but more than or equal to 45m in length.
- 2.1.1.6 The Electrical Contractor shall up-size feeder and branch circuit wiring and associated conduit as required to meet the requirements of the code with respect to acceptable voltage drop.
- 2.1.2 Insulation
 - 2.1.2.1 RW90 is specified for use throughout. RW90 cable shall have thermosetting polyethylene insulation rated at a minimum of 300V for 120/208V wiring and 600V for 347/600V wiring.
- 2.1.3 Colour Coding:
 - 2.1.3.1 120/208V circuits:
 - 2.1.3.1.1 Two conductor, 1 phase: 1 black, 1 white
 - 2.1.3.1.2 Three conductor, 1 phase: 1 red, 1 black, 1 white

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- 2.1.3.1.3 Three conductor, 3 phase: 1 red, 1 black 1 blue
- 2.1.3.1.4 Four conductor, 3 phase: 1 red, 1 black, 1 blue, 1 white
- 2.1.3.1.5 Ground wires: Green
- 2.1.3.2 347/600V, circuits:
 - 2.1.3.2.1 Two conductor, 1 phase: 1 orange, 1 white
 - 2.1.3.2.2 Three conductor, 1 phase: 1 orange, 1 brown, 1 white
 - 2.1.3.2.3 Three conductor, 3 phase: 1 orange, 1 brown, 1 yellow
 - 2.1.3.2.4 Four conductor, 3 phase: 1 orange, 1 brown, 1 yellow, 1 white
 - 2.1.3.2.5 Ground wires: Green
- 2.1.4 Manufacturers:
 - 2.1.4.1 Acceptable manufacturers are:
 - 2.1.4.1.1 Canada Wire and Cable Limited
 - 2.1.4.1.2 General Cable
 - 2.1.4.1.3 SouthWire
 - 2.1.4.1.4 Nexans
- 2.2 TYPE TECK 90 CABLE
 - 2.2.1 Conductors
 - 2.2.1.1 Copper conductors shall be of the sizes indicated, having a minimum conductivity of 98 percent.
 - 2.2.1.2 Each cable shall have a grounding conductor.
 - 2.2.2 Insulation
 - 2.2.2.1 Chemically cross-linked thermosetting polyethylene insulation rated at a minimum of 1000V, type RW 90.
 - 2.2.3 Inner jacket
 - 2.2.3.1 Polyvinyl chloride inner jacket.

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- 2.2.4 Armour
 - 2.2.4.1 Interlocking aluminum armour.
- 2.2.5 Overall jacket
 - 2.2.5.1 Thermoplastic polyvinyl chloride LFS/LGE overall jacket for fire protection and low acid gas evolution, meeting the requirements of the Vertical Tray Fire Test to CSA Standard C22.2 No. 0.3-92 with a maximum flow travel of 1200 mm. (Conform to FT4).
- 2.2.6 Fastenings
 - 2.2.6.1 One hole malleable iron straps to secure surface mounted cables.
 - 2.2.6.2 12-gauge galvanized steel channel type supports for two or more cables at 1500 mm centres.
 - 2.2.6.3 1/4" diameter threaded rods to support the suspended channels.
- 2.2.7 Connectors
 - 2.2.7.1 Watertight TECK connectors, T & B series 10464 and 10470.
- 2.2.8 Manufacturers
 - 2.2.8.1 Acceptable manufacturers are:
 - 2.2.8.1.1 Nexans;
 - 2.2.8.1.2 General Cable;
 - 2.2.8.2 Southwire;
 - 2.2.8.3 United Wire and Cable.
- 2.3 ARMOURED CABLES
 - 2.3.1 AC90 Cable:
 - 2.3.1.1 Conductors: Copper conductors, of the sizes as indicated, having a minimum conductivity of 98%.
 - 2.3.1.2 Insulation: Chemically cross-linked thermosetting polyethylene insulation rated at a minimum of 600 V.
 - 2.3.1.3 Armour: Interlocking armour fabricated from aluminum strip.

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2.3.1.4 Shall be provided with an integral insulated ground wire.

2.3.1.5 Colour Coding:

2.3.1.5.1 2 conductor, 1 phase: 1 black, 1 white

2.3.1.5.2 3 conductor, 1 phase: 1 black, 1 red, 1 white

2.3.1.5.3 Ground wire: green

2.4 MINERAL-INSULATED CABLES

2.4.1 Conductors: Solid bare soft-annealed copper conductors, of the sizes as indicated.

2.4.2 Insulation Compressed powdered magnesium oxide insulation to form a compact homogeneous mass throughout the entire length of the cable.

2.4.3 Sheath:

2.4.3.1 An annealed seamless copper sheath, Type MI, rated 600 V, 250 C.

2.4.3.2 Termination Kits: Provide copper termination kits at each end of each cable.

2.4.4 Manufacturers: Acceptable manufacturers for MI cable are:

2.4.4.1 Pyrotenax of Canada Limited.

2.5 CONTROL CABLES

2.5.1 300V control cable: Stranded annealed copper conductors sized as indicated, with TWH thermoplastic insulation with a shielding of 100% coverage of aluminum polyester tape and drain wire over each group and overall conductors, and an overall jacket of PVC.

2.5.2 300V cables shall conform to CSA standards CAN 3-C21.2 M86.

2.5.3 Custom control cables shall be designed and assembled in the configurations as indicated.

2.5.4 Each conductor shall be black and number coded, pairs shall be black and white and number coded.

2.5.5 Manufacturers: Acceptable manufacturers are:

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2.5.5.1 Nexans

2.5.5.2 General Cable

2.5.5.3 Southwire

2.5.5.4 United Wire and Cable

2.5.5.5 Delco

2.5.5.6 Belden

2.6 DRIVE RX CABLES FOR VARIABLE FREQUENCY DRIVES (VFD) APPLICATIONS

2.6.1 All Variable Frequency Drives both unit and remote mounted shall use Drive RX cables between the VFD unit and the motor served by the VFD.

2.6.1.1 Drive RX cables shall be copper conductor with 1000 volt insulation rating and include three grounds and have an aluminum sheath continuously corrugated and have a PVC jacket.

2.6.1.2 Drive Rx cabling shall comply with C.S.A. Standard C22.2 No. 123-96 (R001).

2.6.2 Manufacturers: Acceptable manufacturers are:

2.6.2.1.1 Nexans

3 **EXECUTION**

3.1 INSTALLATION

3.1.1 Install grounding, grounded and neutral conductors without any fuses, switches or breakers of any kind unless otherwise indicated.

3.1.2 Ground the grounded or neutral conductor at the source of supply as indicated and isolate the grounded or neutral conductor at all other locations.

3.1.3 Do not use any grounded or neutral conductors as a grounding conductor.

3.1.4 Do not use any grounding conductor as a grounded or neutral conductor.

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- 3.1.5 Do not splice any wiring in any raceway. Make splices only at junction boxes.
- 3.1.6 Provide sufficient slack at the connection points of conductors to permit proper connections to be made.
- 3.1.7 Do not install any conductors in any raceway until the raceway is complete and cleared of all obstructions.
- 3.1.8 Install all conductors in any one conduit at the same time taking care not to twist the conductors.
- 3.1.9 Use wire pulling lubricants that will not shorten the life of the insulation.
- 3.1.10 Do not install any wires or cables at temperatures above or below those which will cause damage to the wires or cables.
- 3.2 INSTALLATION OF BUILDING WIRES
- 3.2.1 Install wiring as follows:
 - 3.2.1.1 In conduit systems in accordance with Section 26 05 34.
- 3.3 INSTALLATION OF TECK 90 1000 V
- 3.3.1 Install cables as indicated.
- 3.3.2 Group cables wherever possible on channels.
- 3.3.3 Terminate cables in accordance with Section 26 05 20.
- 3.4 INSTALLATION OF ARMOURED CABLE
- 3.4.1 Group cables wherever possible.
- 3.4.2 Terminate cables in accordance with Section 26 05 20.
- 3.4.3 Shall only be permitted for the final connection to light fixtures and the length of the drop shall not exceed 3 meters. BX shall not be permitted for any other use on this project.
- 3.5 INSTALLATION OF MINERAL INSULATED CABLE
- 3.5.1 Install cable exposed, as indicated securely supported by stainless steel straps. Strap cable every 4 feet along the length of the cable with stainless steel straps.

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- 3.5.2 Make cable terminations by using factory-made kits.
- 3.5.3 At cable terminations use thermoplastic sleeving over bare conductors.
- 3.5.4 Where cables are embedded in cast concrete or masonry, provide a sleeve for the entry or exit of cables.
- 3.5.5 Do not splice the cables.

END OF SECTION

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Section Name: **Wiring and Box Connectors**
Section No.: **26 05 20**
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1 **GENERAL**

1.1 REFERENCES AND RELATED SECTIONS

- 1.1.1 Comply with the requirements of Section 26 05 01 Common Work Results – Electrical.
- 1.1.2 Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.
- 1.1.3 Section 26 05 24 – Wiring Methods.
- 1.1.4 Section 26 05 33.16 – Boxes for Electrical Systems.
- 1.1.5 CSA C22.2No.65-1956 (R1965) Wire Connectors.
- 1.1.6 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

2 **PRODUCTS**

2.1 MATERIALS - GENERAL

- 2.1.1 Provide pressure type wire connectors with current carrying parts of copper sized to fit copper conductors as required.
- 2.1.2 Provide fixture type splicing connectors with current carrying parts of copper sized to fit copper conductors #10 AWG or less.
- 2.1.3 Provide bushing stud connectors in accordance with EEMAC 1Y-2-1961 to consist of:
 - 2.1.3.1 A connector body and a stud clamp for stranded copper conductors.
 - 2.1.3.2 A clamp for stranded copper conductors
 - 2.1.3.3 Stud clamp bolts as required.
 - 2.1.3.4 Bolts for the copper conductors.
 - 2.1.3.5 Sized for the conductors as indicated.
- 2.1.4 Pressure type wire connectors are to be manufactured to CSA C2.22 No. 65. Clamps and connectors are to be manufactured to CSA C22.2 No. 18.

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- 2.1.5 Building wire connectors shall be:
 - 2.1.5.1 For wire sizes up to #6 AWG – Ideal “Wing Nut”.
 - 2.1.5.2 For wire sizes #4 and larger:
 - 2.1.5.2.1 End to end splices – Burndy US
 - 2.1.5.2.2 Parallel splices – Burndy UC
 - 2.1.6 At studs and bus bars – Burndy QQA (CU/AL)
 - 2.1.7 Two or three conductors in parallel – Burndy Q2A or Q3Q (CU/AL).
 - 2.1.8 Cable connectors shall be:
 - 2.1.8.1 For armoured TECK cables, watertight type, with open compounded head – T & B series “Spin-on 2” with corrosion resistant boot.
 - 2.1.8.2 For armoured cables and steel type with nylon insulated throat – T & B “Tite-Bite”.
 - 2.1.8.3 Clamps or connectors for armoured cable, mineral insulated cable, flexible conduit, non-metallic sheathed cable shall be as required.
- 2.2 STANDARD FIXED SPRING TYPE CONNECTORS
 - 2.2.1 Body constructed of polypropylene rated to 105°C. Body shall be wing type. Body shall be threaded to guide wiring to springs. Barrel end shall be long enough to cover bare end of conductors. Body shall be colour coded to indicate size.
 - 2.2.2 Inner spring shall be rated for copper conductors up to 600V. Inner spring shall be designed to reduce corrosion. The spring shall expand to compress the connection.
 - 2.2.3 Manufacturer:
 - 2.2.4 Thomas and Betts Marrette Type II Winged;
 - 2.2.5 Ideal Industries.
- 2.3 VABRATION RESISTANT AND HIGH TEMPERATURE SLEEVE & SCREW TYPE CONNECTORS
 - 2.3.1 Insulator body constructed of rugged phynolic material rated to

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150°C. Insulator cap to mechanically lock securely in place to safeguard against loosening from vibrations.

2.3.2 Insert sleeve and set screw shall be corrosion resistant brass; rated for copper conductors up to 600V. Insert sleeve and set screw shall provide a positive pressure type connection resistant to vibrations and heating cycles.

2.3.3 Manufacturer:

2.3.3.1 Thomas and Betts Marrette Set Screw Vibration Proof/Visible Connection;

2.3.3.2 Ideal Industries.

2.4 WEATHERPROOF FIXED SPRING TYPE CONNECTORS

2.4.1 Body constructed of polypropylene rated to 105°C. Body shall be wing type. Body shall be threaded to guide wiring to springs. Barrel end shall be long enough to cover bare end of conductors. Body shall be colour coded to indicate size.

2.4.2 Inner spring shall be rated for copper conductors up to 600V. Inner spring shall be designed to reduce corrosion. The spring shall expand to compress the connection.

2.4.3 Pre-filled with silicone-based sealant to prevent corrosion. Suitable interior and exterior wet and damp location installations.

2.4.4 Manufacturer:

2.4.4.1 Ideal Industries Weatherproof Wire Connector

2.5 MECHANICAL WIRE CONNECTORS

2.5.1 Tin-plated, cast copper body made from corrosion resistant high strength copper alloy. Serrated barrel for high pull out strength. Barrel to have inspection window to ensure good connection.

2.5.2 Part number and conductor range to be stamped on the connector.

2.5.3 Plated steel hex socket set screw to provide durable electrical contact.

2.5.4 Two hole lugs only where a tong is required.

2.5.5 Rated for copper conductors up to 600V and 90°C.

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2.5.6 Manufacturer:

2.5.6.1 Panduit – Pan-Lug Cast Copper Connectors;

2.5.6.2 Blackburn.

2.6 COMPRESSION WIRE CONNECTORS

2.6.1 Long barrel made from seamless, high conductivity copper tubing, electro tin-plated and burnished to inhibit corrosion. Barrel to have inspection window to ensure good connection.

2.6.2 Colour coded with and stamped to indicate proper crimping die size.

2.6.3 Two hole lugs only where a tong is required.

2.6.4 Rated for copper conductors up to 35KV and 90°C.

2.6.5 Manufacturer:

2.6.5.1 Panduit – Pan-Lug Compression Connectors;

2.6.5.2 Blackburn.

2.7 MECHANICAL LUGS

2.7.1 Solid, high strength, extruded aluminum alloy body, electro tin-plated for corrosion resistance. Inspection window for visible assurance.

2.7.2 Plated steel hex set screw for durable electrical connection.

2.7.3 Part number and conductor range to be stamped on the connector.

2.7.4 Two hole mounting only where a tong is required and mounting pace permits.

2.7.5 Dual rated for copper and aluminum conductors up to 600V and 90°C.

2.7.6 Compatible with equipment to be used with.

2.7.7 Manufacturer:

2.7.7.1 Panduit – Pan-Lug Aluminum Mechanical Connectors

2.7.7.2 Blackburn

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2.8 INSULATED BUTT (HYPRESS) SPLICE

2.8.1 Tinned copper barrel with brazed seam. Barrel to have wire stop to ensure proper insertion length.

2.8.2 Vinyl insulation with expanded wire entry. Colour coded and printed with conductor range.

2.8.3 Rated for up to 600V and 105°C.

2.8.4 Manufacturer:

2.8.4.1 Panduit – Pan-Term Butt Splice.

2.8.4.2 Blackburn

3 **EXECUTION**

3.1 USAGE

3.1.1 Standard Fixed Spring Type Connectors:

3.1.1.1 General purpose wire connections in junction boxes or electrical equipment

3.1.1.2 Indoor dry Locations only.

3.1.1.3 Where vibration is not a concern.

3.1.1.4 Wire sized: #14 - #12 AWG

3.1.2 Vibration Resistant And High Temperature Sleeve & Screw Type Connectors:

3.1.2.1 General purpose wire connections, motor connections, small transformers, vibrating equipment, in junction boxes or electrical equipment

3.1.2.2 Indoor dry locations only.

3.1.2.3 For connection of vibrating equipment, motors, small transformers, etc.

3.1.2.4 Wire sized: #14 - #10 AWG

3.1.3 Weatherproof Fixed Spring Type Connectors:

3.1.3.1 General purpose wire connections in junction boxes or electrical

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- equipment.
- 3.1.3.2 Indoor and outdoor damp and wet locations.
- 3.1.3.3 For all outdoor connections, site lighting, building lighting, parking gates, etc.
- 3.1.3.4 Wire sized: #14 - #10 AWG
- 3.1.4 Mechanical Wire Connectors:
 - 3.1.4.1 General purpose wire connections in junction boxes or electrical equipment for large electrical loads.
 - 3.1.4.2 Provide appropriate insulator and / or waterproof jacket as required.
 - 3.1.4.3 Provide copper bus bars, insulators, and mounting hardware as required to arrange connections in electrical junction boxes.
 - 3.1.4.4 Wire sizes: #8 - #1 AWG
- 3.1.5 Compression Wire Connectors:
 - 3.1.5.1 General purpose wire connections in junction boxes or electrical equipment for large electrical loads.
 - 3.1.5.2 Provide appropriate insulator and / or waterproof jacket as required.
 - 3.1.5.3 Provide copper bus bars, insulators, and mounting hardware as required to arrange connections in electrical junction boxes.
 - 3.1.5.4 Wire sizes: #6 AWG - #750 MCM.
- 3.1.6 Mechanical Lugs:
 - 3.1.6.1 Wire connections to distribution equipment.
 - 3.1.6.2 Select product to suit distribution equipment, conductor sizes, and clearances.
 - 3.1.6.3 Apply a coat of zinc joint compound on the aluminum conductors prior to the installation of the connectors.
 - 3.1.6.4 Provide all accessories for mounting in distribution equipment.
 - 3.1.6.5 Wire sizes: #6 AWG - #750 MCM.

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3.2 INSTALLATION

- 3.2.1 Remove insulation carefully from ends of conductors and:
- 3.2.1.1 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.
- 3.2.1.2 Install fixture type connectors and tighten. Replace insulating cap.
- 3.2.1.3 Install bushing stud connectors in accordance with EEMAC 1Y-2.

END OF SECTION

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Section Name: **Connectors & Terminations**
Section No.: **26 05 22**
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1 **GENERAL**

1.1 RELATED SECTIONS

1.1.1 Section 26 05 01 – Common Work Results – Electrical.

1.1.2 Conform to relevant sections of specification for this and other Divisions.

1.2 INSPECTION

1.2.1 Obtain inspection certificate of compliance covering high voltage stress coning from the Inspection Authority Engineer and include it with as-built drawings and maintenance manuals.

2 **PRODUCTS**

2.1 CONNECTORS AND TERMINATIONS

2.1.1 Copper compression connectors as required sized for conductors.

2.1.2 Contact aid for aluminum cables where applicable.

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.

END OF SECTION

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Section No.: **26 05 24**
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1 **GENERAL**

1.1 REFERENCES AND RELATED SECTIONS

- 1.1.1 Section 26 05 01 – Common Work Results - Electrical.
- 1.1.2 Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.
- 1.1.3 Section 26 05 20 - Wire & Box Connectors (0 – 1000 VOLTS).
- 1.1.4 Section 26 05 32 - Outlet Boxes, Conduit Boxes & Fittings.
- 1.1.5 Section 26 05 33.16 – Boxes for Electrical Systems
- 1.1.6 Section 26 05 34 - Conduits, Conduit Fastenings & Conduit Fittings.
- 1.1.7 Conform to relevant sections of specification for this and other Divisions.

2 **PRODUCTS**

2.1 NIL

3 **EXECUTION**

3.1 GENERAL

3.1.1 The wiring method, final connection, and mounting shall be proposed by the Contractor and submitted in writing for each installation type. Unless noted otherwise or to suit particular site conditions, the methods noted in this specifications section shall be considered the minimum standard.

3.1.2 General: All wiring shall be recessed when located in finished areas. Surface mounted wiring may be used in mechanical rooms, service spaces. Provide protection to conduits which may be subject to mechanical damage.

3.2 120/208V DISTRIBUTION & 120/208V LIGHTING

- 3.2.1 Wire in conduit for all feeders and feeds to mechanical equipment.
- 3.2.2 Wire in conduit for power branch circuits.
- 3.2.3 Wire and conduit shall be provided for all services for this project.

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- 3.2.4 Wire in conduit for lighting circuits. Final drops to luminaires may be made with Type AC90 cable or wire in conduit. No runs of type AC90 cable shall exceed 3 meters in length. AC90 where used shall be provided with an integral insulated ground wire.
- 3.2.5 Final connection to motors and transformer susceptible to vibration shall be made in flexible conduit.
- 3.2.6 Wire in conduit for dimming systems.
- 3.2.7 Provide spare boxes for emergency lighting fixtures that maybe required by Building Inspector.
- 3.2.8 Provide all power wiring to Millwork.
- 3.2.9 Provide separate minimum No. 12 AWG insulated green ground wire in all conduit runs.
- 3.2.10 Provide a separate No. 10 AWG neutral wire for all circuits.
- 3.3 347/600V DISTRIBUTION
- 3.3.1 Wire in conduit for all feeders and feeds to mechanical equipment.
- 3.3.2 Wire in conduit for power branch circuits.
- 3.3.3 Provide separate minimum No. 12 AWG green insulated ground wire in all conduit and runs.
- 3.3.4 Final connection to motors and transformer susceptible to vibration shall be made in flexible conduit.
- 3.4 FEEDERS 600V & 120/208V
- 3.4.1 Wire in conduit for all feeders.
- 3.4.2 Where specifically noted in the electrical documents, use of armoured cables of the type noted will be acceptable.
- 3.4.3 Each feeder shall be complete with a ground wire, sized as per Code.
- 3.5 VERTICAL RISER CABLE INSTALLATIONS
- 3.5.1 Provide supports for riser cables installed in vertical manner in accordance with OESC Article 12-120. Provide cable pullbox and strain-relief for cable support at intervals as required by the article.

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Where the riser cables are installed in inaccessible shaft or within concrete structure, provide access panels at all pullbox and strain-relief locations. Where provision of such accessible installation cannot be accommodated, the Contractor shall use self-supporting vertical riser cables specifically designed for such installations without intermediate supports.

3.6 FIRE ALARM SYSTEM WIRING

- 3.6.1.1 Wire in conduit with the approved fire rating as per authorities having jurisdiction.
- 3.6.1.2 Wiring for fire alarm system shall conform to the requirements of CAN/ULC-S524.
- 3.6.1.3 Provide flexible connections to supervised valves, pressure switches, flow switches, smoke dampers, and mechanical equipment. Use of flexible armoured conduits or flexible liquid-tight conduits will be acceptable.

3.7 TELEPHONE & DATA COMMUNICATIONS SYSTEMS

- 3.7.1 Provide blank coverplates on existing outlets as noted on drawings and provide conduit and boxes for all new outlets.
- 3.7.2 Provide pull cord in conduit system.

3.8 SECURITY SYSTEM

- 3.8.1 Provide blank coverplates on existing outlets as noted on drawings and provide conduit and boxes for all new outlets.
- 3.8.2 Provide pull cord in conduit system.

3.9 EMERGENCY POWER FEEDER & FEEDS

- 3.9.1 All emergency feeders and branch circuits and fire alarm system wiring shall have the required fire rating as per the O.B.C.
- 3.9.2 Emergency circuits and fire alarm system wiring run in ceiling spaces or wall will have to achieve the required fire rating as per the O.B.C. by means of drywall enclosures or use of MICC cables.
- 3.9.3 Wire in conduit with approved fire rating per authorities having jurisdiction or MICC cables.

3.10 BX CABLING (AC90)

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- 3.10.1 BX shall only be used for final drops to light fixtures only and the drop shall not exceed 3 meters.
- 3.10.2 BX is not to be permitted for any other use on this project.
- 3.11 VIBRATING EQUIPMENT:
 - 3.11.1 Vibrating equipment includes: motors, transformers, pumps, solenoid valves, telecommunications racks or cabinets, UPS, generator, or any equipment that is prone to vibration.
 - 3.11.2 Provide flexible connection by means of minimum 300mm of armoured flexible conduit or liquid tight conduit.

END OF SECTION

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Section Name: **Grounding - Secondary**
Section No.: **26 05 28**
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1 **GENERAL**

1.1 RELATED SECTIONS

- 1.1.1 Section 26 05 01 – Common Work Results – Electrical.
- 1.1.2 Section 26 22 13 – Dry Type Transformers Up To 600 V Primary.
- 1.1.3 Conform to relevant sections of specification for this and other Divisions.

1.2 REFERENCES

- 1.2.1 ANSI/IEEE 837-1988, Qualifying Permanent Connections Used in Substation Grounding.
- 1.2.2 CSA Z32.1-M1986, Safety in Anaesthetizing Locations.

1.3 DESCRIPTION OF WORK

- 1.3.1 Work includes providing all materials, equipment, accessories, services, and tests necessary to complete and make ready for operation. All system grounding, equipment grounding, grounding of outlets, special grounding for telecommunication, grounding of raceways and conduits, grounding of electrical distribution equipment, grounding rod and plates, and accessories work shall be in accordance with drawings and specifications and as required for a complete system.

2 **PRODUCTS**

2.1 EQUIPMENT

- 2.1.1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.
- 2.1.2 Copper conductor: minimum 3 m (10') long for each concrete encased electrode, bare, stranded, tinned, soft annealed, size 4/0 AWG or as indicated.
- 2.1.3 Rod electrodes: copper clad steel 19 mm ($\frac{3}{4}$ " dia by 3 m (10') long.
- 2.1.4 Plate electrodes: Copper surface area 0.2 m², 1.6 mm thick.

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- 2.1.5 Grounding conductors: bare stranded copper, tinned, soft annealed, size 4/0 AWG or as indicated.
- 2.1.6 Insulated grounding conductors: green, type RW90.
- 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:
 - 2.1.8.1 Grounding and bonding bushings.
 - 2.1.8.2 Protective type clamps.
 - 2.1.8.3 Bolted type conductor connectors.
 - 2.1.8.4 Thermite welded type conductor connectors.
 - 2.1.8.5 Bonding jumpers, straps.
 - 2.1.8.6 Pressure wire connectors.

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 copper welding by thermite process 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.

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- 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, where specified.
- 3.1.11 Connect building structural steel and metal siding to ground.
- 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 armored cables to cabinet at supply end, and provide non-metallic entry plate at load end.
- 3.1.14 Ground secondary service pedestals.

3.2 ELECTRODES

- 3.2.1 Make ground connections to continuously conductive underground water pipe on street side of water meter.
- 3.2.2 Install water meter shunt.
- 3.2.3 Install concrete encased electrodes in building foundation footings, with terminal connected to grounding network.
- 3.2.4 Install rod electrodes and make grounding connections.
- 3.2.5 Bond separate, multiple electrodes together.
- 3.2.6 Use size 4/0 AWG copper conductors for connections to electrodes.
- 3.2.7 Make special provision for installing electrodes that will give 5 ohm resistance to ground value where rock or sand terrain prevails. Ground as indicated.

3.3 SYSTEM AND CIRCUIT GROUNDING

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3.3.1 Install system and circuit grounding connections to neutral of primary 600 V system, secondary 120V system.

3.4 EQUIPMENT BONDING

3.4.1 Install bonding connections from exposed non-current carrying metal part of equipment including, but not necessarily limited to, the following:

3.4.1.1 Frames of motors;

3.4.1.2 Motor control centres;

3.4.1.3 Starters;

3.4.1.4 Control panels;

3.4.1.5 Panelboards and Distribution Panels;

3.4.1.6 Isolations Switch(es);

3.4.1.7 Communication Rooms and equipment;

3.4.1.8 Transformers;

3.4.1.9 Transfer Switch(es);

3.4.1.10 Raceway systems.

3.5 GROUNDING BUS

3.5.1 Install copper grounding bus mounted on insulated supports on wall of electrical room.

3.5.2 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size 2/0 AWG.

3.6 COMMUNICATION SYSTEMS

3.6.1 Install grounding connections for telephone, sound, fire alarm, intercommunication systems as follows:

3.6.1.1 Telephones: make telephone grounding system in accordance with telephone company's requirements.

3.6.1.2 Sound, fire alarm, intercommunication systems as indicated.

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3.7 FIELD QUALITY CONTROL

- 3.7.1 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Engineer and local authority having jurisdiction over installation.
- 3.7.2 Perform tests before energizing electrical system.
- 3.7.3 Disconnect ground fault indicator during tests.
- 3.7.4 Weld grounding conductors to underground grounding electrodes.
- 3.7.5 Connect together system neutral, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, earthing conductor in raceways and cables, receptacle ground connectors, and plumbing system.

3.8 INSPECTIONS AND TEST PROCEDURES

- 3.8.1 The tests to be carried out shall include but not be necessarily limited to:
 - 3.8.1.1 Visual and mechanical inspection:
 - 3.8.1.1.1 Inspect physical and mechanical conditions.
 - 3.8.1.1.2 Inspect anchorage.
 - 3.8.1.2 Electrical Tests:
 - 3.8.1.2.1 Perform fall of potential or alternative test in accordance with IEEE Standard 81 on the main earthing electrode or system.
 - 3.8.1.2.2 Perform point-to-point tests to determine the resistance between the main earthing system and all major electrical equipment frames, system neutral, and/or derived neutral points.

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3.8.2 Test Values:

3.8.2.1 The resistance between the main earthing electrode and ground should be no greater than two ohms for commercial or industrial systems and one ohm or less for generating or transmission station grounds unless otherwise specified by the employer. (Reference ANSI/IEEE Standard 142).

END OF SECTION

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Section No.: **26 05 29**
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1 **GENERAL**

1.1 RELATED SECTIONS

- 1.1.1 Section 26 05 01 – Common Work Results – Electrical.
- 1.1.2 Section 26 22 13 – Dry Type Transformers up to 600V Primary.
- 1.1.3 Section 26 24 16 – Panelboards Breaker Type.
- 1.1.4 Conform to relevant sections of specification for this and other Divisions.

2 **PRODUCTS**

2.1 SUPPORT CHANNELS

- 2.1.1 U shaped, steel channel, accurately cold rolled formed from 12 gauge, low carbon steel with finished dimensions of 1 5/8" x 1 5/8" (3.1 mm x 3.1 mm), inturned clamping ridges and a continuous slot along one (1) side for the insertion of slotted nuts. Hot dip galvanize the channel after fabrication with a zinc weight of 1.5 oz/ft sq.
- 2.1.2 Nuts with 2 serrated grooves to engage the clamping ridges of the channel, a spring to hold the nut in place during installation and threaded with Unified and American course threads. Case harden and electrogalvanize after fabrication.
- 2.1.3 Electrogalvanized bolts, threaded rod, flat and lockwashers as required.
- 2.1.4 Angle, U, Z and special fittings, brackets, bases, clamps, hangers, couplings and other fittings as required and galvanized unless otherwise indicated.
- 2.1.5 Provide channel and fittings of one (1) manufacturer. Acceptable manufacturers are:
- 2.1.6 Unistrut of Canada Ltd;
- 2.1.7 Burndy Canada Ltd.;
- 2.1.8 Electrovert Ltd.;
- 2.1.9 Pilgrim Technical Products Limited.

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2.2 CONCRETE ANCHORS

2.2.1 Drilled expansion anchors for anchors set in concrete block or poured concrete after the concrete has set. Size the insert and number of anchors so that the maximum load per anchor does not exceed 25% of the manufacturer's published maximum loading.

2.2.2 Provide concrete anchors of one (1) manufacturer. Acceptable manufacturers are:

2.2.2.1 Hilti Canada Ltd.

2.2.3 U channel concrete inserts shall be 12 gauge steel 1 5/8 in. square with insert anchors 1 3/8 in. long and 4 in. on centre. Acceptable manufacturers are:

2.2.3.1 Pilgrim Technical Products Limited;

2.2.3.2 Electrovert Limited;

2.2.3.3 Unistrut.

3 **EXECUTION**

3.1 INSTALLATION

3.1.1 Secure equipment to solid 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.

3.1.6 Fasten exposed conduit or cables to building construction or support system using straps.

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- 3.1.6.1 One-hole steel straps to secure surface conduits and cables 50 mm (2") and smaller.
- 3.1.6.2 Two-hole steel straps for conduits and cables larger than 50 mm (2").
- 3.1.6.3 Beam clamps to secure conduit to exposed steel work.
- 3.1.7 Suspended support systems.
- 3.1.8 Support individual cable or conduit runs with 6 mm (1/4") diameter threaded rods and spring clips:
 - 3.1.8.1 Support two or more cables or conduits on channels supported by 6 mm (1/4") diameter threaded rod hangers where direct fastening to building construction is impractical.
- 3.1.9 For surface mounting of two or more conduits use channels at 5 m oc spacing.
- 3.1.10 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- 3.1.11 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- 3.1.12 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- 3.1.13 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.
- 3.1.14 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

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3.1.15 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 out of steel members or of steel pipe and fittings designed to safely support the equipment.

END OF SECTION

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Section No.: **26 05 32**
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1 **GENERAL**

1.1 RELATED SECTIONS

- 1.1.1 Section 26 05 01 – Common Work Results – Electrical.
- 1.1.2 Section 26 05 33.16 – Boxes for Electrical Systems.
- 1.1.3 Section 26 05 34 – Conduits, Conduit Fastenings & Conduit Fittings.
- 1.1.4 Conform to relevant sections of specification for this and other Divisions.

1.2 SHOP DRAWINGS & PRODUCT DATA

- 1.2.1 Submit shop drawings and product data in accordance with Section 26 05 01.
- 1.2.2 Provide samples of all floor boxes for Consultant's review.

1.3 STANDARDS

- 1.3.1 Outlet Boxes, Conduit Boxes and Fittings to C.S.A. C22.2 No.18-92.
- 1.3.2 Rigid PVC Boxes and Fittings to C.S.A. C22.2 No.85-M89.

2 **PRODUCTS**

2.1 OUTLET AND CONDUIT BOXES GENERAL

- 2.1.1 Size boxes in accordance with CSA C22.1 and electrical code
- 2.1.2 All sheet steel boxes shall have pre-punched 19 mm knockouts.
- 2.1.3 Do not use boxes with cable clamps.
- 2.1.4 Boxes shall be minimum size 75 mm x 50 mm x 50 mm deep. Provide 100 mm square or larger outlet boxes as required for special devices. Add extension and plaster rings as required.
- 2.1.5 Provide 100 mm square or octagonal outlet boxes for luminaire outlets.
- 2.1.6 Provide multi-gang boxes for power and switching devices, do not gang tel/data system boxes unless detailed specifically.

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2.1.7 Provide blank cover plates for boxes without wiring devices as described in Section 26 27 26.

2.1.8 347 V outlet boxes for 347 V switching devices.

2.2 SHEET STEEL OUTLET BOXES

2.2.1 Electro-galvanized steel single and multi-gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm (3" x 2" x 1½") or as required for special devices or as indicated. 102 mm (4") square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.

2.2.2 Boxes for door switch and pushbuttons shall be sized as required.

2.2.3 102 mm (4") square or octagonal outlet boxes for lighting fixture outlets.

2.2.4 102 mm (4") square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster or tile walls.

2.3 MASONRY BOXES

2.3.1 Electro-galvanized steel masonry single and multi-gang MBD 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 brass faceplate. Device mounting plate to accommodate short or long ear duplex receptacles. Minimum depth: 28 mm (1 1/8") for receptacles; 73 mm (3") for communication equipment.

2.5.2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 12 mm and 19 mm (½" and ¾") conduit. Minimum size: 3 mm (3") deep.

2.6 CONDUIT BOXES

2.6.1 Cast FS or FD ferrous alloy boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle in all

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public areas and 1110 utility boxes in all service rooms.

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 (3" x 2" x 2½") with two double clamps to take non-metallic sheathed cables.

2.8 PVC BOXES

2.8.1 All PVC boxes to have approved ground straps and shall be compatible with PVC conduit used.

2.9 FITTINGS – GENERAL

2.9.1 Bushing and connectors with nylon insulated throats.

2.9.2 Knock-out fillers to prevent entry of debris.

2.9.3 Conduit outlet bodies for conduit up to 32 mm (1¼") and pull boxes for larger conduits.

2.9.4 Double locknuts and insulated bushings on sheet metal boxes.

2.10 WEATHERPROOF COVERS

2.10.1 Light switches:

2.10.1.1 Clear bubble plate with silicone rubber for use with all AC toggle switches. Hubbell Cat No. HBL1795

2.10.1.2 For locations with 2-ganged switches and/or 2-gang boxes with single switch and blank, provide custom Hubbell cover to suit requirements.

2.10.2 Fire Alarm Manual Pull Stations:

2.10.2.1 STI Series Stopper II, STI-1250 WeatherStopper Flush Mount kit. Consisting of STI-1230 clear Lexan, UV stabilized pull-station cover, STI-3002 gasket.

2.10.2.2 STI Series Stopper II, STI-3150 WeatherStopper Surface Mount kit. Consisting of STI-1230 clear Lexan, UV stabilized pull-station cover, 2xSTI-3002 gaskets, 2" STI-3100 spacer, STI-3004 Conduit insert and STI-3003 Neoprene conduit gasket.

2.11 PARKING PEDESTAL

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- 2.11.1 Parking pedestal shall be gooseneck construction:
 - 2.11.1.1 Height: 42"
 - 2.11.1.2 Mounting: Pad mounted
 - 2.11.1.3 Material: Cold rolled steel
 - 2.11.1.4 Finish: UV stable black wrinkle powder paint.
 - 2.11.1.5 Product: Viking electronics VE-GNP.
- 2.11.2 Parking pedestal shall be complete with surface mount gang box. Gang box shall be mounted to the gooseneck parking pedestal. The gang box shall have the following properties:
 - 2.11.2.1 Dimensions: 10"H x 5"W x 3.5"D
 - 2.11.2.2 Material: Cold rolled steel
 - 2.11.2.3 Finish: UV stable black fine texture powder paint.
 - 2.11.2.4 Product: Viking electronics VE-5x10.
- 3 **EXECUTION**
 - 3.1 INSTALLATION
 - 3.1.1 Support boxes independently of connecting conduits. All boxes to be hung independently of ducts, pipes, etc.
 - 3.1.2 Fill boxes with 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 ($\frac{1}{4}$ ") of opening.
 - 3.1.4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.
 - 3.1.5 Size boxes in accordance with electrical code.
 - 3.1.6 Gang boxes together where wiring devices are grouped.
 - 3.1.7 Provide matching blank cover plates for boxes without wiring

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devices.

3.1.8 When using PVC conduit, use approved boxes.

3.1.9 Prior to pouring concrete secure flush floor boxes to reinforcing steel, adjust level and to correct height, install cement cover securely. After pour make final adjustments.

END OF SECTION

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Project No.: 2021-0245
Section Name: **Conduit for Electrical Systems**
Section No.: **26 05 20**
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1 **GENERAL**

1.1 RELATED SECTIONS

- 1.1.1 Section 26 05 01 – Common Work Results – Electrical.
- 1.1.2 Section 26 05 24 – Wiring Methods.
- 1.1.3 Section 26 27 26 – Wiring Devices.
- 1.1.4 Conform to relevant sections of specification for this and other Divisions.

1.2 REFERENCES

- 1.2.1 Canadian Standards Association (CSA).
- 1.2.2 CAN/CSA C22.2 No.18-92, Outlet Boxes, Conduit Boxes, and Fittings.
- 1.2.3 CSA C22.2 No.45-M1981 (R1992), Rigid Metal Conduit.
- 1.2.4 CSA C22.2 No.56-1977 (R1977), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- 1.2.5 CSA C22.2 No.83-M1985 (R1992), Electrical Metallic Tubing.
- 1.2.6 CSA C22.2 No.211.2-M1984 (R1992), Rigid PVC (Un-plasticized) Conduit.
- 1.2.7 CAN/CSA C22.2 No.227.3-M91, Flexible Nonmetallic Tubing.

1.3 LOCATION OF CONDUIT

- 1.3.1 The drawings do not show all conduits. Those shown are in diagrammatic form only. Conduits are to be provided to create complete raceway systems.
- 1.3.2 No conduits shall be installed within concrete columns unless specifically approved by the Structural Engineer.

1.4 NUMBER & SIZES OF CONDUITS

- 1.4.1 Conduits to be provided shall be as indicated on documents and/or as required to suit requirements of systems installed.

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2 PRODUCTS

2.1 CONDUITS

- 2.1.1 Rigid metal conduit: to CSA C22.2 No.45, galvanized steel threaded.
- 2.1.2 Epoxy coated conduit: to CSA C22.2 No.45, with zinc coating and corrosion resistant epoxy finish inside and outside.
- 2.1.3 Electrical metallic tubing (EMT): to CSA C22.2 No.83, with couplings.
- 2.1.4 Rigid Schedule 40 PVC conduit of the sizes indicated and required to CSA C22.2 No.211.2-M1984 (R1992).
- 2.1.5 Flexible metal conduit: liquid-tight flexible metal conduit of the sizes indicated and required to CSA C22.2 No.56-1977(R1992).
- 2.1.6 Electrical non-metallic tubing, flexible and flexible liquid-tite included, of the sizes indicated and required to C.S.A. C22.2 No.227.1-1988, No.227.2-M1987 and No.227.3-M91.
- 2.1.7 Do not use conduits smaller than 3/4" unless specifically detailed in these documents.

2.2 CONDUIT FASTENINGS

- 2.2.1 One hole malleable iron, hot dipped galvanized straps to secure surface mounted conduits. Provide complete with properly sized pan head screw.
- 2.2.2 Beam clamps to secure conduits to exposed steel work.
- 2.2.3 Provide 12 gauge galvanized steel "U" channel type supports for two or more conduits on minimum 1500 mm centres. Use suitable conduit clamps in channel.
- 2.2.4 Threaded rods, 6 mm (1/4") dia., to support suspended channels.

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2.3 CONDUIT FITTINGS

- 2.3.1 Fittings: manufactured for use with the conduit specified with the same coating as conduit.
- 2.3.2 Provide insulated bushings on all rigid, threaded conduits.
- 2.3.3 Provide insulated steel set screw connectors and couplings for EMT conduits 2" and smaller.
- 2.3.4 Provide nylon insulated concrete tight steel set screw connectors and couplings for EMT conduits 2" and smaller installed in cast-in-place concrete.
- 2.3.5 Provide nylon insulated steel set screw couplings and connectors for all EMT conduits 2-1/2" and larger.
- 2.3.6 Provide double locknuts and a nylon insulated bushing for Schedule 40 conduit connections to sheet steel boxes and enclosures.
- 2.3.7 Cast Fitting shall not be used on this project.
- 2.3.8 Provide raintight connectors on conduits into the distribution equipment including, but not limited to, switchboards, distribution panels, panelboards, and motor control centres.
- 2.3.9 Provide raintight connectors on conduits in underground parking and parking garages.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

- 2.4.1 Weatherproof expansion fittings with an integral bonding assembly suitable for a 100 (4") mm linear expansion.
- 2.4.2 Watertight expansion fittings with an integral bonding jumper suitable for linear expansion and a 20 mm deflection in all directions.
- 2.4.3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 FISH CORD

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2.5.1 Provide fish cords to be minimum 3 mm polypropylene in all feeder and branch conduit runs.

2.5.2 Provide fish cords to be minimum 3 mm polypropylene in all systems conduit runs.

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 No conduits shall be installed within slabs, columns or concrete walls, unless specifically noted otherwise.

3.1.3 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.

3.1.4 Do not surface mount conduits on building exterior surfaces unless otherwise indicated.

3.1.5 Use rigid PVC or flexible non-metallic tubing (ENT) in cast concrete indoor slab, in accordance with Section 26 05 24 (Wiring Methods).

3.1.6 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

3.1.7 Mechanically bend steel conduit over 19 mm (¾") dia.

3.1.8 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

3.1.9 Install fish cord in empty conduits.

3.1.10 Run 2-1" spare conduits up to ceiling space from each flush panel. Terminate these conduits in 6" x 6" x 4" (152 mm x 152 mm x 102 mm) junction boxes at top of wall above panel. Box to be selected to suit finish required.

3.1.11 Where conduits become blocked, remove and replace blocked section.

3.1.12 Dry conduits out before installing wire.

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- 3.1.13 Use rigid, threaded Schedule 40, galvanized steel threaded conduit where specified.
- 3.1.14 Use rigid PVC conduit underground for duct bank or otherwise shown within the confines of all applicable codes.
- 3.1.15 Use electrical metallic tubing (EMT) in general areas except in cast concrete and below 2.4 m above finished floor where not subject to mechanical injury.
- 3.1.16 Use flexible metal conduit for connection to motors and transformers, connection to recessed incandescent fixtures without a prewired outlet box, connection to surface or recessed fluorescent fixtures and work in movable metal partitions.
- 3.1.17 Use liquid tight flexible metal conduit for connection to motors, transformers etc.
- 3.1.18 Use flexible conduit (seal tight) connects on line and load side of all transformers.
- 3.1.19 Box offsets must be provided where conduits terminate at a junction box or piece of electrical equipment or distribution.
- 3.1.20 The conduits for the following circuits and systems shall be run separately, except as noted and directed for some low energy systems such as CCTV and intercoms.
 - 3.1.20.1 Normal power to luminaires
 - 3.1.20.2 Emergency power to luminaires
 - 3.1.20.3 Normal power to receptacle outlets
 - 3.1.20.4 Exit lighting system
 - 3.1.20.5 Life safety system
 - 3.1.20.6 Security system
 - 3.1.20.7 Tele/data system
 - 3.1.20.8 A/V system
 - 3.1.20.9 P.A. system wiring
 - 3.1.20.10 CCTV system

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3.1.20.11 Cable TV – AM/FM

3.1.20.12 Intercom system

3.1.20.13 Other auxiliary systems

3.2 PVC CONDUITS

3.2.1 PVC conduits may be bent in the field using approved electrical heating devices or by using the appropriate bends. Damaged or improper bends shall be replaced. All joints shall be made using an approved coupling with solvent welds. Clean all joints with solvent cleaner prior to applying the solvent. Liberally apply the solvent to the conduit fitting, force the conduit into the fitting and rotate the conduit 45 degrees within the flange to form a tight bond. Allow proper curing time.

3.2.2 All scorched PVC conduit shall be removed.

3.3 SURFACE CONDUITS

3.3.1 Run parallel or perpendicular to building lines.

3.3.2 Locate conduits behind infrared or gas fired heaters with 1.5 m (5') clearance.

3.3.3 Run conduits in flanged portion of structural steel.

3.3.4 Group conduits wherever possible on suspended or surface channels.

3.3.5 Do not pass conduits through structural members except as indicated, or approved in writing by the Structural Consultant.

3.3.6 Do not locate conduits less than 75 mm (1 1/8") parallel to steam or hot water lines with minimum of 25 mm (1") 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 and partition.

3.4.3 Do not install conduits in terrazzo or concrete toppings.

3.5 CONDUITS IN CAST-IN-PLACE CONCRETE

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- 3.5.1 Locate to suit reinforcing steel. 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. Use cold mastic between sleeve and conduit.
- 3.5.5 Do not place conduits in slabs in which slab thickness is less than 4 times conduit diameter.
- 3.5.6 Encase conduits completely in concrete with minimum 3" (75mm) concrete cover.
- 3.5.7 Organize conduits in slab to minimize crossovers.
- 3.5.8 Conduits cast-in-concrete shall be installed in accordance with the requirements of the Structural Engineer. Refer to additional details and requirements as noted in the structural drawings.
- 3.6 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE
- 3.6.1 Run conduits 25 mm (1") and larger below slab and encased in 75 mm (3") concrete envelope. Provide 50 mm (2") of sand over concrete envelope below floor slab.
- 3.7 CONDUITS UNDERGROUND
- 3.7.1 Slope conduits away from building to provide drainage.
- 3.7.2 Provide drainage or soak-away pit where conduits enter the building below grade.
- 3.7.3 Waterproof joints (except PVC) with heavy coat of bituminous paint.
- 3.8 EXTERIOR
- 3.8.1 All exterior conduits shall be of rigid PVC or rigid steel.

END OF SECTION

Project Name: METRO HALL DAYCARE
Project No.: 2021-0245
Section Name: **Boxes for Electrical Systems**
Section No.: **26 05 33.16**
Date: January 26, 2024

1 GENERAL

1.1 RELATED SECTIONS

1.1.1 Section 26 05 01 – Common Work Results for Electrical.

1.1.2 Conform to relevant sections of specification for this and other Divisions.

1.2 REFERENCES

1.2.1 CSA C22.2 No. 76 – Splitters

1.2.2 CSA C22.2 No. 40 – Cutout, Junction, and Pull Boxes

2 PRODUCTS

2.1 SPLITTERS

2.1.1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

2.1.2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.

2.1.3 At least three (3) spare terminals on each set of lugs in splitters in all splitters

2.2 JUNCTION AND PULL BOXES

2.2.1 Welded steel construction with screw-on flat covers for surface mounting.

2.2.2 Covers with 25 mm (1") minimum extension all around for flush-mounted junction boxes and pull boxes.

2.3 CABINETS

2.3.1 Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.

2.3.2 Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing 19 mm ($\frac{3}{4}$ ") G1S plywood backboard for surface mounting.

3 EXECUTION

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Section Name: **Boxes for Electrical Systems**
Section No.: **26 05 33.16**
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3.1 SPLITTER INSTALLATION

3.1.1 Install splitters and mount plumb, true and square to the 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 junction boxes and pull boxes in inconspicuous but accessible locations.

3.2.2 Mount cabinets with top not higher than 2 m (6' – 6") above finished floor.

3.2.3 Install terminal block as indicated in Type T cabinets.

3.2.4 Only main junction and pull boxes are indicated on plans. Install pull boxes so as not to exceed 30 m (100') of conduit run or three (3) 90-degree bends between pull boxes.

3.3 IDENTIFICATION

3.3.1 Provide equipment identification in accordance with Section 26 05 01 – Common Work Results – Electrical and 26 05 53 - Identification for Electrical Systems.

3.3.2 Install size 2 identification labels indicating voltage and phase.

END OF SECTION

Project Name: METRO HALL DAYCARE
Project No.: 2021-0245
Section Name: **Surface Raceways for Electrical Systems**
Section No.: **26 05 33.23**
Date: January 26, 2024

1 **GENERAL**

1.1 RELATED SECTIONS

- 1.1.1 Comply with the requirements of Section 26 05 01 – Common Work Results – Electrical.
- 1.1.2 Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.
- 1.1.3 Section 26 05 24 – Wiring Methods.
- 1.1.4 Conform to relevant sections of specification for this and other Divisions.

1.2 REFERENCES

- 1.2.1 Canadian Standards Association (CSA).
- 1.2.2 CAN/CSA C22.2 No.62-93, Surface Raceway Systems.

1.3 SUBMITTALS

- 1.3.1 Submit shop drawings and product data in accordance with Section 26 05 01.
- 1.3.2 Provide samples of all surface mounted raceways for Consultant's review.

2 **PRODUCTS**

2.1 SURFACE FLOOR RACEWAY SYSTEM

- 2.1.1 Steel: to CSA C22.2 No.62, two-piece, manufactured as lay-in type raceway.
- 2.1.2 Finish: Matte Black
- 2.1.3 Product: Legrand 4000 Series Multi-Channel Metal Raceway.

2.2 FITTINGS

- 2.2.1 Elbows, tees, couplings and hanger fittings: to CSA C22.2 No.62, manufactured as accessories to raceway supplied.

3 **EXECUTION**

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Project No.: 2021-0245
Section Name: **Surface Raceways for Electrical Systems**
Section No.: **26 05 33.23**
Date: January 26, 2024

3.1.1 INSTALLATION

3.1.2 Install raceways before installation of wiring. Install covers for raceways and fittings after installation or wiring.

3.1.3 Install supports, elbows, tees, connectors, fittings, bushings, adaptors as required.

3.1.4 Keep number of elbows, offsets, connections to minimum.

3.1.5 Use wiring with mechanical protection in channel raceways.

3.1.6 Install barriers in raceways where different voltage systems are indicated.

END OF SECTION

Project Name: METRO HALL DAYCARE
Project No.: 2021-0245
Section Name: **Conduits, Conduit Fastening & Conduit Fittings**
Section No.: **26 05 34**
Date: January 26, 2024

1 **GENERAL**

1.1 RELATED SECTIONS

- 1.1.1 Section 26 05 01 – Common Work Results – Electrical.
- 1.1.2 Section 26 05 24 – Wiring Methods.
- 1.1.3 Section 26 27 26 – Wiring Devices.
- 1.1.4 Conform to relevant sections of specification for this and other Divisions.

1.2 REFERENCES

- 1.2.1 Canadian Standards Association (CSA).
- 1.2.2 CAN/CSA C22.2 No.18-92, Outlet Boxes, Conduit Boxes, and Fittings.
- 1.2.3 CSA C22.2 No.45-M1981 (R1992), Rigid Metal Conduit.
- 1.2.4 CSA C22.2 No.56-1977 (R1977), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- 1.2.5 CSA C22.2 No.83-M1985 (R1992), Electrical Metallic Tubing.
- 1.2.6 CSA C22.2 No.211.2-M1984 (R1992), Rigid PVC (Un-plasticized) Conduit.
- 1.2.7 CAN/CSA C22.2 No.227.3-M91, Flexible Nonmetallic Tubing.

1.3 LOCATION OF CONDUIT

- 1.3.1 The drawings do not show all conduits. Those shown are in diagrammatic form only. Conduits are to be provided to create complete raceway systems.
- 1.3.2 No conduits shall be installed within concrete columns.

1.4 NUMBER & SIZES OF CONDUITS

- 1.4.1 Conduits to be provided shall be as indicated on documents and/or as required to suit requirements of systems installed.

2 **PRODUCTS**

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Section No.: **26 05 34**
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2.1 CONDUITS

- 2.1.1 Rigid metal conduit: to CSA C22.2 No.45, galvanized steel threaded.
- 2.1.2 Epoxy coated conduit: to CSA C22.2 No.45, with zinc coating and corrosion resistant epoxy finish inside and outside.
- 2.1.3 Electrical metallic tubing (EMT): to CSA C22.2 No.83, with couplings.
- 2.1.4 Rigid Schedule 40 PVC conduit of the sizes indicated and required to CSA C22.2 No.211.2-M1984(R1992).
- 2.1.5 Flexible metal conduit: liquid-tight flexible metal conduit of the sizes indicated and required to CSA C22.2 No.56-1977(R1992).
- 2.1.6 Electrical non-metallic tubing, flexible and flexible liquid-tite included, of the sizes indicated and required to C.S.A. C22.2 No.227.1-1988, No.227.2-M1987 and No.227.3-M91.
- 2.1.7 Do not use conduits smaller than 3/4" unless specifically detailed in these documents.

2.2 CONDUIT FASTENINGS

- 2.2.1 One hole malleable iron, hot dipped galvanized straps to secure surface mounted conduits. Thomas & Betts series 1275 for rigid, threaded conduit and Thomas & Betts Series 4176 for EMT complete with properly sized pan head screw.
- 2.2.2 Beam clamps to secure conduits to exposed steel work.
- 2.2.3 Provide 12 gauge galvanized steel "U" channel type supports for two or more conduits on minimum 1500 mm centres. Use suitable conduit clamps in channel.
- 2.2.4 Threaded rods, 6 mm (1/4") dia., to support suspended channels.

2.3 CONDUIT FITTINGS

- 2.3.1 Fittings: manufactured for use with the conduit specified with the same coating as conduit.
- 2.3.2 Provide insulated bushings on all rigid, threaded conduits.
- 2.3.3 Provide insulated steel set screw connectors and couplings for

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EMT conduits 2" and smaller, Thomas & Betts series.

2.3.4 Provide nylon insulated concrete tight steel set screw connectors and couplings for EMT conduits 2" and smaller installed in cast-in-place concrete. Thomas & Betts 5031 and 5030 Series.

2.3.5 Provide nylon insulated steel set screw couplings and connectors for all EMT conduits 2-1/2" and larger, Thomas & Betts.

2.3.6 Provide double locknuts and a nylon insulated bushing for Schedule 40 conduit connections to sheet steel boxes and enclosures.

2.3.7 Cast Fitting shall not be used on this project.

2.3.8 Provide raintight connectors on conduits into panelboards and MCC's.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

2.4.1 Weatherproof expansion fittings with an integral bonding assembly suitable for a 100 (4") mm linear expansion.

2.4.2 Watertight expansion fittings with an integral bonding jumper suitable for linear expansion and a 20 mm deflection in all directions.

2.4.3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 FISH CORD

2.5.1 Provide fish cords to be minimum 3 mm polypropylene in all feeder and branch conduit runs.

2.5.2 Provide fish cords to be minimum 3 mm polypropylene in all systems conduit runs.

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 No conduits shall be installed within slabs, columns or concrete walls.

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- 3.1.3 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.
- 3.1.4 Do not surface mount conduits on building exterior surfaces unless otherwise indicated.
- 3.1.5 Use rigid PVC or flexible non-metallic tubing (ENT) in cast concrete indoor slab, in accordance with Section 26 05 24 (Wiring Methods).
- 3.1.6 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- 3.1.7 Mechanically bend steel conduit over 19 mm ($\frac{3}{4}$ " dia).
- 3.1.8 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- 3.1.9 Install fish cord in empty conduits.
- 3.1.10 Run 2-1" spare conduits up to ceiling space from each flush panel. Terminate these conduits in 6" x 6" x 4" (152 mm x 152 mm x 102 mm) junction boxes at top of wall above panel. Box to be selected to suit finish required.
- 3.1.11 Where conduits become blocked, remove and replace blocked section.
- 3.1.12 Dry conduits out before installing wire.
- 3.1.13 Use rigid, threaded Schedule 40, galvanized steel threaded conduit where specified.
- 3.1.14 Use rigid PVC conduit underground for duct bank or otherwise shown within the confines of all applicable codes.
- 3.1.15 Use electrical metallic tubing (EMT) in general areas except in cast concrete and below 2.4 m above finished floor where not subject to mechanical injury.
- 3.1.16 Use flexible metal conduit for connection to motors and transformers, connection to recessed incandescent fixtures without a prewired outlet box, connection to surface or recessed fluorescent fixtures and work in movable metal partitions.
- 3.1.17 Use liquid tight flexible metal conduit for connection to motors, transformers etc.

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- 3.1.18 Use flexible conduit (seal tight) connects on line and load side of all transformers.
- 3.1.19 Box offsets must be provided where conduits terminate at a junction box or piece of electrical equipment or distribution.
- 3.1.20 The conduits for the following circuits and systems shall be run separately, except as noted and directed for some low energy systems such as CCTV and intercoms.
- 3.1.21 Normal power to luminaires
- 3.1.22 Emergency power to luminaires
- 3.1.23 Normal power to receptacle outlets
- 3.1.24 Exit lighting system
- 3.1.25 Life safety system
- 3.1.26 Security system
- 3.1.27 Tele/data system
- 3.1.28 A/V system
- 3.1.29 P.A. system wiring
- 3.1.30 CCTV system
- 3.1.31 Cable TV – AM/FM
- 3.1.32 Intercom system
- 3.1.33 Other auxiliary systems
- 3.2 **PVC CONDUITS**
- 3.2.1 PVC conduits may be bent in the field using approved electrical heating devices or by using the appropriate bends. Damaged or improper bends shall be replaced. All joints shall be made using an approved coupling with solvent welds. Clean all joints with solvent cleaner prior to applying the solvent. Liberally apply the solvent to the conduit fitting, force the conduit into the fitting and rotate the conduit 45 degrees within the flange to form a tight bond. Allow proper curing time.

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3.2.2 All scorched PVC conduit shall be removed.

3.3 SURFACE CONDUITS

3.3.1 Run parallel or perpendicular to building lines.

3.3.2 Locate conduits behind infrared or gas fired heaters with 1.5 m (5') clearance.

3.3.3 Run conduits in flanged portion of structural steel.

3.3.4 Group conduits wherever possible on suspended or surface channels.

3.3.5 Do not pass conduits through structural members except as indicated, or approved in writing by the Structural Consultant.

3.3.6 Do not locate conduits less than 75 mm (1 1/8") parallel to steam or hot water lines with minimum of 25 mm (1") 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 and partition.

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. 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. Use cold mastic between sleeve and conduit.

3.5.5 Do not place conduits in slabs in which slab thickness is less than 4 times conduit diameter.

3.5.6 Encase conduits completely in concrete with minimum 3" (75mm) concrete cover.

3.5.7 Organize conduits in slab to minimize crossovers.

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3.6 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

3.6.1 Run conduits 25 mm (1") and larger below slab and encased in 75 mm (3") concrete envelope. Provide 50 mm (2") 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 (except PVC) with heavy coat of bituminous paint.

3.8 EXTERIOR

3.8.1 Run conduit to exterior equipment as detailed.

END OF SECTION

Project Name: METRO HALL DAYCARE
Project No.: 2021-0245
Section Name: **Cable Trays for Electrical Systems**
Section No.: **26 05 36**
Date: January 26, 2024

1 **GENERAL**

1.1 RELATED SECTIONS

1.1.1 Section 26 05 01 – Common Work Results – Electrical.

1.1.2 Conform to relevant sections of specification for this and other Divisions.

1.2 REFERENCES

1.2.1 Canadian Standards Association (CSA).

1.2.2 CAN/CSA C22.2 No.126-M91, Cable Tray Systems.

1.2.3 Electrical and Electronic Manufacturers' Association of Canada (EEMAC).

1.2.4 EEMAC F5-1-1976, Cable tray Systems and Accessories.

1.3 SHOP DRAWINGS AND PRODUCT DATA

1.3.1 Submit shop drawings and product data in accordance with relevant section 26 05 01 and Division 01.

1.3.2 Identify types of cable tray used.

2 **PRODUCTS**

2.1 BASKET TYPE CABLE TRAY

2.1.1 Cable tray and fittings: to EEMAC F5-1.

2.1.1.1 Basket style try with a depth of minimum 4" (100mm) and width as shown on the drawings.

2.1.1.2 Tray system to include all components and have an electroplated zinc finish.

2.1.1.3 Fittings: horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers where required, manufactured accessories for cable tray supplied. Radii on fittings 600 mm (24") minimum.

2.1.1.4 Barriers where different voltage systems are in the same cable tray.

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2.2 SUPPORTS

2.2.1 The Basket Tray System shall be supported using trapeze style support. Provide 3/8" threaded rod. Alternatively, support can be provided by the Hang Fast Gripple product.

2.2.2 Where the Basket Tray System is to be supported from wall, utilize wall mount shell brackets

2.3 FITTINGS

2.3.1 Provide all fittings necessary to provide a complete Basket Tray System installation as specified by manufacturer. Recommended fittings are as listed below:

Description	Part #
Splice Hardware	Flextray FLEXMATE2 or Cablofil EDRN
Drop Out Fitting	Flextray DROP OUT
Ground Bolt	Flextray GROUND BOLT or Cablofil GNDSB
Ground Wire Support	Flextray GROUND SPT GS or Cablofil SCMT
Ceiling Rod Anchor	Flextray FT3820CTB (Concrete), FT3820STB (Steel)
Threaded Rod	Flextray FT1908 (Length to suit) or Cablofil THRD3/8
90 Degree horizontal Elbow	Flextray FTC4X16HE or Cablofil EZT90 kit (1/2 kit for each elbow)
Horizontal Sweep	Flextray FTC4X16HS or Cablofil FASLOCKXL
Horizontal Tee	Flextray FTC4X16X16HT or Cablofil EZT90 kit (1 per Tee)

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Description	Part #
Horizontal Cross Fitting	Flextray FTC4X16X16HX or Cablofil EZT90 kit (2 per Cross)

2.3.2 Provide all other miscellaneous hardware such as coupling nuts, hex nuts, washers beam clamps required to provide a complete installation.

2.4 TOOLS

2.4.1 Use only manufacturer's approved tools when installing all parts of the Basket Tray System.

2.5 ACCEPTABLE MANUFACTURERS:

2.5.1 Thomas & Betts Canada;

2.5.2 Cablofil;

2.5.3 Canadian Electrical Raceways;

2.5.4 Eaton B-Line.

2.6 LADDER TYPE CABLE TRAY

2.6.1 The ladder type cable tray shall be aluminum, CSA Class 'D', ladder type with rungs spaced on 18" (450 mm) centers.

2.6.2 Cable tray shall be extruded aluminum alloy with I-beam side rails and welded cross rungs.

2.6.3 Rungs shall have the provision for clamping cables on top by means of adjustable UC clamps.

2.6.4 Tray dimensions as indicated on drawings.

2.6.5 Provide covered tray where indicated on drawings.

3 **EXECUTION**

3.1 INSTALLATION

3.1.1 Install complete cable tray system.

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- 3.1.2 Support cable tray on both sides, every 5' (1500mm) to support 50lb per liner foot.
- 3.1.3 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.
- 3.1.4 Provide all required off-sets for each floor level where Basket Tray has been identified on the drawings or within the specifications. Maintain clearances from any obstructions such as mechanical ductwork, structural members, piping, conduit, etc.
- 3.1.5 Ground Basket Tray system at the end of each run of tray and every 60' to nearest grounding point (telecom room bus bar) in compliance with ANSI/ISA/EIA-607 (CSA T527) & OESC.
- 3.2 CABLE IN CABLE TROUGHES
- 3.2.1 Install cables individually.
- 3.2.2 Lay cables into cable tray. Use rollers when necessary to pull cables.
- 3.2.3 Secure cables in cable tray at 6 m (20') centers, with nylon ties.
- 3.2.4 Identify cables every 30 m (100') with size 2 nameplates.
- 3.3 FIRE BARRIERS
- 3.3.1 Arrange for opening in fire rated walls, and floors for width and depth of cables. Stop Basket Trays on either side of firewall and bond through firewall.
- 3.3.2 Arrange and make good fire rating of floors or walls after cables have been installed.

END OF SECTION

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1 **GENERAL**

1.1 RELATED SECTIONS

1.1.1 Section 26 05 01 – Common Work Results – Electrical.

1.1.2 Conform to relevant sections and specification for this and other Divisions.

2 **PRODUCTS**

3 **EXECUTION**

3.1 CABLE INSTALLATION IN DUCTS

3.1.1 Install cables as indicated in ducts.

3.1.2 Do not pull spliced cables inside ducts.

3.1.3 Install multiple cables in duct simultaneously.

3.1.4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.

3.1.5 To facilitate matching of colour coded multi-conductor control cables reel off in same direction during installation.

3.1.6 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.

3.1.7 After installation of cables, seal duct ends with duct sealing compound.

3.2 FIELD QUALITY CONTROL

3.2.1 Perform tests in accordance with Section 26 05 01 – Common Work Results – Electrical.

3.2.2 Perform tests using qualified personnel. Provide necessary instruments and equipment.

3.2.3 Check phase rotation and identify each phase conductor of each feeder.

3.2.4 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 mega-

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ohms.

3.2.5 Pre-acceptance Tests.

3.2.5.1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.

3.2.5.2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

3.2.6 Acceptance Tests:

3.2.6.1 Ensure that terminations and accessory equipment are disconnected.

3.2.6.2 Ground shields, ground wires, metallic armor and conductors not under test.

3.2.6.3 High Potential (Hipot) Testing:

3.2.6.3.1 Conduct hipot testing in accordance with manufacturer's recommendations.

3.2.6.4 Leakage Current Testing:

3.2.6.4.1 Raise voltage in steps from zero to maximum values as specified by manufacturer for type of cable being tested.

3.2.6.4.2 Record leakage current at each step.

3.2.7 Provide Consultant with list of test results showing.

3.2.8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

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Project No.: 2021-0245
Section Name: **Identification for Electrical Systems**
Section No.: **26 05 20**
Date: January 26, 2024

1 GENERAL

1.1 REFERENCES AND RELATED SECTIONS

1.1.1 Comply with the requirements of Section 26 05 01 – Common Work Results – Electrical.

1.1.2 Conform to relevant sections of specification for this and other Divisions.

2 PRODUCTS

2.1 NAMEPLATES

2.1.1 Construct all nameplates from laminated plastic having a white core with a black top lamination such that engraving through the top lamination will reveal white lettering on a black background.

2.1.2 Construct all warning and emergency power nameplates from laminated plastic having a white core with a red top lamination such that engraving through the top lamination will reveal white lettering on a black background.

2.2 SIZES

2.2.1 Provide nameplates of the sizes indicated. Where a size is not given, provide a standard size nameplate of sufficient size to contain the text indicated.

2.2.2 Where a numerical size is indicated, provide a nameplate of a size as indicated in the table below. Provide lettering of the height indicated below unless another size is indicated.

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Size	Width (mm)	Height (mm)	First Line lettering height (mm)	Following Lines lettering height (mm)
1	50	25	13	-
1A	50	25	7.5	7.5
2	75	50	13	10
3	75	50	10	7.5
4	100	50	25	10
5	125	75	25	10
6	200	100	25	10

2.2.3 Provide lettering of the height indicated. Where no height is indicated, provide lettering 10 mm high for the first line and 7.5 mm high for all following lines.

2.3 SPECIFIC NAMEPLATES

2.3.1 For each power and distribution transformer, provide a Size 5 nameplate to indicate the following information. The number in brackets indicates the lettering height in millimeters:

2.3.1.1 Line 1: Equipment tag number (25)

2.3.1.2 Line 2: KVA, Rated voltage (10)

2.3.1.3 Line 3: Power source (10)

Example: **TX-2A01**
150KVA 600V-208/120V
FED FROM DP-6A0B

2.3.2 For each panelboard, disconnect switch, loose starter, etc. provide a Size 5 nameplate to indicate the following information. The number in brackets indicates the lettering height in millimeters:

2.3.2.1 Line 1: Equipment tag number (25)

2.3.2.2 Line 2: Rated bus, Rated voltage, phase, and wires (10)

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2.3.2.3 Line 3: Power Source (10)

Example: **PP-2A01**
225A, 208/120V, 3-PH, 4-W
FED FROM DP-2A01

2.4 WARNING NAME PLATES

2.4.1 Type "A", width = 100 mm , height = 100 mm
(Text height in millimetres in brackets)

Text: **DANGER**..... (25)
MORE THAN ONE POWER SOURCE..... (10)
CONTAINED WITHIN,..... (10)
DISCONNECT ALL POWER.....(10)
SOURCES BEFORE SERVICING.....(10)
THIS EQUIPMENT.....(10)

3 EXECUTION

3.1 INSTALLATION

3.1.1 Coordinate final nameplate design, colour and nomenclature with the Engineer prior to ordering of nameplates.

3.1.2 Install nameplates on the front of the equipment on a prominent flat surface. Attach the nameplates with non-rusting screws.

3.1.3 Provide red mimic bus as specified.

3.1.4 Provide an Excel spreadsheet with all Nameplates for review by the Owner and the Consultant prior to manufacturing. Submit as a shop drawing.

END OF SECTION

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1 **GENERAL**

1.1 RELATED WORK

1.1.1 Comply with relevant Sections of this and other Divisions of this Specification.

1.2 RELATED SECTIONS

1.2.1 Section 26 05 01 – Common Work Results – Electrical

1.2.2 Section 26 24 13 – Switchboards

1.2.3 Section 26 24 16 – Panelboards

1.2.4 Section 26 25 00 – Enclosed Bus Assemblies

1.2.5 Section 26 28 13 – Fuses – Low Voltage.

1.2.6 Section 26 28 16.13 – Enclosed Circuit Breakers

1.2.7 Section 26 28 16.16 – Enclosed Switches

1.2.8 Conform to relevant sections of specification for this and other Divisions.

1.3 SUMMARY

1.3.1 The short circuit analysis evaluates the adequacy of the electrical equipment to withstand or to interrupt the calculated maximum available short circuit current at its location.

1.3.2 The overcurrent device time-current coordination analysis determines the suggested settings and, where appropriate, the ampere ratings and types for the electrical power system protective devices to achieve the desired system protection and electrical service continuity goals.

1.3.3 The harmonic analysis is performed to provide a baseline model predicting the system's level of harmonic distortion. This information is then to be used to evaluate conformance to IEEE 519.

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- 1.3.4 The arc flash analysis calculates arc flash incident energy, flash protection boundary distances and personal protective equipment (PPE) to be used within the flash protection boundary. This analysis is required to meet CSA Z462 and NFPA 70E requirements.
- 1.3.5 For an existing electrical system, it may be required to perform a field survey to accurately model the analysis. The field survey shall include, but not limited to verification of transformers, meters, fuses, circuit breakers, relays, cable length, impedance and size of conductor, Busway type, etc., as required to perform an accurate analysis.
- 1.3.6 Complete engineering as-built one line diagrams shall be provided using engineering software.
- 1.3.7 The furnishing and the installation of Arc Flash warning labels shall be provided.
- 1.3.8 The company performing the studies shall have at least ten (10) years of experience performing such studies and shall be a registered professional engineer.
- 1.3.9 Studies shall be performed using the latest edition of one of the following software, unless otherwise noted:
 - 1.3.9.1 SKM System Analysis Power
 - 1.3.9.2 ETAP – Electrical Power Systems Analysis
- 1.4 ACCEPTABLE SERVICE PROVIDERS
 - 1.4.1 Acceptable companies to provide coordination study:
 - 1.4.1.1 Brosz and Associates
 - 1.4.1.2 Eastenghouse
 - 1.4.1.3 Enkompas
 - 1.4.1.4 G.T. Wood
 - 1.4.1.5 Pelikan
 - 1.4.1.6 Schneider Electric

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1.4.1.7 Eaton Electric

2 **STUDIES**

2.1 ELECTRICAL POWER SYSTEM STUDIES

2.1.1 An electrical system Coordination and Short Circuit Analysis:

2.1.1.1 Shall compare the calculated maximum fault current with interrupting ratings of overcurrent protective devices such as fuses and circuit breakers.

2.1.1.2 Shall investigate applicable short circuit series ratings and the protection of electrical equipment by current limiting devices.

2.1.1.3 Shall verify the adequacy of other equipment (such as transformers, switches, equipment bussing) to withstand the effects of the calculated maximum fault current levels.

2.1.1.4 Shall assist in the selection and/or determination of settings for relays, fuses and circuit breakers in order to provide best coordination and minimum Arc Flash.

2.1.1.5 Calculate the maximum available rms symmetrical three-phase short-circuit current at each significant location in the electrical system shall be made using a digital computer.

2.1.1.6 Shall simulate a bolted three phase fault at each point of consideration in the system, and calculate the maximum available short circuit current at that point without any reduction due to current limiting overcurrent devices which may be present.

2.1.1.7 Shall include appropriate motor generators and transformer short-circuit contributions (contribution and transformer data) at the appropriate locations in the system so that the computer calculated values represent the highest short-circuit current the equipment will be subjected to under fault conditions.

2.1.1.8 Shall include a tabular computer printout (three phase fault report and fault study summary) which lists the calculated short-circuit currents, X/R ratios, equipment short-circuit interrupting or withstand current ratings.

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- 2.1.1.9 Shall include a computer printout of input circuit data (feeder data) including 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.
- 2.1.1.10 Shall include a computer printout identifying the maximum available short-circuit current (short circuit comparison tables) in rms symmetrical amperes and the X/R ratio of the fault current for each bus/branch calculation.
- 2.1.1.11 Shall include a system one-line diagram which is a simplified version of the engineer's drawings showing only those parts of the electrical system under consideration.
- 2.1.2 An Overcurrent Device Time-Current Coordination Analysis is an organized effort to determine the settings and, where appropriate, the ampere ratings and types for the overcurrent protective devices in an electrical system. The objective of the coordination analysis is to effect a time current coordination among the devices which achieves the desired system protection and electrical service continuity goals.
- 2.1.2.1 The time-current coordination analysis shall be performed with the aid of a digital computer and shall include the determination of settings, ratings, or types for the overcurrent protective devices supplied.
- 2.1.2.2 Where necessary, an appropriate compromise shall be made between system protection and service continuity with system protection and service continuity considered to be of equal importance.
- 2.1.2.3 A sufficient number of computer generated log-log plots (time current curves) 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.

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- 2.1.2.4 Computer printouts shall accompany the log-log plots and shall contain descriptions for each of the devices shown, settings of the adjustable devices, short-circuit current availability at the device location when known, and device identification numbers to aid in locating the devices on the log-log plots and the system one-line diagram.
- 2.1.2.5 The study shall include a separate, tabular computer printout containing the suggested device settings of all adjustable overcurrent protective devices.
- 2.1.2.6 Significant deficiencies in protection and/or coordination shall be called to the attention of the owner or designated representative and recommendations made for improvements as soon as they are identified.
- 2.1.3 Arc-Flash Hazard Analysis
 - 2.1.3.1 The Analysis shall be performed with the aid of computer software intended for this purpose in order to calculate Arc-Flash Incident Energy (AFIE) levels and flash protection boundary distances.
 - 2.1.3.2 The Analysis shall be performed in conjunction with a short-circuit analysis and a time-current coordination analysis.
 - 2.1.3.3 Results of the 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, personal-protective equipment classes and AFIE levels.
 - 2.1.3.4 The Analysis shall be performed for minimum and maximum utility short circuit values.
 - 2.1.3.5 Analysis shall be performed upon all electrical equipment connected to transformers sized at 125kVA and above. This procedure is in accordance with IEEE Standard 1584-2018.
 - 2.1.3.6 The Arc-Flash Hazard Analysis shall be performed in compliance with IEEE Standard 1584-2018, the IEEE Guide for Performing Arc-Flash Calculations and NFPA 70E.

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- 2.1.3.7 The Arc-Flash Hazard Analysis shall include recommendations for reducing AFIE levels and enhancing worker safety. One or more additional reiterations of the analysis shall be performed in attempt to lower incident energy levels to desired level in consultation with the Owner and the consultant, but not more than category 2. If the categories cannot be achieved without the change out of existing equipment, recommendations shall be provided for such new equipment to reduce AIFE levels, which may be exercised at the Owner's discretion. The recommendations shall be discussed with the Owner consultant.
- 2.1.3.8 The proposed vendor shall demonstrate experience with Arc-Flash Hazard Analysis.
- 2.1.3.9 The proposed vendor shall demonstrate capabilities in providing equipment, services, and training to reduce Arc-Flash exposure and train workers in accordance with NFPA 70E and other applicable standards.
- 2.1.3.10 The proposed vendor shall demonstrate experience in providing equipment labels in compliance with ANSI Z535.4 to identify AFIE and appropriate Personal Protective Equipment classes and must also include the following information
- 2.1.3.10.1 Equipment Name
 - 2.1.3.10.2 AFIE flash hazard boundary
 - 2.1.3.10.3 AFIE value (cal/cm²)
 - 2.1.3.10.4 Hazard Risk Category
 - 2.1.3.10.5 System Voltage
 - 2.1.3.10.6 Limited Approach Boundary
 - 2.1.3.10.7 Restricted Approach Boundary
 - 2.1.3.10.8 Prohibited Approach Boundary

END OF SECTION

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1 **GENERAL**

1.1 REFERENCES

1.1.1 Read and be governed by Section 26 05 01 Common Work Results for Electrical.

1.2 RELATED WORK

1.2.1 Comply with relevant Sections of this and other Divisions of this specification.

1.3 REFERENCE STANDARDS

1.3.1 Follow elevator services work as per CAN 3-B44, and as described in Division 14 documents, except where specified otherwise.

1.4 DESCRIPTION OF SYSTEM

1.4.1 Division 26 work includes elevator, machine power supply, disconnect with associated relays, wiring, lighting, life safety and receptacle systems for machine rooms, pits, power, and life safety provisions and conduit and wiring to and for associated control, and transfer switch equipment, telephone line.

2 **PRODUCTS**

2.1 MATERIALS

2.1.1 Individual lockable fusible disconnect switches, or panelboards, with rating, number of poles, and configuration, as indicated and where required for:

2.1.1.1 Machine power.

2.1.1.2 Lensed lighting for machine room and pits on emergency.

2.1.1.3 Machine room and pit GFI receptacles on emergency.

2.1.1.4 Machine room exhaust fan, or A/C unit.

2.1.1.5 Group controller power on emergency.

2.1.1.6 Power for cab exhaust fan.

2.1.1.7 Cab lighting.

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2.1.2 All outlet, junction and pull boxes, cover plates, terminal cabinets, conduits, cable troughs, plywood backboards, sleeves, caps, pulling cables and required conductors, are described elsewhere in this Specification.

2.2 ELEVATOR WIRING

2.2.1 Provide conduit, wiring, fittings, disconnect switches, and auxiliary devices to wire into service and elevators as called for herein, shown on the drawings required by the elevator contract and as required by TSSA.

2.2.2 For each elevator provide:

2.2.2.1 A 600 V 3-phase power service (or as indicated on drawings) to include a protective device at the distribution point, a fusible disconnect switch in the elevator machine room located on the lock-jamb side of the entrance door to the room and feeder from the distribution point through the disconnect switch in the elevator machine room. The disconnect switch shall be fused and be complete with auxiliary contacts to connect to elevator controller.

2.2.2.2 Provide dedicated ground in machine room for each elevator disconnect and to each elevator controller and dispatcher.

2.2.2.3 A separate 120 V, 15A lighting branch circuit to include a protective device at the distribution point, a fusible disconnect switch located in the elevator machine room. The disconnect switch to be located on the lock-jamb side of the elevator machine room entrance door. Provide wiring from the distribution point through the disconnect switch in the elevator machine room.

2.2.2.4 A 120V, 20A dedicated circuit with fused disconnect switch in machine room for security card reader packs including conduit and wiring to controllers.

2.2.2.5 A 120V, 20A dedicated circuit with fused disconnect switch in machine room for CCTV cameras including conduit and wiring to controllers.

2.2.2.6 A 120V, 20A dedicated circuit with fused disconnect switch in machine room for media screens including conduit and wiring to controllers.

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- 2.2.2.7 A separate 120V, 15A, GFCI duplex receptacle in the elevator machine room supplying no other receptacles. Provide one dedicated receptacle per elevator.
- 2.2.2.8 21 mm conduit and 4-pair telephone cable from the telephone backboard to the terminal box complete with terminal strip in the elevator machine room.
- 2.2.2.9 21 mm conduit and wiring from elevator to the local fire alarm data gathering panel for fire alarm system interface.
- 2.2.2.10 A separate 120V, 15A feed to the elevator equipment duplex or triplex controller.
- 2.2.2.11 A 2-wire pre-transfer signal wiring from the transfer switch upstream of the elevator to the elevator controller.
- 2.2.3 Provide 27 mm conduit from each elevator controller to the remote elevator control station. All wiring in these conduits shall be supplied by elevator contract and installed in this contract.
- 2.2.4 Provide a 35 mm spare conduit from each Elevator Machine Room to the Central Alarm and Control Facility (CACF) room.
- 2.2.5 All wiring required between hoistways and elevator machine room and all wiring shall be supplied by the Elevator Contractor to be provided by the Electrical Contractor. All associated conduit raceways required for such wiring shall be the responsibility of the Electrical Contractor.
- 2.3 FIRE ALARM PROVISIONS
- 2.3.1 Fire and smoke detectors in following spaces. Interconnection for these devices to the elevator controller shall be provided through auxiliary contacts on the fire alarm control panel or auxiliary contact directly from the devices themselves.
 - 2.3.1.1 Elevator Machine Room
 - 2.3.1.2 Top of hoistway
 - 2.3.1.3 Bottom of hoistway
 - 2.3.1.4 All elevator lobby areas.

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2.3.2 Conduit and wiring from smoke detectors in machine room to elevator controllers.

2.3.3 Fire alarm signals to the elevator controllers in the machine room for automatic emergency recalling of elevators.

3 **EXECUTION**

3.1 INSTALLATION

3.1.1 Install conduits, conductors, and make connections, as required for:

3.1.1.1 Power.

3.1.1.2 Lighting.

3.1.1.3 Life Safety System.

3.1.1.4 Intercommunication control systems.

3.1.1.5 Security and Music system(s).

3.1.2 Electrical Contractor shall obtain a copy of approved Elevator Shop drawing prior to commencing any installation work on the elevator services. Ensure all electrical service, including but not limited to power, conduit, wiring, etc., as noted in the elevator shop drawing are provided.

3.1.3 Interface between work for Division 14 and Division 26, for power systems, is at supply terminals of elevator controller(s) in machine room.

3.1.4 Install 25mm conduit from nearest communication/telephone room to a 600mm x 600mm plywood backboard in each elevator machine room. Install 19mm conduit system for telephones to each elevator controller.

3.1.5 In each elevator machine room, provide the required wires from each smoke detector auxiliary contract, to terminate at the elevator controllers.

3.1.6 Install lights, switches and receptacles for machine room, pit and shaft, where indicated.

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- 3.1.7 Provide six (6) #12 in 21 mm conduit from each elevator machine room to associated automatic transfer switch, to initiate emergency mode operation.
- 3.1.8 Provide six (6) #12 in 21 mm conduit from each elevator machine room to Life Safety System control panel to initiate recall mode.
- 3.1.9 Provide separate 50mm conduit from each elevator shaft to Security desk for dispatch panel provisions. Install control wiring within these conduits. Wiring to be supplied by Division 14.
- 3.1.10 Provide 27mm conduit between each elevator machine room.
- 3.1.11 For hydraulic elevators, provide on the main disconnect switch, a CSA approved, positive action auxiliary interlock switch that prevents accidental “down” operation, when open, as required by and as approved by the Ontario Ministry of Consumer and Commercial Relations (Elevator Branch), and wire to controller.

END OF SECTION

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1 **GENERAL**

1.1 SUMMARY

1.1.1 Related Documents:

1.1.1.1 Drawings and general provisions of the Contract/ Subcontract apply to this Section, including General and Supplementary conditions and all Division Specifications Sections, apply to this Section.

1.1.1.2 This section covers the Contractor's responsibility for commissioning; each subcontractor or installer responsible for installation of a particular system or equipment item to be commissioned is responsible for the commissioning activities relating to that system or equipment item

1.1.1.3 Review these documents for coordination with additional requirements and information that apply to work under this Section.

1.1.1.4 The Commissioning Authority (who will act on behalf of the Owner) scope of work includes the requirements as outlined by LEED CaGBC for New Construction 2009 and the separation in scope is for Fundamental Commissioning and Enhanced Commissioning, as applicable to the project.

1.1.2 Section Includes:

1.1.2.1 This section specifies the unique responsibilities that are a part of, or are related to the commissioning process for the electrical systems. Electrical systems include those listed in Division 01 Section "General Commissioning Requirements" as being commissioned. All statements are the responsibility of the Subcontractor, unless specifically stated otherwise.

1.1.2.2 Electrical testing specified for systems not listed as formally commissioned are not under the commissioning umbrella and are not governed by this section.

1.1.2.3 Electrical Systems Commissioning consists of static checks of component and system installations and review of all electrical testing executed by Authorities Having Jurisdictions / Independent Electrical Testing Authority/ CTC (Certified Testing Company) .

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- 1.1.2.4 Electrical Systems Commissioning consist of testing of monitoring, alarms and communication from the Electrical Systems to other building systems.
- 1.1.2.5 Electrical Systems Commissioning consists of verification of the operation normal and emergency power including but not limited to the resumption of power after power transfers and /or power loss.
- 1.1.2.6 The Commissioning Authority or Owner will review and approve, prior to use, all test procedures and forms used and will witness a varying fraction of the initial checks and testing performed by the Subcontractor. The Commissioning Authority will review the completed check and test documentation of the Subcontractor of all checks and tests.
- 1.1.2.7 Electrical testing requirements are found in various sections in Division 01 and in Division 26 (Division 01 Section "General Commissioning Requirements" and this section). It is not the intent of the commissioning process or these specifications to duplicate efforts or to require the Subcontractor to perform any check or test twice. Checks and testing by the Subcontractor are expected to occur once in the normal sequence of installation and checkout, if appropriate coordination has occurred allowing the Owner and the Commissioning Authority to witness installations and initial testing. Identical electrical checks and testing requirements in both Division 01 and Division 26 are referring to the same event.
- 1.1.2.8 The test requirements listed in this section do not release the Subcontractor from the obligation to perform all other appropriate, industry standard, manufacturer-recommended or code-required checks and tests.
- 1.1.2.9 Testing Participants. The work of this section shall be performed by parties identified in the Check and Testing Responsibility Table-a supplement to Division 01 Section "General Commissioning Requirements". Static checks and testing shall be fully documented according to provisions in Division 01 Section "General Commissioning Requirements".
- 1.1.3 Related Sections:
 - 1.1.3.1 Division 01 Section General Requirements
 - 1.1.3.1.1 Section 01 33 00 Submittal Procedures
 - 1.1.3.1.2 Section 01 33 29 General LEED Requirements

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1.1.3.1.3 Section 01 77 00 Closeout Procedures

1.1.3.1.4 Section 01 78 00 Closeout Submittals

1.1.3.2 Division 26 Electrical Sections

1.2 REFERENCES

1.2.1 General:

1.2.1.1 The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.

1.2.1.2 Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.

1.2.1.3 Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.

1.2.1.4 Refer to Division 23 Section "Common Results for HVAC" for codes and standards, and other general requirements.

1.2.2 Standards:

1.2.2.1 ASHRAE Guideline 0 – The Commissioning Process, 2013

1.2.2.2 ASHRAE Guideline 1.1 – The HVAC&R Technical Requirements for the Commissioning Process, 2012

1.2.2.3 ASHRAE Standard 202 - Commissioning Process for Building and Systems, 2013

1.2.2.4 CSA Z320-11 – Building Commissioning

1.2.2.5 CaGBC LEED V4 BD+C

1.2.2.6 ANSI / NETA Standards

1.2.2.7 Canadian Electrical Safety codes

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1.3 DESCRIPTION

- 1.3.1 The purpose of commissioning is to ensure the Owner that work has been completed as specified and that systems are functioning in the manner as described in Division 26 Section "Common Results for Electrical" and specified system operating criteria. It will assist operating staff training and familiarization with new systems. It will serve as a quality assurance program to reduce post-occupancy critical systems operational difficulty or failure. It will, also, be used to develop test protocol and record the associated test data in an effort to advance the building systems from a state of substantial completion to a full dynamic operation.
- 1.3.2 Commission will commence after startup of equipment and systems have been confirmed as under power, meggered, with confirmed verification of safeties and protective devices.
- 1.3.3 Commissioning work shall include, but not be limited to:
- 1.3.3.1 Attendance at all Commissioning Meetings.
- 1.3.3.2 Preparation of Commissioning Plan.
- 1.3.3.3 Preparation of Commissioning Schedule.
- 1.3.3.4 Development and completion of Commissioning Report forms and check sheets for each system and piece of equipment.
- 1.3.3.5 Demonstration to the Owner and Consultant(s) that the equipment/system have been installed per contract documents.
- 1.3.3.6 Preparation of O&M Manual.
- 1.3.3.7 Preparation of Record Drawings.
- 1.3.3.8 Start-up and verification of systems and equipment.
- 1.3.3.9 Performance testing of equipment.
- 1.3.3.10 Review and verification of Testing, Adjusting and Balancing work and report.
- 1.3.3.11 Correction of all deficiencies and performance deviations.

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- 1.3.3.12 Demonstration and training to Owner and Consultant of all systems and equipment provided in this Division.
- 1.3.3.13 Preparation and assembly of Commissioning Documentation.
- 1.3.3.14 Coordination of Division 23 - HVAC commissioning activities with all other trades.
- 1.3.3.15 Coordinate with and assist Division 21 - Fire Suppression, Division 22 - Plumbing, Division 25 - Integrated Automation, and 26 - Electrical for Commissioning of their respective works.
- 1.3.4 The milestones associated with commissioning are outlined below:
 - 1.3.4.1 Installation Verification
 - 1.3.4.2 System Start-Up.
 - 1.3.4.3 Functional Performance Testing.
 - 1.3.4.4 Issues Review and Retesting
 - 1.3.4.5 Operations and Maintenance Manual Review
 - 1.3.4.6 Building Operations Demonstration and Training
 - 1.3.4.7 Seasonal Testing and Warranty Review (as required)
- 1.3.5 Operational staff training is essential to the commission process and will run concurrently with the commissioning milestones listed above.
- 1.3.6 The Commissioning Team will include representatives of the Owner, Construction and Installing Subcontractors, Test and Balance Subcontractor, FMCS Subcontractor and Construction Subcontractor's Commissioning Agent. Equipment manufacturer's representatives will be present for start-up as specified in the equipment specification sections and for equipment training.
- 1.4 **SYSTEMS TO BE COMMISSIONED**
 - 1.4.1 Commissioning will be performed on the following systems:
 - 1.4.1.1 Electrical Distribution
 - 1.4.1.1.1 Medium-Voltage Distribution

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- 1.4.1.1.2 Low-Voltage Electrical Distribution
- 1.4.1.1.3 Bus Duct
- 1.4.1.2 Electrical Power Generating and Storing Equipment
 - 1.4.1.2.1 Generators
 - 1.4.1.2.2 Battery Equipment
 - 1.4.1.2.3 Transfer Switches
- 1.4.1.3 Lighting and Lighting Controls including Dimming Controls
 - 1.4.1.3.1 Interior Lighting
 - 1.4.1.3.2 Exterior Lighting
 - 1.4.1.3.3 Emergency Lighting
- 1.4.1.4 Underground Ducts and Raceways for Electrical Systems
- 1.4.1.5 Identification of Electrical Systems
- 1.4.1.6 Switchboards
- 1.4.1.7 Panelboards
- 1.4.1.8 Electrical Power Monitoring and Control
- 1.4.1.9 Lightning Protection System
- 1.4.1.10 Surge Protective Devices
- 1.4.1.11 Fire Alarm System
- 1.5 **SUBMITTALS**
 - 1.5.1 See Section 26 05 01 – Common Work Results, for submittal procedures.
 - 1.5.2 Construction Schedule with Commissioning Milestones
 - 1.5.3 Updated Submittals: Keep the Commissioning Authority informed of all changes to control system documentation made during programming and setup; revise and resubmit when substantial changes are made.

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- 1.5.4 Calibration certifications of all testing equipment to be used during functional testing period
- 1.5.5 Equipment Factory Acceptance Tests
- 1.5.6 Start up and testing procedures
- 1.5.7 Start-Up Reports including but not limited to Manufacturer Start-Up Reports, prefunctional checklists, pressure and leakage tests, BAS point to point verification reports and graphics and TAB reports for CxA Approval and Review.
 - 1.5.7.1 Proof of Coordination of Protective Devices including:
 - 1.5.7.2 Settings of overcurrent trips, relays, circuit breakers, fuses and ground fault
 - 1.5.7.3 Short Circuit Analysis
 - 1.5.7.4 Verification of incoming services
 - 1.5.7.5 Harmonic Studies
 - 1.5.7.6 Megger Tests and associated insulation resistance testing
- 1.5.8 Method of Procedures as required for any required shut-downs for testing
- 1.5.9 Training Requirements, agenda, and schedule
 - 1.5.9.1 Draft Training Plan: In addition to requirements specified in Section 01 79 00, include:
 - 1.5.9.1.1 Follow the recommendations of ASHRAE Guideline 1.
 - 1.5.9.1.2 Control system manufacturer's recommended training.
 - 1.5.9.1.3 Demonstration and instruction on function and overrides of any local packaged controls not controlled by the HVAC control system.
 - 1.5.10 Training Manuals: See Section 01 79 00 for additional requirements.
 - 1.5.10.1 Provide three extra copies of the controls training manuals in a separate manual from the O&M manuals.

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- 1.5.11 Operations and Maintenance Manuals
 - 1.5.11.1 Electrical Systems O&M Manual Requirements. In addition to documentation specified elsewhere, compile and organize at minimum the following data on the electrical system:
 - 1.5.11.1.1 Specific step-by-step instructions on how to perform and apply all functions, features, modes, etc. mentioned in electrical training sections of this specification and other features of this system. Provide an index and clear table of contents. Include the panel schedules, single line diagrams, and alarms and monitoring points at Control Panels and HMIs
 - 1.5.11.1.2 Full as-built set of drawings and single line diagrams.
 - 1.5.11.1.3 Full as-built sequence of operations for each piece of equipment.
 - 1.5.11.1.4 Full print out of all test and verification reports, and acceptance of the system performed by the Contractor, and / or Certified Testing Company.
 - 1.5.11.1.5 Electronic copy on disk of the entire program for this facility.
 - 1.5.11.1.6 Maintenance instructions, including calibration requirements, emergency and protective settings.
 - 1.5.11.1.7 Warranty requirements.
- 1.6 QUALITY ASSURANCE
 - 1.6.1 Qualifications:
 - 1.6.1.1 The CTC (Certified Testing Company) performing the work of this section shall be qualified to test electrical equipment and is a NETA (National Electrical Testing Association)-certified testing agency. The CTC shall not be associated with the manufacturer of equipment or systems under test.
 - 1.6.2 Test Equipment:
 - 1.6.2.1 The Subcontractor shall provide all test equipment necessary to fulfill the checks and testing requirements. Test equipment shall have been calibrated within one (1) year of its use on the project.
 - 1.6.2.2 Refer to Division 01 Section "General Commissioning Requirements" for additional requirements.

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2 PRODUCTS

2.1 COMMISSIONING PLAN

2.1.1 The commissioning plan shall outline the organization, scheduling, team members, and documentation pertaining to the overall commissioning process.

2.2 NARRATIVE DESCRIPTIONS

2.2.1 A narrative description of the design intents of the systems and their intended modes of sequences of operation.

2.3 PREFUNCTIONAL CHECKLISTS

2.3.1 Draft Prefunctional Checklists and Functional Test Procedures for Control System: Detailed written plan indicating the procedures to be followed to test, checkout and adjust the control system prior to full system Functional Testing; include at least the following for each type of equipment controlled:

2.3.1.1 System name.

2.3.1.2 List of devices.

2.3.1.3 Step-by-step procedures for testing each controller after installation, including:

2.3.1.4 Process of verifying proper hardware and wiring installation.

2.3.1.5 Process of downloading programs to local controllers and verifying that they are addressed correctly.

2.3.1.6 Process of performing operational checks of each controlled component.

2.3.1.7 Plan and process for calibrating valve and damper actuators and all sensors.

2.3.1.8 Description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.

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- 2.3.1.9 Copy of proposed log and field checkout sheets to be used to document the process; include space for initial and final read values during calibration of each point and space to specifically indicate when a sensor or controller has “passed” and is operating within the contract parameters.
- 2.3.1.10 Description of the instrumentation required for testing.
- 2.4 FUNCTIONAL FTPTEST PLANS (FTPS) (UPDATE TO REFLECT CURRENT TEST PLANS)
- 2.4.1 The FTP procedures at the minimum shall consist of the following sections:
 - 2.4.1.1 Narrative Description:
 - 2.4.1.1.1 This section provides a narrative description of the design intents of the systems and their intended modes of sequences of operation.
 - 2.4.1.2 Testing Prerequisites:
 - 2.4.1.2.1 This section contains verification that primary mechanical, electrical, and controls systems that support or interact with the system that the FTP is prepared against are completed, tested and operational.
 - 2.4.1.3 Installation Verification:
 - 2.4.1.3.1 This section contains verification that the system installation is completed and is ready for commissioning.
 - 2.4.1.4 Commencement of Functional Performance Testing:
 - 2.4.1.4.1 This section records the date and time of the start of system commissioning.
 - 2.4.1.5 System Condition Prior to Starting Performance Testing:
 - 2.4.1.5.1 This section records the current set points and parameters of the system at the start of commissioning.
 - 2.4.1.6 Functional Performance Test:
 - 2.4.1.6.1 This section shall provide the following:

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- 2.4.1.6.1.1 Sequential steps required to set parameters and conditions required to test component and functions throughout intended ranges of operation.
- 2.4.1.6.1.2 Full range of checks and tests carried out to determine if electric and pneumatic connections, components, subsystems, systems and interfaces between systems function in accordance with the contract documents and design intents.
- 2.4.1.6.1.3 All modes and sequences of control operations, interlocks and conditional control responses and specified responses to abnormal emergency conditions.
- 2.4.1.7 End of Functional Performance Test:
 - 2.4.1.7.1 This section records the date and time of the end of system commissioning.
- 2.4.1.8 Issue Log:
 - 2.4.1.8.1 This section records notes or remarks during system commissioning.
 - 2.4.1.8.2 List systems modifications, not required by the Contract Documents, but provided by the Subcontractor. List other questions regarding such system modifications.
 - 2.4.1.8.3 List problems discovered during Commissioning that were corrected.
 - 2.4.1.8.4 List problems discovered during Commissioning that were not corrected.
 - 2.4.1.8.5 List recommended party that should take action on these problems.

3 **EXECUTION**

3.1 SUBMITTALS

- 3.1.1 Submit under provisions of Divisions 01 Section "General Requirements" and "Special Procedures."

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- 3.1.2 Sixty (60) days before any testing is conducted, submit an overall testing plan and schedule for electrical systems that lists the equipment, modes to be tested, dates of testing and parties conducting the tests. Put these tests into the master construction schedule. Keep this plan and schedule updated.
- 3.1.3 Additional submittal requirements relative to commissioning are found in this Section and in Division 01 Section "General Commissioning Requirements" and Division 01 Section "General Requirements."
- 3.2 COMMON RESPONSIBILITIES
- 3.2.1 The following are responsibilities applicable to all electrical systems being commissioned.
- 3.2.2 The general commissioning requirements and coordination are detailed in Division 01 Section "General Commissioning Requirements" and apply to electrical systems. The Subcontractor shall be familiar with all parts of Division 01 Section "General Commissioning Requirements" and the commissioning plan issued by the Commissioning Authority and shall execute all commissioning responsibilities assigned to them in the Contract Documents.
- 3.2.3 The work of this Section shall be performed by a CTC (Certified Testing Company, Electrical), by the EC (Electrical Subcontractor), or the MSR (Manufacturer's Service Representative). The Commissioning Authority has some testing responsibilities for some equipment. The specified checks and static tests are conducted by any of the above listed parties, but the tests requiring measurements or special tools or skills are generally conducted only by the CTC. The Check and Testing Responsibility Table, included as a supplement to Division 01 Section "General Commissioning Requirements" provides specific allocation of checklist oversight and testing responsibilities. The CTC, EC, and MSR shall document all checks and testing on check and test procedure forms submitted to and approved by the Commissioning Authority prior to testing.

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- 3.2.4 The Subcontractor shall notify the Owner ahead of time when commissioning activities not yet performed or not yet scheduled will delay construction. The Subcontractor shall be proactive in seeing that commissioning processes are executed and that the CA has the scheduling information needed to efficiently execute the commissioning process.
- 3.2.5 The Subcontractor shall respond to notices of issues identified during the commissioning process, making required corrections or clarifications and returning prompt notification to the Commissioning Authority according to the process given in Division 01 Section "General Commissioning Requirements".
- 3.2.6 When completion of a task or other issue has been identified as holding up any commissioning process, particularly functional testing, the Subcontractor shall, within two (2) days of notification of the issue, notify the Commissioning Authority in writing providing an expected date of completion. The Subcontractor shall notify the Commissioning Authority in writing within one day of completion. It is not the responsibility of the Commissioning Authority to obtain this status information through meeting attendance, asking questions or field observation
- 3.2.7 Construction Checklists. The Commissioning Authority or Subcontractor shall develop checklists as noted in the list of commissioned systems in Division 01 Section "General Commissioning Requirements", following the process described in Division 01 Section "General Commissioning Requirements" and in this Section. At a minimum, for a given piece of equipment, checks from the inspection checklists in NETA Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems shall be included in the electrical checklists. The Subcontractor shall execute and document all checks.
- 3.2.8 Check and testing procedure and startup plan development and execution responsibilities are described in the Check and Testing Responsibility Table in the supplements to Division 01 Section "General Commissioning Requirements".
- 3.2.9 The Subcontractor shall review design documents, shop drawings and O&M manuals and manufacturer recommended installation and testing procedures of each system installation.

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- 3.2.10 The Subcontractor shall monitor installation to ensure the equipment, configuration and quality of construction meets the design requirements, approved submittals and shop drawings.
- 3.2.11 The Subcontractor shall develop test procedures and forms and execute and document testing according to the requirements of this Section, Division 01 Section "General Commissioning Requirements" and other specification sections containing testing requirements.
- 3.2.12 Tests of energized equipment shall be conducted when the equipment is operating at its normal capacity. This may require some tests to be conducted after occupancy.
- 3.2.13 Training and Orientation. The Subcontractor shall follow the facility staff orientation and training requirements as described in Division 01 Section "Demonstration and Training" and other applicable technical sections.
- 3.2.14 Operation And Maintenance (O&M) Manuals. Refer to Division 01 Section "General Commissioning Requirements" and Division 01 Section "General Requirements" for requirements for O&M manuals.

4 **EQUIPMENT-SPECIFIC VERIFICATION AND TESTING REQUIREMENTS**

4.1 SUMMARY

- 4.1.1 This Part specifies the check and testing requirements for electrical components and systems. From these requirements, the Commissioning Authority or Subcontractor will develop detailed procedures and forms. The general testing process, requirements and test method definitions are described in Division 01 Section "General Commissioning Requirements".

4.2 CHECKS AND TESTS

- 4.2.1 Checks are intended to begin upon completion of a component or equipment installation. Testing generally occurs later when systems are energized or nearing that point. Beginning system testing before full completion, does not relieve the Subcontractor from fully completing the system as soon as possible, including all construction checklists and may require retesting portions of the system once all components are fully functioning.

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- 4.2.2 Refer to Division 01 Section "General Commissioning Requirements" for specific details on non-conformance issues relating to construction checklists and tests. Refer to Division 01 Section "General Commissioning Requirements", for common requirements of deferred testing and to articles in this Section.
- 4.2.3 The check and test procedures and record forms shall contain the following:
- 4.2.3.1 The Subcontractors executing the checks or tests.
- 4.2.3.2 A list of the integral components being inspected and tested, equipment tag numbers, manufacturer, model number, pertinent performance information / rating data.
- 4.2.3.3 Test equipment used.
- 4.2.3.4 Construction checklists associated with the components, if any.
- 4.2.3.5 Any special required conditions of the check or test for each procedure.
- 4.2.3.6 Items, conditions or functions to be inspected, verified or tested, the checks and testing method given and a place provided with results recorded.
- 4.2.3.7 Acceptance criteria (or reference by specific table where the acceptance criteria is found).
- 4.2.3.8 For each procedure, list the technician performing check or test and company, witnesses of the tests and dates of tests.
- 4.2.3.9 Sampling strategies used.
- 4.2.4 The test procedures for dynamic equipment like lighting controls, emergency generator or fire alarm shall contain more step-by-step procedures with expected responses similar to the sample test provided as a supplement to Division 01 Section "General Commissioning Requirements". The test procedures and forms for more static components like panel boards, switch gear, circuit breakers, transformers, etc., can be more checklist-like in format. For each piece of equipment, checks and test procedures and their documentation record forms may be different documents or combined in the same document, but checks and tests should be grouped.

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4.2.5 At the Commissioning Authority's discretion, if large numbers or repeated deficiencies are encountered, the Subcontractor shall test and troubleshoot all remaining systems at issue on their own before commissioning with the Commissioning Authority will resume.

4.2.6 Sampling for Identical Units. When there are a number of identical units, at the Commissioning Authority's discretion, some or all procedures of a test for a piece of equipment or assembly may be omitted when these same tests on other pieces of identical equipment or assemblies were conducted without deficiency.

4.3 EQUIPMENT-SPECIFIC TESTING REQUIREMENTS

4.3.1 The following paragraphs define the testing requirements for each type of system or feature that is a part of the project. The Commissioning Authority shall use this information to develop specific testing procedures for each of the systems to be commissioned. The Subcontractor shall be responsible for support, execution and coordination of these tests as described in the project specifications including intersystem tests and interlocks with systems in Divisions other than Division 26.

4.3.2 The Commissioning Authority and Subcontractor shall coordinate with the project LEED coordinator to verify that LEED requirements for testing electrical systems are included in the tests.

4.3.3 Common Testing Requirements

4.3.3.1 The following requirements apply to all electrical systems and features that are to be commissioned when referenced below. Tests shall:

4.3.3.1.1 Verify functionality and compliance with the design intent for each individual sequence module in the sequences of operation. Verify proper operation of all control strategies, energy efficiency and self-diagnostics features by stepping through each sequence and documenting equipment and system performance. Test every step in every written sequence and other significant modes, sequences and operational features not mentioned in written sequences; including startup, normal operation, shutdown, scheduled on and off, unoccupied and manual modes, safeties, alarms, over-rides, lockouts and power failure.

4.3.3.1.2 Verify all alarm and high and low limit functions and messages generated on all points with alarm settings.

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- 4.3.3.1.3 Verify integrated performance of all components and control system components, including all interlocks and interactions with other equipment and systems.
- 4.3.3.1.4 Verify shut down and restart capabilities both for scheduled and unscheduled events (e.g. power failure recovery and normal scheduled start/stop).
- 4.3.3.1.5 When applicable, demonstrate a full cycle from off to on and no load to full load and then to no load and off.
- 4.3.3.1.6 Verify time of day schedules and setpoints.
- 4.3.3.1.7 Verify all energy saving control strategies.
- 4.3.3.1.8 Verify that monitoring system graphics are representative of the systems and that all points and control elements are in the same location on the graphic as they are in the field.
- 4.3.3.1.9 Verify operator control of all commandable control system points including proper security level access.
- 4.3.3.1.10 When testing procedures for commissioned equipment are listed in NETA Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems the NETA test procedures shall be part of the testing requirements of this specification. Additional testing procedures may be listed in this specification.
- 4.3.3.1.11 Common Acceptance Criteria
- 4.3.3.2 The following common acceptance criteria apply to all mechanical equipment, assemblies and features:
 - 4.3.3.2.1 For the conditions, sequences and modes tested, the equipment, integral components and related equipment shall respond to varying loads and changing conditions and parameters appropriately as expected, according to the sequences of operation, as specified, according to acceptable operating practice and the manufacturer's performance specifications. Verify that equipment operates within tolerances specified in: governing codes, acceptance criteria contained in the construction documents, manufacturer's literature and according to good operating practice.

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- 4.3.3.2.2 Systems shall accomplish their intended function and performance.
- 4.3.3.2.3 All safety trips shall require a manual reset to allow a system restart.
- 4.3.3.2.4 Resetting a manual safety shall result in a stable, safe, and predictable return to normal operation by the system.
- 4.3.3.2.5 Safety circuits and permissive control circuits shall function in all possible combinations of selector switch positions (hand, auto, inverter, bypass, etc.).
- 4.3.3.2.6 Other acceptance criteria is given in the equipment testing requirements articles or referenced standards.
- 4.3.3.2.7 Additional acceptance criteria will be developed by the Commissioning Authority when detailed test procedures are developed.
- 4.3.3.2.8 When testing procedures for commissioned equipment are listed in NETA Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems the NETA performance criteria shall apply.
- 4.3.4 Equipment-Specific Testing Requirements:
 - 4.3.4.1 Scheduled Lighting Controls.
 - 4.3.4.1.1 Apply the applicable common testing requirements and acceptance criteria.
 - 4.3.4.1.2 Test Methods. Utilize active testing, and trending when available. If able to trend, trend all zones over a week period and follow the trending guidelines in Division 23 Section "Commissioning of HVAC".
 - 4.3.4.1.3 Sampling Strategy. Manually test 20 percent of the zones or at least four. If more than 10 percent or two zones fail, test another 10 percent sample. If the second sample fails the Subcontractor shall document retesting on all zones on their own using a Commissioning Authority approved form.
 - 4.3.4.2 Occupancy Sensor Lighting Controls.

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- 4.3.4.2.1 Apply applicable common testing requirements and acceptance criteria. Test all the units functions, including sensor sensitivity and time-to-OFF functions and ensure that sensor location is proper and won't be tripped inadvertently by other occupants and movements outdoors, etc.
- 4.3.5 Test Methods. Utilize active test methods.
- 4.3.5.1 Sampling Strategy. Test 10 percent of the sensors or six, whichever is greater. If more than 10 percent or two sensors fail, test another 10 percent sample. If the second sample fails the Subcontractor shall document retesting on all units on their own using a Commissioning Authority approved form.
- 4.3.5.2 Additional Acceptance Criteria. Reasonable sensitivity, no inadvertent trips, lights go off within 15 seconds of design.
- 4.3.5.3 Emergency Generator System
 - 4.3.5.3.1 Apply applicable common testing requirements and acceptance criteria.
 - 4.3.5.3.2 Test according to NETA 7.22.1 and NFPA 110 5.13 and per Division 01 Section "Special Procedures."
 - 4.3.5.3.3 Record all data and results.
 - 4.3.5.3.4 Include the following tests:
 - 4.3.5.3.4.1 When in enclosed spaces, verify combustion and ventilation air damper functions and pressure drop of exhaust.
 - 4.3.5.3.4.2 Verify fuel oil system, diesel fuel storage tank, and level and low fuel indication alarms.
 - 4.3.5.3.4.3 Verify all alarms, meters, and auxiliaries and interlocks to the BAS.
 - 4.3.5.3.5 Building Test. Under a cold generator condition, provide full utility power interruption under load and cause emergency power service operation. Include all UPS in this test. Load bank the UPS if necessary during test.
 - 4.3.5.3.6 Verify all generator functions
 - 4.3.5.3.7 Test auto-transfer switch operation under actual voltage drop, per specification Division 26 Section "Automatic Transfer Switch with Bypass-Isolation Feature".

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- 4.3.5.3.8 Using a power line disturbance monitor, measure the following times: power failure to engine start command, engine start command to engine start (cranking time), engine start to point where generator is at proper volts and frequency and total time from power failure until ATS switches.
- 4.3.5.3.9 Verify system reporting & control monitoring point-to-point
- 4.3.5.3.10 Verify that each circuit and equipment served by emergency power, does power up. Verify all functions of the Emergency Power Response Matrix.
- 4.3.5.3.11 Verify appropriate mechanical system and control system restart functions of all equipment served by the generator.
- 4.3.5.4 Step Load Tests.
 - 4.3.5.4.1 Test at 0 percent, 25 percent, 50 percent and 100 percent of full load. Measure voltage and frequency and record all gaged engine conditions. The test shall consist of running the engine-generator while connected to the resistive load bank for one hour, and then shutting down for 30 minutes.
 - 4.3.5.4.2 Test for multiple generator starts.
 - 4.3.5.4.3 Verify all operational data and start-up minimum time interval.
 - 4.3.5.4.4 Verify 2-hour full load run full load bank (building load can serve as part of the load).
 - 4.3.5.4.5 Verify all generator-running characteristics.
 - 4.3.5.4.6 Verify battery-charging system.
- 4.3.5.5 Fire Alarm.
 - 4.3.5.5.1 Apply applicable common testing requirements and acceptance criteria.
 - 4.3.5.5.2 Test the fire alarm and High Sensitivity Smoke Detection systems according to NFPA 110-1999 7-1 through 7-2, and specification Division 28 Sections "High Sensitivity Air Sampling Smoke Detection System" and "MXL Fire Detection & Alarm System".
 - 4.3.5.5.3 Document all test procedures and results. A fire alarms system printout of the test annunciation record is not sufficient documentation.

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- 4.3.5.5.4 Verify all fire alarm panel functions, alarms and troubles.
- 4.3.5.5.5 Verify all functions in the Fire Alarm Response Matrix, including remote communications.
- 4.3.5.5.6 Verify resetting of all equipment affected by an alarm.
- 4.3.5.5.7 Sampling Strategy. Verify device functions and annunciations per using the approved sampling rate of the authority having jurisdiction and per LBNL.

END OF SECTION

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1 **GENERAL**

1.1 REFERENCES

1.1.1 Section 26 05 01 – Common Work Results - Electrical

1.2 STANDARDS

1.2.1 Except as noted by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the Canadian Electrical Manufacturer's Association CSA and Measurement Canada.

1.2.2 Approved by Consumer and Corporate Affairs Canada (CCAC) and certification for legal sub-metering.

1.2.3 Listed by the Underwriters Laboratory Inc., Standard (UNUCNL file E124377), 1 and FCC Part 15, Subpart. J. FCC Class A is required for commercial installations. The system shall be approved by Industry and Science Canada of Measurement Canada AE0763, AE0763 Rev 1, AE019AE-97-0028, AE0818.

1.3 DESCRIPTION

1.3.1 Provide complete, working, computer based digital metering system (DMS) to break down and track Electricity measurements of the building.

1.3.2 The digital metering system shall be revenue-grade meter as certified by Measurement Canada and be in compliance with the requirements outlined in ANSI Standard C-12.1-2008 (Addendum E-01).

1.3.3 The DMS price will include all costs associated with the coordination of system installation, material supply, commissioning, installation verification, and customer training during the entire period of construction and system start-up.

1.3.4 The total number of electrical meters to be monitored by the DMS shall be as shown on the electrical single line drawing.

1.3.5 The electrical contractor will provide all labour, equipment, materials and services and install all interconnecting wire and conduit required for the Supplier's and/or Owner's digital metering system (DMS).

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- 1.3.6 Provide current transformers (CTs) and potential transformers (PTs) as required by meters.
- 1.3.7 The DMS Supplier will provide a detailed installation manual to the electrical subcontractor, which recognizes all applicable codes and requires final electrical as-built documentation.
- 1.4 SUBMITTALS
 - 1.4.1 Submit dimensioned drawings and manufacturers' data of the DMS components including but not limited to digital meter, pulse data logger, network controller, meter enclosure.
 - 1.4.2 Submit shop drawings in accordance with Section 26 05 01
 - 1.4.2.1 Interconnecting wiring diagram for the completely installed DMS.
 - 1.4.2.2 Data sheets for each system component.
 - 1.4.2.3 Operation and Maintenance manual.
 - 1.4.3 Any deficiencies in the shop drawings must be resolved in order to achieve the LEED Measurement and Verification credit EAc5.
 - 1.4.4 Submit shop drawings and manufacturer's data for the component items shown and specified under this section of the specification.
 - 1.4.5 Do not supply any equipment to this project prior to shop drawing review by the Consultant. Shop drawings shall be stamped and signed by the Contractor prior to submittal.
 - 1.4.6 Submit a one-line diagram of the proposed system configuration for review.
 - 1.4.7 After shop drawing review, the Approved Drawings will be issued to the Electrical Contractor for installation.
 - 1.4.8 At the completion of the Project, As-Built Drawings will be submitted by the DMS Supplier, who will prepare a complete manufacturer's manual including all As-Built Wiring Diagrams.
- 1.5 COMMISSIONING AND TRAINING
 - 1.5.1 After completion of the system testing, the Manufacturer shall conduct training of the Owner's operating and maintenance staff. Training will include both hardware items and computerized system operation.

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1.6 ACCEPTABLE MANUFACTURERS

- 1.6.1 Intellimeter Canada;
- 1.6.2 Quadlogic Controls Corp.;
- 1.6.3 Schneider Electric;
- 1.6.4 Eaton Electric.

1.7 ELECTRONIC POWER METERING

- 1.7.1 The meters shall be manually readable using local Liquid Crystal Display (LCD) via push-button and automatically readable utilizing Frequency Hopping Spread Spectrum Power Line Carrier Communication ("PLC").
- 1.7.2 The metering system shall consist of the Quadlogic MiniCloset-5, MiniCloset-5c, RSM-5, RSM-5c, S-20, S-10 & Transponder(s) or equal.
- 1.7.3 Meter shall be configured for commercial application and applied on 120/208V, 347/600V and 600V delta 3P3W nominal systems and as indicated on the drawings.
 - 1.7.3.1 Commercial/Industrial Use (kWh and Demand):
 - 1.7.3.1.1 120/208V and 347/600V, 3 phase/4 wire
 - 1.7.3.1.2 600V Delta, 3 phase/3 wire
 - 1.7.4 kW Demand shall be measured and recorded every 15 minutes. (Demand is factory configured in block intervals. Rolling (overlapping) time interval demand shall also be configurable as an option.) Demand shall be recorded along with the time and date at which it occurs. The meter shall be classed as a mass memory interval meter (meters which record and store the energy use by time). The demand interval and optional time-of-use schedules shall be factory programmed and stored in each meter. Daily peak demands shall be capable of being read by a remote computer.
- 1.7.5 The Meter shall have the following Testing and Certification:
 - 1.7.5.1 UL/CUL recognized
 - 1.7.5.2 Meets or exceeds requirements of ANSI C12.1, ANSI/IEE C37.90.2. ANSI/IEEE C37.90.1, and Measurement Canada.

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- 1.7.6 Each meter shall interface to the electrical load being measured with a direct voltage tap, up to 600 VAC, and with 0.1Amp or 5.0A secondary for split and solid core current transformers.
- 1.7.7 Monitoring
 - 1.7.7.1 Provide true RMS measurement of current, volts, %THD, kW, kVA, kVAR, kWh, power factor.
 - 1.7.7.2 The Meter shall have an accuracy of $\pm 0.5\%$ or better.
- 1.7.8 User Interface
 - 1.7.8.1 Reading shall be accessible on a local LCD display. The display shall consist of two rows of 16 characters on each row. The consumption reading shall be up to six (6) digits.
 - 1.7.8.2 Provide an IEC type optical port capable of direct connection to a laptop.
- 1.7.9 The system shall be a fully automated, microprocessor-based electric utility measurement system. The system shall be capable of measuring and recording the usage of electricity and shall be capable of communicating the reading to an optional on-site or remote computer (i.e. the billing computer) via modem or other means of communications.
- 1.7.10 The meter shall not depend on battery power for maintaining functionality. Meter shall monitor all metering parameters and perform communication tasks using a non-volatile flash memory. On-board battery shall only be used in power failure to maintain time, log incoming pulses (if applicable) and to store the data acquired within the incomplete interval at the time of the power failure.
- 1.7.11 Each meter shall be capable of reading minimum of four (4) dry contact, Form A pulse inputs to automate the reading of other utilities such as gas, water or BTU's. MiniCloset-5 and MiniCloset-5c shall be capable of reading up to 48 pulses.
- 1.7.12 Each meter shall be equipped with a clock/calendar that automatically accommodates leap years. The clock/calendar shall be backed up by battery and continue operating during power outages. The time and date shall be automatically synchronized by the Scan Transponder(s) and capable of being reset by a remote computer.

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- 1.7.13 Each meter shall be complete with internal CT termination and shorting and fuse block.
- 1.7.14 Revenue related metering parameters (i.e. demand intervals) shall be permanent and stored in each individual meter. It shall not be possible to change metering parameters through unauthorized access to the system.
- 1.7.15 Provide Phase Diagnostic Registers that include multipliers for amperage, voltage, watts, and line frequency. On a per-phase basis Phase Diagnostics shall include voltage, VAR phase shift, accumulated kWh and kVARh and instantaneous amps, watts, VAR's, VA's, phase angle (degrees displacement between current and voltage waveforms), and Power Factor.
- 1.7.16 Provide Event Diagnostic Registers that include time and date and the number of times the time has been changed, number of power downs, power ups and start ups with time and date of last occurrence, and the number of times the accumulated peak demand has been reset, also with the time and date of the last occurrence. Meters that communicate by Power Line Carrier Communications shall also include counts of properly received messages, rejected messages and the numbers of transmissions without replay.
- 1.7.17 On-board Memory Storage
 - 1.7.17.1 The meter shall maintain a minimum of 60-day log of daily Time-of-Use consumption, interval data and peak demand readings along with the time and date at which the daily peak demands occur. The consumptions recorded shall be the reading at the end of the Time-of-Use period of the end of the day. The peak demand recorded in the log shall be the peak demand for the Time-of-Use period for that day.
 - 1.7.17.2 Each meter shall maintain a minimum of 60-day date logging capacity consisting of fifteen (15) minute or hourly demands with time and date stamp.
 - 1.7.17.3 Memory shall be non-volatile.
- 1.7.18 Control power for the meter shall be obtained via the monitored voltage connections. A separate control power input is not allowed.
- 1.7.19 Communications Interface

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- 1.7.19.1 The system shall communicate with a remote computer using one or more of the methods noted below:
 - 1.7.19.1.1 The meter shall communicate over the electrical power wiring to a Scan Transponder via bi-directional, frequency hopping, spread spectrum power line carrier communications. These signals shall be capable of passing through a single 600/120V or 480/120V transformer. The Scan Transponder and each meter shall select the best available combination of phase, frequency range and baud rate for communication at any given time.
- 1.7.19.2 RS-485. Install per manufacture's guidelines and recommended wire specification.
- 1.7.19.3 All meters shall have as an option a local RS-485 serial port for direct connection to the PC.
- 1.7.19.4 Individual meters shall be capable of being equipped with a modem for direct connection to a telephone line if necessary.
- 1.8 **SCAN TRANSPONDER**
 - 1.8.1 Scan Transponders shall be installed to collect data from meters on a daily basis and provide a centralized data access point.
 - 1.8.2 All communication shall be direct between a Scan Transponder and each meter, and under the control of the Scan Transponder. Meters will not repeat messages from other meters nor will message routing be determined by meters.
 - 1.8.3 A Scan Transponder shall be provided for every 240 electric metering points and one Scan Transponder shall be provided per utility transformer or electrical service. Contractor shall provide required location, quantities and voltage connections for Transponders based on manufacture's specifications and instructions.
 - 1.8.4 Scan Transponder shall begin each communication with a meter with verification of clock and meter ID to ensure date integrity.
 - 1.8.5 The Scan Transponder shall download meter values in flash memory and shall hold at least 365 days worth of records.
 - 1.8.6 All communication shall be direct between a Scan Transponder and each meter, and under the control of the Scan Transponder.

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- 1.8.7 Multiple Scan Transponders shall be connected by Data Link (RS-485).
- 1.8.8 Where indicated on manufacturer's shop drawings, meter shall be connected to the Scan Transponder by Data Link (RS-485).
- 1.8.9 Provide a modem on the Scan Transponder for phone line connection to remote computer.
- 1.8.10 Scan Transponder locations shall be approved by manufacture and installed per manufactures' guidelines. Upon request, manufacture shall provide a project specific design for Scan Transponder system.
- 1.8.11 Owner shall provide a dedicated telephone line for remote access to the Transponder.
- 1.9 **SOFTWARE**
- 1.9.1 Quadlogic's IQ software or comparable system shall be capable of reading the system, downloading the metered data, and generating energy bills for electricity. (System must also be capable of compiling data from other utility meters such as BTU, gas, water and steam.)
- 1.9.2 Quadlogic's IQ software or comparable system shall be capable of producing graphs and charts for load profiling including intervals ranging from 5 through 60 minute time periods.
- 1.9.3 Data collected through IQ software or comparable must be able to be uploaded to spreadsheet programs for analysis such as Microsoft Excel.
- 2 **EXECUTION**
- 2.1 **INSTALLATION**
- 2.1.1 A circuit breaker shall be provided at the metering location to allow safe access to metering components without powering down the entire panel. Where utilized, S-20 200A meters require tenant disconnect to be on the line side of the electric meter.
- 2.1.2 All meters shall be installed to manufacture's installation instructions.

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- 2.1.3 The installation of the metering equipment shall be performed by licensed electricians, under the direct supervision of factory trained personnel.
- 2.1.4 Install meters as indicated on drawings.
- 2.1.5 Division 16 is responsible for installing electric meters equipped with a pulse output and visual readout.
- 2.1.6 All wiring shall be completed by Division 16 as per specifications. All wiring will be done in accordance with the Ontario Electrical Safety Code.
- 2.1.7 Size and colour code wiring according to manufacturer's recommendations. All wiring shall be CSA approved and rated for 600V for low voltage conditions and 300V for extra low voltage conditions. Communication wiring shall be installed in twisted pairs to prevent interference from outside sources.
- 2.1.8 All current transformers will be installed with shorting switches so meters can be removed without high voltage electrical hazard.
- 2.2 CALIBRATION AND MAINTENANCE SERVICE
- 2.2.1 Setup meters according to manufacturer's instructions.
- 2.2.2 Commission the system to the satisfaction of the Measurement and Verification consultant and demonstrate the proper functioning of the system.
- 2.2.3 Provide a 3 hour training session to the owner's staff and Measurement and Verification consultant.
- 2.2.4 Provide Measurement & Verification consultant with remote access to the system.
- 2.3 WARRANTY
- 2.3.1 All equipment shall be free from defect in materials and work under normal use and service for the period of twelve (12) months from the date of substantial completion.
- 2.3.2 All equipment will be verified by a factory-trained technician and certified for its Revenue Class accuracy.

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2.3.3 A certificate shall be issued on final completion to confirm that the system is operating according to specifications.

2.4 SYSTEM COMISSIONING AND START-UP

2.4.1 Contractor to provide third party testing of power metering system or “commissioning”. The owner’s submetering service company or manufacturer’s qualified service organization can provide third party testing. Testing shall be performed prior to tenant occupancy through the following process:

2.4.1.1 Have the installation contractor record the “cross reference” or the meter serial number (unique ID), meter point, to apartment/unit relationship.

2.4.1.2 Check for power to the meter.

2.4.1.3 Check the serial number inside the meter.

2.4.1.4 Open the panel so that all CT's are visible.

2.4.1.5 Verify the CT ratio and write up the cross reference information for the meter.

2.4.2 Test Results:

2.4.2.1 Submit two draft copies of test results to the Owner for review.

2.4.2.2 After approval by the Owner, submit the test results in two final printed copies and one computer readable copy.

2.4.3 Third party testing shall include testing of Power Line Carrier Communications between power meters and Transponders referred to as “start up”.

2.4.3.1 Testing shall confirm that all power meters included in cross reference are properly communicating with the Transponders.

2.4.3.2 Testing shall confirm that remote connection system via phone line is complete.

2.4.3.3 Testing shall confirm that all Transponders on the RS-485 network are communicating properly.

END OF SECTION

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1 **GENERAL**

1.1 RELATED SECTIONS

- 1.1.1 Section 26 05 01 – Common Work Results – Electrical.
- 1.1.2 Section 26 27 26 – Wiring Devices.
- 1.1.3 Conform to relevant sections of specification for this and other Divisions.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- 1.2.1 Submit shop drawings and product data in accordance with Section
- 1.2.2 26 05 01 – Common Work Results – Electrical.
- 1.2.3 Samples: Samples of specified devices upon request.

2 **PRODUCTS**

2.1 POWER PANELS

- 2.1.1 Mechanical:
 - 2.1.1.1 Listed to UL 508 as industrial control equipment. CSA certified, or NOM approved as applicable.
 - 2.1.2 Delivered and installed as a CSA listed factory assembled panel.
 - 2.1.3 Field wiring accessible from front of panel without need to remove dimmer assemblies or other components.
 - 2.1.4 Ship panels with each dimmer in mechanical bypass position by means of jumper bar inserted between input and load terminals. Jumpers to carry full rated load current and be reusable at any time. Mechanical bypass device to allow for switching operation of connected load with dimmer removed by means of circuit breaker.
- 2.1.5 Electrical
 - 2.1.5.1 Panels contain branch circuit protection for each input circuit unless the panel is a dedicated feed-through type panel or otherwise indicated on the drawings.
 - 2.1.5.2 Branch circuit breakers; meet following performance requirements:

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- 2.1.5.2.1 Listed to UL 489 as molded case circuit breaker for use on lighting circuits.
- 2.1.5.2.2 Contain visual trip indicator; rated at 10,000 AIC, 120 V Dimming.
- 2.1.5.2.3 Thermal-magnetic construction for overload, short-circuit, and over-temperature protection. Use of breakers without thermal protection requires dimmers/relays to have integral thermal protection to prevent failures when overloaded or ambient temperature is above rating of panel.
- 2.1.5.2.4 Accept tag-out/lock-out devices to secure circuit breakers in off position when servicing loads.
- 2.1.5.2.5 Replaceable without moving or replacing dimmer/relay assemblies or other components in panel. UL listed as switch duty (SWD) so that loads can be switched on and off by breakers.
- 2.1.5.3 Minimum UL listed Short Circuit Current Rating (SCCR) of 25,000A.
- 2.1.6 LCD Panel Processor:
 - 2.1.6.1 Separate password protection for installer and end user system settings.
 - 2.1.6.2 Language selection: English.
 - 2.1.6.3 Integral contact closure inputs.
 - 2.1.6.4 Programming and system operation:
 - 2.1.6.4.1 Time clock
 - Integral astronomical time clock
 - Selectable geographic location (city or latitude/longitude).
 - Selectable time zone.
 - Selectable date and time format.
 - Adjustable starting and ending of daylight savings time.
 - Schedule adjustable to add, copy, modify, view, and delete events.

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- Assign functionality to time clock events:

- 2.1.6.4.2 Select global scene
- 2.1.6.4.3 Select customized scene
- 2.1.6.4.4 Enable/Disable all control stations (keypads)
- 2.1.6.4.5 Initiate delay to off
- 2.1.6.4.6 Enable/disable after hours mode
- 2.1.6.5 Shut off sequence can be delayed by button press or occupancy sensor override for 30 minutes.
 - 2.1.6.5.1 Repeat shut off sequence after the delay period.
 - 2.1.6.5.2 Global Scene: Set and recall scene programming for multiple wall station locations.
- 2.1.7 Overrides:
 - 2.1.7.1 Enable/disable time clock
 - 2.1.7.2 Enable/disable all control stations
 - 2.1.7.3 Enable/disable after-hours
- 2.1.8 Diagnostics and Service:
 - 2.1.8.1 Replacing dimmer/relay does not require re-programming of system or processor.
 - 2.1.8.2 Dimmers/relays: Include diagnostic LED's to verify proper operation and assist in system troubleshooting.
 - 2.1.8.3 Dimming/relay panels: Include tiered control scheme for dealing with component failure that minimizes loss of control for occupant.
 - 2.1.8.4 If lighting control system fails, lights to remain at current level. Panel processor provides local control of lights until system is repaired.
 - 2.1.8.5 If panel processor fails, lights to remain at current level. Circuit breakers can be used to turn lights off or to full light output, allowing non-dim control of lights until panel processor is repaired.

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2.1.8.6 If dimmer fails, factory-installed mechanical bypass jumpers to allow each dimmer to be mechanically bypassed. Mechanical bypass device to allow for switching operation of connected load with dimmer removed by means of circuit breaker.

2.2 GENERAL – 0-10V DIMMERS

2.2.1 These products shall be coordinated with switching devices in Section 26 27 26 which must be in the same line up and have similar appearances.

2.2.2 Provide linear slide dimmer controls: specifically for the required loads (i.e. incandescent, fluorescent, magnetic low voltage, electronic low voltage). All devices shall be CSA listed.

2.2.3 The dimmers shall provide a smooth and continuous Square-Law Dimming curve, calibrated linear slide control, Air Gap off switch, voltage compensation circuitry and utilize a filter network to minimize interference from partially installed radio, audio, and video equipment.

2.2.4 Dimmer numbers are based on Lutron.

2.2.5 Fluorescent Dimmer (0-10V)

2.2.5.1 Dimmer shall have direct control of fluorescent dimming ballast up to the ballast manufacturer's specified rating.

2.2.5.2 Dimmers shall not void warranty of fixture manufacturer.

2.2.5.3 Dimmer shall be rated for minimum load of 300W.

2.2.5.4 Dimmer shall be complete with power pack, as required, to allow for control of 347V ballasts

2.2.5.5 Lutron DIVA DDTV or equivalent.

2.2.6 Acceptable Manufacturers:

2.2.6.1 Product to be selected as part of the Design Assist process. Electrical Contractor to submit shop drawing indicating manufacturer as per the Design Assist coordination.

2.3 GENERAL – OCCUPANCY SENSORS

2.3.1 Sensor Type: 360° Dual Technology Occupancy Sensors

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- 2.3.1.1 The dual technology sensor shall be capable of detecting presence in the control area by detecting Doppler shifts in transmitted ultrasound and passive infrared heat changes.
- 2.3.1.2 Sensors shall use patent pending ultrasonic diffusion technology that spreads coverage to a wider area.
- 2.3.1.3 Sensors shall utilize dual sensing verification principle for coordination between ultrasonic and PIR technologies. Detection verification of both technologies must occur in order to activated lighting systems. Upon verification, detection by either shall hold lighting on.
- 2.3.1.4 Sensor shall have a retrigger feature in which detection by either technology shall retrigger the lighting system on within 5 seconds of being switched off.
- 2.3.1.5 Sensors shall be mounted to the ceiling with a flat, unobtrusive appearance and provide 360° of coverage.
- 2.3.1.6 Ultrasonic sensing shall be volumetric in coverage with a frequency of 40 KHz. It shall utilize Advanced Signal Processing which automatically adjusts the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.
- 2.3.1.7 To avoid false ON activations and to provide immunity to RFI and EMI, Detection Signature Analysis shall be used to examine the frequency, duration, and amplitude of a signal, to respond only to those signals caused by human motion.
- 2.3.1.8 The PIR technology shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. The lens shall be Poly IR4 material to offer superior performance in the infrared wavelengths and filter short wavelength IR, such as those emitted by the sun and other visible light sources. The lens shall have grooves facing in to avoid dust and residue build up which affects IR reception.
- 2.3.1.9 Sensors shall operate at 24VDC/VAC and halfwave rectified and utilize a Watt Stopper power pack.
- 2.3.1.10 Sensors shall have a fixed time delay of 5 to 30 minutes, set by DIP switch.
- 2.3.1.11 Sensors shall feature a walk-through mode, where lights turn off 3

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minutes after the area is initially occupied if no motion is detected after the first 30 seconds.

- 2.3.1.12 The DT-300 sensors shall have a built-in light level sensor that works from 30 to 300 footcandles.
- 2.3.1.13 The DT-300 and DT-305 sensors shall have a manual on function that is facilitated by installing a momentary switch.
- 2.3.1.14 Sensors shall have eight occupancy logic options that give the ability to customize control to meet application needs.
- 2.3.1.15 The sensors shall feature terminal style wiring, which makes installation easier.
- 2.3.1.16 DT-300 sensor shall have an additional single-pole, double throw isolated relay with normally open, normally closed and common outputs. The isolated relay is for use with HVAC control, data logging, and other control options.
- 2.3.1.17 Each sensing technology shall have an LED indicator that remains active at all times in order to verify detection within the area to be controlled. The LED can be disabled for applications that require less sensor visibility.
- 2.3.1.18 To ensure quality and reliability, sensor shall be manufactured by an ISP 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.
- 2.3.1.19 Sensors shall have standard 5 year warranty and shall be UL and CUL listed.
- 2.3.1.20 Provide low voltage power pack as required for sensor operation.
- 2.3.2 Automatic Wall Switch Sensor:
 - 2.3.2.1 The passive infrared sensor shall be a completely self-contained control system that replaces a standard toggle switch. Switching mechanism shall be a latching air gap relay, compatible with electronic ballasts, compact fluorescent and inductive loads. Triac and other harmonic generating devices shall not be allowed. Sensor shall have ground wire and grounded strap for safety.
 - 2.3.2.2 Sensor shall be capable of detecting presence in the control area by detecting changes in infrared energy. Small movements shall be detected, such as when a person is writing while seated at a desk.

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- 2.3.2.3 Detection Signature Processing (DSP) shall be used to avoid false offs and false activations and to provide immunity to RFI and EMI.
- 2.3.2.4 Continuously adjusting Zero Cross relay control shall be used to guarantee reliable operation with non-linear loads (electronic, PL lamp ballasts) even with temperature changes and product aging.
- 2.3.2.5 Sensor shall have a fixed time delay of 5, 10, 15, 20 or 30 minutes, walk-through mode, or test mode, set by DIP switch, In walk-through mode, lights shall turn off 3 minutes after the area is initially occupied if no motion is detected after the first 30 seconds.
- 2.3.2.6 Sensor shall have the choice of light flash alert and/or audible alert of impending light shut off, selectable with DIP switch.
- 2.3.2.7 Sensor shall have sensitivity adjustment that is set with DIP switch.
- 2.3.2.8 Sensor shall have a built-in light level feature selectable with DIP switch.
- 2.3.2.9 Sensor shall have automatic-ON or manual-ON operation adjustable with DIP switch.
- 2.3.2.10 Sensor shall have no minimum load requirement.
- 2.3.2.11 Sensor shall utilize a temperature compensated, dual element sensor, and a multi-element Fresnel lens.
- 2.3.2.12 For vandal resistance, Fresnel lens shall be made of hard, 1.0mm Poly IR 2 material that offers protection against direct impact. Lens shall have grooves facing in to avoid dust and residue build up which affects IR reception
- 2.3.2.13 Sensitivity to motion and detection performance. Lens shall have grooves facing in to avoid dust and residue build up which affects IR reception.
- 2.3.2.14 Sensor shall cover up to 300 sq ft for walking motion, with a field of view of 180 degrees.
- 2.3.2.15 Adjustments and mounting hardware shall be concealed under a removable, tamper resistant cover to prevent tampering of adjustments and hardware.
- 2.3.2.16 Sensor shall have a 100% off switch with no leakage current to the load.

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2.3.2.17 Sensor shall not protrude more than 3/8" from the wall and shall blend in aesthetically.

2.3.3 Acceptable Manufacturers:

2.3.3.1 All sensors shall be of one manufacturer. Provide lighting control devices from one of the following approved manufacturers:

2.3.3.1.1 Watt Stopper

2.3.3.1.2 Sensor Switch

2.3.3.2 Lutron

3 EXECUTION

3.1 INSTALLATION

3.1.1 It shall be the Contractor's responsibility to locate and aim sensory in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. Rooms shall have ninety (90) to one hundred (100) percent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. The Contractor shall provide additional sensors if required to properly and completely cover the respective room.

3.1.2 It is the Contractor's responsibility to arrange a pre-installation meeting with the manufacturer's factory authorized representative, at the Owner's facility, to verify placement of sensors and installation criteria.

3.1.3 Proper judgement must be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components. The Contractor shall also provide, at the Owner's facility, training to the owner's personnel in the operation, use, adjustment, and problem solving diagnosis of the occupancy sensing devices and systems.

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END OF SECTION

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1 GENERAL

1.1 INTRODUCTION

1.1.1 The work covered in this section is subject to all of the requirements in Section 26 05 01 – Common Work Results – Electrical.

1.1.2 The Contractor shall coordinate all of the work in this section and all of the trades covered in other sections of the specification to provide a complete and operable system.

1.2 DESCRIPTION OF WORK

1.2.1 Provide a lighting control system as indicated on the drawings and as specified here-in. the lighting control system shall include, but not limited to:

1.2.1.1 Low voltage switching system with lighting automation relay panels or modules, associated low voltage switches, and occupancy sensors, daylight sensors, and photocells.

1.2.1.2 Fully programmable networked lighting control system comprised of the following components:

1.2.1.2.1 System Software Interfaces:

- Management and Visualization Interface
- Historical Database and Analytics Interface
- Personal Control Applications
- Smartphone Programming Interface for wired devices

1.2.1.2.2 System backbone and Integration Equipment:

Systems Controller

Open ADR Interface

1.2.1.2.3 Wired Networked Devices

- Wired Wall Switches, Dimmers, and Scene Controllers
- Graphic Wall Stations

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- Auxiliary Input/ Output Devices
- Occupancy and Photocell Sensors
- Power Packs and Secondary Packs
- Networked Luminaires
- Relay and Dimming Panels

1.2.1.2.4 Wireless Networked Devices:

- Sensor Interface
- Light Controllers
- Digital Sensor Attachments
- Networked Luminaires
- Communication Bridge

1.2.1.3 The networked lighting control system shall meet all of the characteristics and performance requirements specified herein.

1.2.1.4 The contractor shall provide, install and verify proper operation of all equipment necessary for proper operation of the system as specified herein and as shown on applicable drawing. This includes all equipment and associated components comprising of the lighting control system, as well as, all associated electrical circuits, wiring, and conduits.

1.2.1.5 Refer to the specifications on the drawings for work including, but not limited to, raceways and electrical boxes and fitting required for installation on control equipment and wiring.

1.3 QUALITY ASSURANCE

1.3.1 Manufacturers: Firms regularly engaged in manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.3.2 Product Qualifications

1.3.2.1 System electrical components shall be listed or recognized by a nationally recognized testing laboratory (e.g., UL, ETL, or CSA)

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and shall be labeled with required markings as applicable.

- 1.3.2.2 System luminaires and controls are certified by manufacturer to have been designed, manufactured and tested for interoperability.
- 1.3.2.3 All components shall be subjected to 100% end of line testing prior to shipment to the project site to ensure proper device operation.
- 1.3.2.4 All components and the manufacturing facility where product was manufactured must be RoHS compliant.
- 1.3.3 Installation and Start Up Qualifications
 - 1.3.3.1 System startup shall be performed by qualified personnel approved or certified by the manufacturer.
- 1.3.4 Service and Support Requirements
 - 1.3.4.1 Phone Support: Toll free technical support shall be available.
 - 1.3.4.2 Remote Support: The bidder shall offer a remote support capability.
 - 1.3.4.3 Onsite Support: The bidder shall offer onsite support that is billable at whole day rates.
 - 1.3.4.4 Service Contract: The bidder shall offer a Service Contract that packages phone, remote, and onsite support calls for the project. Response times for each type of support call shall be indicated in the terms of the service contract included in the bid package.
- 1.4 SUBMITTALS
 - 1.4.1 Submittal shall be provided including the following items:
 - 1.4.1.1 Bill of Materials necessary to install the networked lighting control system.
 - 1.4.1.2 Product Specification Sheets indicating general device descriptions, dimensions, electrical specifications, wiring details, and nomenclature.
 - 1.4.1.3 Riser Diagram showing device wiring connection of system backbone and also typical per room/area type.
 - 1.4.1.4 Information Technology (IT) connection information pertaining to interconnection with facility IT networking equipment and third-

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party systems.

- 1.4.1.5 Sequence of Operation summary table for each room and area of the building. This document will be the basis of review by the Consultant and the Owner to confirm the sequence of operation and shall form the basis of the programming of the network lighting control system.
- 1.4.1.6 Other Diagrams and Operational Descriptions – as needed to indicate system operation or interaction with other system(s).
- 1.4.1.7 Contractor Start up/Commissioning Worksheet (must be completed prior to factory start up).
- 1.4.1.8 Service Specification Sheets indicating general service descriptions, including start up, training, post-start up support, and service contract terms.
- 1.4.1.9 Hardware and Software Operation Manuals.

1.5 ACCEPTABLE MANUFACTURERS

- 1.5.1 This specification and part numbers are based on the Acuity Brand nLight system, and shall be used as reference for the minimum requirements and quality of materials. Each manufacturer shall present their product to the owner and engineer, and demonstrate compliance with the specification.
- 1.5.2 The low voltage lighting control system shall be as manufactured by:
 - 1.5.2.1 Acuity Brand – nLight
 - 1.5.2.2 Lutron
 - 1.5.2.3 Douglas Lighting Control
 - 1.5.2.4 Wattstopper

1.6 WARRANTY

- 1.6.1 The manufacturer shall provide a minimum five-year warranty on all hardware devices supplied and installed. Warranty coverage shall begin on the date of substantial completion of the project.
- 1.6.2 The hardware warranty shall cover repair or replacement any defective products within the warranty period.

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1.7 MAINTENANCE AND SUSTAINABILITY

1.7.1 The manufacturer shall make available to the owner new parts, upgrades, and/or replacements available for a minimum of 5 years following installation.

2 **MATERIALS**

2.1 SYSTEM PERFORMANCE REQUIREMENTS

2.1.1 System Architecture

2.1.1.1 System shall have an architecture that is based upon three main concepts: (a) networkable intelligent lighting control devices, (b) standalone lighting control zones using distributed intelligence, (c) optional system backbone for remote, time based and global operation between control zones.

2.1.1.1.1 Intelligent lighting control devices shall have individually addressable network communication capability and consist of one or more basic lighting control components: occupancy sensor, photocell sensor, relay, dimming output, contact closure input, analog 0-10V input, and manual wall station capable of indicating switching, dimming, and/or scene control. Combining one or more of these components into a single device enclosure shall be permissible so as to minimize overall device count of system.

2.1.1.1.2 Lighting control zones consisting of one or more networked luminaires and intelligent lighting control devices and shall be capable of providing automatic control from sensors (occupancy and/or photocell) and manual control from local wallstations without requiring connection to a higher level system backbone; this capability is referred to as "distributed intelligence."

2.1.1.1.3 System must be capable of interfacing directly with networked luminaires such that either low voltage network cabling or wireless RF communication is used to interconnect networked luminaires with control components such as sensors, switches and system backbone (see Control Zone Characteristics sections for each type of network connection, wired or wireless).

2.1.1.2 The system shall be capable of providing individually addressable switching and dimming control of the following: networked luminaires, control zones to include multiple switch legs or circuits, and relay and dimming outputs from centralized panels to provide design flexibility appropriate with sequence of operations required

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in each project area or typical space type. A single platform shall be used for both indoor and outdoor lighting controls.

- 2.1.1.3 Lighting control zones shall be capable of being networked with a higher level system backbone to provide time based control, remote control from inputs and/or systems external to the control zone, and remote configuration and monitoring through a software.
- 2.1.1.4 All system devices shall support remote firmware update, such that physical access to each device is not necessary, for purposes of upgrading functionality at a later date.
- 2.1.1.5 System shall be capable of “out of box” sequence of operation for each control zone. Standard sequence is:
 - 2.1.1.5.1 All switches control all fixtures in a zone
 - 2.1.1.5.2 All occupancy sensors automatically control all fixtures in the control zone with a default timeout.
- 2.1.2 Wired Networked Control Zone Characteristics
 - 2.1.2.1 Following proper installation and provision of power, all networked devices connected together with low voltage network cable shall automatically form a functional lighting control zone without requiring any type of programming, regardless of the programming mechanism (e.g., software application, handheld remote, pushbutton). The “out of box” default sequence of operation is intended to provide typical sequence of operation so as to minimize the system startup and programming requirements and to also have functional lighting control operation prior to system startup and programming.
 - 2.1.2.2 System shall be able to automatically discover all connected devices without requiring any provisioning of system or zone addresses.
 - 2.1.2.3 The following types of wired networked control devices shall be provided for egress and/or emergency light fixtures:
 - 2.1.2.3.1 Low-Voltage power sensing: These devices shall automatically provide 100% light level upon detection of loss of power sensed via the low voltage network cable connection.
 - 2.1.2.3.2 UL924 Listed Line-Voltage power sensing: These devices shall be listed as emergency relays under the UL924 standard, and shall

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automatically close the load control relay(s) and provide 100% light output upon detection of loss of power sensed via line voltage connections.

- 2.1.2.3.3 Emergency egress devices shall be provided and UL labeled by the lighting control manufacturer.
- 2.1.3 Wireless Networked Control Zone Characteristics
 - 2.1.3.1 Following proper installation and provision of power, all wireless networked devices paired, meshed or grouped together shall automatically follow the “out of box” default sequence of operations.
 - 2.1.3.2 Wireless network communication shall support uniform and instant response such that all luminaires in a lighting control zone respond immediately and synchronously in response to a sensor or wallstation signal.
 - 2.1.3.3 To support the system architecture requirement for distributed intelligence, wireless network communication shall support communication of control signals from sensors and wallstations to networked luminaires and wireless load control devices, without requiring any communication, interpretation, or translation of information through a backbone device such as a wireless access point, communication bridge or gateway.
 - 2.1.3.4 All wireless communication shall be encrypted using at least 128-bit Advanced Encryption Standard (AES).
 - 2.1.3.5 The following types of wired networked control devices shall be provided for egress and/or emergency light fixtures:
 - 2.1.3.5.1 UL924 Listed Line-Voltage power sensing: These devices shall be listed as emergency relays under the UL924 standard, and shall automatically close the load control relay(s) and provide 100% light output upon detection of loss or interruption of power sensed via line voltage connections.
- 2.1.4 System Integration Capabilities
 - 2.1.4.1 The system shall interface with third party building management systems (BMS) to support two-way communication using the industry standard BACnet/IP or BACnet/MSTP protocols.
- 2.2 SYSTEM SOFTWARE INTERFACES

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2.2.1 Management Interface

2.2.1.1 System shall provide a web-based management interface that provides remote system control, live status monitoring, and configuration capabilities of lighting control settings and schedules.

2.2.1.2 Management interface must be compatible with industry-standard web browser clients.

2.2.1.3 All system software updates must be available for automatic download and installation via the internet.

2.2.2 Historical Database and Analytics Interface

2.2.2.1 System shall provide a browser-based trending and monitoring interface that stores historical data for all occupancy/daylight sensors and lighting loads. Additionally, the system shall optionally upload that data to a cloud based server.

2.2.3 Visualization Interfaces

2.2.3.1 System shall provide an optional web-based visualization interface that displays a graphical floorplan. System data, to include status of occupancy sensors, daylight sensors and light output shall be overlaid to the floorplan to provide a graphical status page.

2.2.4 Portable Programming Interface for Standalone Control Zones

2.2.4.1 Portable handheld application interface for standalone control zones shall be provided for systems that allows configuration of lighting control settings.

2.2.4.2 Programming capabilities through the application shall include, but not be limited to, the following:

2.2.4.2.1 Switch/occupancy/photosensor group configuration

2.2.4.2.2 Manual/automatic on modes

2.2.4.2.3 Turn-on dim level

2.2.4.2.4 Occupancy sensor time delays

2.2.4.2.5 Dual technology occupancy sensors sensitivity

2.2.4.2.6 Photosensor calibration adjustment and auto-setpoint

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2.2.4.2.7 Trim level settings

2.3 SYSTEM BACKBONE AND SYSTEM INTEGRATION EQUIPMENT

2.3.1 System Controller

2.3.1.1 System Controller shall be a multi-tasking, real-time digital control processor consisting of modular hardware with plug-in enclosed processors, communication controllers, and power supplies.

2.3.1.2 System Controller shall perform the following functions:

2.3.1.2.1 Facilitation of global network communication between different areas and control zones.

2.3.1.2.2 Time-based control of downstream wired and wireless network devices.

2.3.1.2.3 Linking into an Ethernet network.

2.3.1.2.4 Integration with Building Management Systems (BMS) and Heating, Ventilation and Air Conditioning (HVAC) equipment.

2.3.1.2.5 Connection to various software interfaces, including management interface, historical database and analytics interface, visualization interface, and personal control applications.

2.3.1.3 System Controller shall not require a dedicated PC or a dedicated cloud connection.

2.3.1.4 Device shall automatically detect all networked devices connected to it, including those connected to wired and wireless communication bridges.

2.3.1.5 Device shall have a standard and astronomical internal time clock.

2.3.1.6 Shall be capable of connecting to the customers Local Area Network (LAN) via IEEE 802.11.x Wireless and IEEE 802.3 Wired connection.

2.3.1.7 System Controller shall support BACnet/IP and BACnet/MSTP protocols to directly interface with BMS and HVAC equipment without the need for additional protocol translation gateways.

2.3.1.7.1 BACnet/MSTP shall support a minimum of 50 additional BACnet MS/TP controllers in addition to the Expansion I/O modules.

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- 2.3.1.7.2 BACnet/MSTP shall support 9600 to 115200 baud.
- 2.3.1.7.3 System Controller shall be BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC) with outlined enhanced features.
- 2.3.1.7.4 System controller must support BACnet/IP Broadcast Management Device (BBMD) and Foreign Device Registration (FDR).
- 2.3.1.8 OpenADR Interface
- 2.3.1.8.1 System shall provide an interface to OpenADR protocol Demand Response Automation Servers (DRAS) typically provided by local electrical utility.
- 2.3.1.8.2 OpenADR interface shall meet all of the requirements of Open ADR 2.0a Virtual End Nodes (VEN), including:
- Programmable with the account information of the end-user's electrical utility DRAS account credentials.
 - On/Off or On/Off/Dimming
 - Preset Level Scene Type
 - Reprogramming of other devices within daisy-chained zone so as to implement user selected lighting scene
 - Selecting a lighting profile to be run by the system's upstream controller so as to implement a selected lighting profile across multiple zones
- 2.4 WIRED NETWORKED DEVICES
- 2.4.1 Wired Networked Wall Switches, Dimmers, Scene Controllers
- 2.4.1.1 Wall switches & dimmers shall support the following device options:
- 2.4.1.1.1 Number of control zones: 1, 2 or 4
- 2.4.1.1.2 Control Types Supported: On/Off or On/Off/Dimming
- 2.4.1.2 Scene controllers shall support the following device options:
- 2.4.1.2.1 Number of scenes: 1, 2 or 4

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- 2.4.1.2.2 Control Types Supported:
- On/Off or On/Off/Dimming
 - Preset Level Scene Type
 - Reprogramming of other devices within daisy-chained zone so as to implement user selected lighting scene
 - Selecting a lighting profile to be run by the system's upstream controller so as to implement a selected lighting profile across multiple zones
- 2.4.2 Wired Networked Graphic Wall Stations
- 2.4.2.1 Device shall have a full color touch screen.
- 2.4.2.2 Device shall enable configuration of all switches, dimmers, and lighting preset scenes via password protected setup screens.
- 2.4.2.3 Graphic wall stations shall support the following device options:
- 2.4.2.3.1 Number of control zones: Minimum of 16
- 2.4.2.3.2 Number of scenes: Minimum of 16
- 2.4.2.3.3 Optional password protection for setup screens.
- 2.4.3 Wired Networked Auxiliary Input / Output (I/O) Devices
- 2.4.3.1 Auxiliary Input/Output Devices shall be specified as an input or output device with the following options:
- 2.4.3.1.1 Contact closure input
- Input shall be programmable to support maintained or momentary inputs that can activate local or global scenes and profiles, ramp light level up or down, or toggle lights on/off.
- 2.4.3.1.2 0-10V analog input
- Input shall be programmable to function as a daylight sensor.
- 2.4.3.1.3 RS-232/RS-485 digital input

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- Input supports activation of up to 4 local or global scenes and profiles, and on/off/dimming control of up to 16 local control zones.

2.4.3.1.4 0-10V dimming control output, capable of sinking a minimum of 20mA of current

- Output shall be programmable to support all standard sequence of operations supported by system.

2.4.4 Wired Networked Occupancy and Photosensors

2.4.4.1 Sensors shall utilize passive infrared (PIR) or passive dual technology (PDT) to detect both major and minor motion as defined by NEMA WD-7 standard.

2.4.4.2 Sensing technologies that are acoustically passive, meaning they do not transmit sound waves of any frequency do not require additional commissioning. Ultrasonic or Microwave based sensing technologies may require commissioning due to the active nature of their technology, if factory required.

2.4.4.3 Sensor programming parameter shall be available and configurable remotely from the software and locally via the device.

2.4.4.4 Sensor mounting type shall match project design requirements as shown on plans.

2.4.4.4.1 Sensors shall have optional features for photosensor/daylight override, dimming control, and low temperature/high humidity operation.

2.4.4.5 The system shall support the following types of photocell-based control:

2.4.4.5.1 On/Off: The control zone is automatically turned off if the photocell reading exceeds the defined setpoint and automatically turned on if the photocell reading is below the defined setpoint. A time delay or adaptive setpoint adjustable behavior may be used to prevent the system from exhibiting nuisance on/off switching.

2.4.4.5.2 Continuous Dimming: The control zone automatically adjusts its dimming output in response to photocell readings, such that a minimum light level consisting of both electric light and daylight sources is maintained at the task. The photocell response shall be configurable to adjust the photocell setpoint and dimming rates.

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- 2.4.5 Wired Networked Wall Switch Sensors
 - 2.4.5.1 Wall switches sensors shall support the following device options:
 - 2.4.5.1.1 User Input Control Types Supported: On/Off or On/Off/Dimming
 - 2.4.5.1.2 Occupancy Sensing Technology: PIR only or Dual Tech
 - 2.4.5.1.3 Daylight Sensing Option: Inhibit Photosensor
 - 2.4.6 Wired Networked Embedded Sensors
 - 2.4.6.1 Embedded sensors shall support the following device options:
 - 2.4.6.1.1 Occupancy Sensing technology: PIR only or Dual Tech
 - 2.4.6.1.2 Daylight Sensing Option: Occupancy only, Daylight only, or combination Occupancy/Daylight sensor
 - 2.4.7 Distributed System Power, Switching and Dimming Controls
 - 2.4.7.1 Devices shall incorporate one optional Class 1 relay, optional 0-10 VDC dimming output, and contribute low voltage Class 2 power to the rest of the system.
 - 2.4.7.2 Device programming parameters shall be available and configurable remotely from the software and locally via the device push-button.
 - 2.4.7.3 Device shall be plenum rated.
 - 2.4.7.4 Devices shall be UL Listed for load and load type as specified on the plans.
 - 2.4.8 Wired Networked Luminaires
 - 2.4.8.1 Networked luminaire shall have a factory installed mechanically integrated control device and carry a UL Listing as required.
 - 2.4.8.2 Networked LED luminaire shall provide low voltage power to other networked control devices.
 - 2.4.8.3 System shall be able to maintain constant lumen output over the specified life of the LED luminaire (also called lumen compensation) by automatically varying the dimming control signal to account for lumen depreciation.

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- 2.4.8.4 System shall be able to provide control of network luminaire intensity, in addition to correlated color temperature of specific LED luminaires.
- 2.4.8.5 Controls manufacturer is responsible for primary troubleshooting and tech support of complete fixture.
- 2.4.9 Wired Networked Relay and Dimming Panel
 - 2.4.9.1 Relay and dimming panel(s) shall be capable of providing the required amount of relay capacity, as required per panel schedules shown on drawings, with an equal number of individual 0-10V dimming outputs.
 - 2.4.9.2 Standard relays used shall have the following required properties:
 - 2.4.9.2.1 Configurable in the field to operate with normally closed or normally open behavior.
 - 2.4.9.2.2 Provides visual status of current state and manual override control of each relay.
 - 2.4.9.2.3 Be individually programmable
 - 2.4.9.3 0-10 dimming outputs shall support a minimum of 100mA sink current per output.
 - 2.4.9.4 Panel shall be UL924 listed for control of emergency lighting circuits.
 - 2.4.9.5 Panel shall provide a contact closure input that acts as a panel override to activate the normally configured state of all relays (i.e., normally open or normally closed) in the panel.
- 2.5 WIRELESS NETWORKED DEVICES
 - 2.5.1 Wireless Networked Sensor Interface
 - 2.5.1.1 The device shall be capable of broadcasting the following manual wall control commands: on, off, and adjust dim level.
 - 2.5.2 Wireless Networked Light Controllers (No Sensor)
 - 2.5.2.1 The wireless light controller shall be capable of providing continuous dimming and on/off control of one commercial light fixture including fluorescent, HID, induction and LEDs.

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- 2.5.2.2 An external antenna attached to the luminaire shall not be allowed.
- 2.5.2.2.1 Each wireless light controller shall provide measurement capability of the amperage, voltage, wattage, and watt-hours of its controlled lighting.
- 2.5.3 Wireless Networked Digital Sensors
 - 2.5.3.1 In addition to providing Wireless Networked Light Controllers functionality, also provides:
 - 2.5.3.1.1 Integrated digital occupancy sensing and digital photocell sensor.
 - 2.5.3.1.2 Sensor shall connect directly to the wireless light controller and shall be suitable for embedding into the enclosure of a luminaire.
 - 2.5.3.1.3 Sensor shall have software-adjustable settings
 - 2.5.3.1.4 Photocell shall be suitable for closed and open loop applications.
- 2.5.4 Wireless Network Communication Bridge
 - 2.5.4.1 A communication bridge device shall be provided that interfaces with the System Controller via Owner's LAN connection and interfaces with wireless network.
 - 2.5.4.2 Device shall be capable of communicating with a group of a minimum of 250 wireless networked devices and luminaires, so as to reduce the amount of communication bridges required in the system.
- 2.6 SWITCHES PLATES
 - 2.6.1 Provide Specification Grade standard, pilot, or locator configuration momentary pushbutton type switches as shown on the plans for overriding the relays. Colors and markings as indicated on plans and specifications
- 2.7 LIGHTING CONTROL SEQUENCE OF OPERATION
 - 2.7.1.1 Lighting controls for typical rooms and/or area shall be programmed as follows. Submit manufacturer's proposed sequence of operation as part of the shop drawing for individual rooms and type of spaces for the Owner and Consultant's review.

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Room/Space Type	Control Type	Sequence of Operation
Lobby	Scheduled, Occupancy	<p>5am-11pm: Normal Lighting to be on full level.</p> <p>11pm – 5am: Normal Lighting to be dimmed to 50% level. When an occupant is detected by the occupancy sensor, lights to be raised to full level. After 30 minutes of no occupants, lights to dim to 50%.</p> <p>Emergency Lighting remains on full level.</p>
Public Corridors	Scheduled	<p>5am-11pm: Normal Lighting to be on full level.</p> <p>11pm – 5am: Normal Lighting to be dimmed to 50% level. When an occupant is detected by the occupancy sensor, lights to be raised to full level. After 30 minutes of no occupants, lights to dim to 50%.</p> <p>Emergency Lighting remain on full level.</p>
Service Corridors	Scheduled, Occupancy Sensor	<p>Lights to remain on full level when occupant is detected by occupancy sensor. After 15 minutes of no occupants, lights to dim to 50%.</p> <p>Emergency Lighting to remain on full level.</p>
Service Rooms	Occupancy Sensor, Manual Switch	<p>Lights to be turned on by manual switch.</p> <p>After 15 minutes of no occupants, lights to shutoff.</p> <p>Any Emergency Lighting in service rooms are to be controlled with the local controls with UL924 relay such that the lights turn on to full level when there is a loss of power.</p>

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Loading Room	Scheduled, Occupancy Sensor	<p>5am-11pm: Normal Lighting to be on full level.</p> <p>11pm – 5am: Normal Lighting to be dimmed to 50% level. When an occupant is detected by the occupancy sensor, lights to be raised to full level. After 30 minutes of no occupants, lights to dim to 50%.</p> <p>Emergency Lighting remain on full level.</p>
Washrooms	Occupancy Sensor	<p>Lights to be turned on by Occupancy Sensor. After 15 minutes of no occupants, lights to turn off.</p> <p>Emergency Lighting remains on full level.</p>
Parking Garage	Scheduled	<p>5am-11pm: Normal Lighting to be on full level.</p> <p>11pm – 5am: Normal Lighting to be dimmed to 50% level. When an occupant is detected by the occupancy sensor, lights to be raised to full level. After 30 minutes of no occupants, lights to dim to 50%.</p> <p>Emergency Lighting remain on full level.</p>
Parking Vestibules	Scheduled, Occupancy Sensor	<p>5am-11pm: Normal Lighting to be on full level.</p> <p>11pm – 5am: Normal Lighting to be dimmed to 50% level. When an occupant is detected by the occupancy sensor, lights to be raised to full level. After 30 minutes of no occupants, lights to dim to 50%.</p> <p>Emergency Lighting remain on full level.</p>
Stairwells	Scheduled	Lighting to remain on all time.

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Offices	Occupancy Sensor, Manual Switch	Lights to be turned on by manual switch. After 15 minutes of no occupants, lights to shutoff.
Retail Spaces	Scheduled, Manual Switch	Allow for one lighting control zone and device as part of the base contract. To be programmed based on the tenant requirement. Emergency Lighting to remain on full level.
Office Spaces	Scheduled, Manual Switch	Allow for one lighting control zone and device as part of the base contract. To be programmed based on the tenant requirement. Emergency Lighting to remain on full level.
Office Level Elevator Lobbies	Scheduled, Occupancy Sensor	5am-11pm: Normal Lighting to be on full level. 11pm – 5am: Normal Lighting to be dimmed to 50% level. When an occupant is detected by the occupancy sensor, lights to be raised to full level. After 30 minutes of no occupants, lights to dim to 50%. Emergency Lighting remain on full level.
Building Exterior	Scheduled, Photocell	Exterior lighting shall be on between sundown and sunrise based on levels detected by the photocell.

3

EXECUTION

3.1

INSTALLATION REQUIREMENTS

3.1.1

Installation Procedures and Verification

3.1.1.1

The successful bidder shall review all required installation and pre-startup procedures with the manufacturer's representative through

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pre-construction meetings.

- 3.1.1.2 The successful bidder shall install and connect the networked lighting control system components according to the manufacturer's installation instructions, wiring diagrams, the project submittals and plans specifications.
- 3.1.1.3 The successful bidder shall be responsible for testing of all low voltage network cable included in the bid. Bidder is responsible for verification of the following minimum parameters:
 - 3.1.1.3.1 Wire Map (continuity, pin termination, shorts and open connections, etc.)
 - 3.1.1.3.2 Length
 - 3.1.1.3.3 Insertion Loss
- 3.1.2 Coordination with Owner's IT Network Infrastructure
 - 3.1.2.1 The successful bidder is required to coordinate with the owner's representative to secure all required network connections to the owner's IT network infrastructure.
 - 3.1.2.1.1 The bidder shall provide to the owner's representative all network infrastructure requirements of the networked lighting control system.
 - 3.1.2.1.2 The bidder shall provide, to the manufacturer's representative, all necessary contacts pertaining to the owner's IT infrastructure, to ensure that the system is properly connected and started up.
 - 3.1.3 Coordination with Mechanical Division
 - 3.1.3.1 The successful bidder shall provide all integration equipment detailed in Division 260943.
 - 3.1.3.2 The successful bidder to verify integration scope with the Mechanical Contractor prior to submittal phase and provide all necessary schedules to the Lighting Control manufacturer.
- 3.1.4 Documentation and Deliverables
 - 3.1.4.1 The installing contractor shall be responsible for documenting installed location of all networked devices, including networked luminaires. This includes responsibility to provide as-built plan drawing showing device addresses corresponding to locations of

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installed equipment.

3.1.4.2 The installing contractor is also responsible for the following additional documentation to the manufacturer's representative if visualization / graphical floorplan software is provided as part of bid package:

3.1.4.2.1 As-Built floor plan drawings showing wired network control zones outlined, in addition to device address locations required above. All documentation shall remain legible when reproducing\scanning drawing files for electronic submission.

3.1.4.2.2 As-Built electrical lighting drawings (reflected ceiling plan) in PDF and CAD format. Architectural floor plans shall be based on as-built conditions.

- CAD files shall have layers already turned on/off as desired to be shown in the graphical floorplan background images. The following CAD elements are recommended to be hidden to produce an ideal background graphical image:
 - Title block
 - Text- Inclusive of room names and numbers, fixture tags and drawings notes
 - Fixture wiring and homeruns
 - Control devices
 - Hatching or poché of light fixtures or architectural elements
- CAD files shall be of AutoCAD 2013 or earlier. Revit file overall floor plan views shall be exported to AutoCAD 2013.

3.2 SYSTEM STARTUP

3.2.1 Upon completion of installation by the installer, including completion of all required verification and documentation required by the manufacturer, the system shall be started up and programmed by an authorized representative of the manufacturer.

3.2.1.1 Low voltage network cable testing shall be performed prior to system startup at the discretion of the manufacturer.

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- 3.2.2 System start-up and programming shall include:
 - 3.2.2.1 Verifying operational communication to all system devices.
 - 3.2.2.2 Programming the network devices into functional control zones to meet the required sequence of operation.
 - 3.2.2.3 Programming and verifying all sequence of operations.
 - 3.2.2.4 Customization of owner's software interfaces and applications.
- 3.2.3 Initial start-up and programming is to occur on-site. Additional programming may occur on-site or remotely over the Internet as necessary.
- 3.3 PROJECT TURNOVER
 - 3.3.1 System Documentation
 - 3.3.1.1 Submit software database file with desired device labels and notes completed.
 - 3.3.2 Owner Training
 - 3.3.2.1 Provisions for onsite training for owner and designated attendees to be included in submittal package.

END OF SECTION

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1 **GENERAL**

1.1 RELATED SECTIONS

- 1.1.1 Section 26 05 01 – Common Work Results – Electrical.
- 1.1.2 Section 26 05 24 – Wiring Methods.
- 1.1.3 Section 26 05 28 – Grounding – Secondary.
- 1.1.4 Section 26 05 29 – Hangers & Supports.
- 1.1.5 Section 26 05 53 – Identification For Electrical Systems
- 1.1.6 Section 26 05 73 – Short Circuit, System Coordination, Arc Flash Study.
- 1.1.7 Conform to relevant sections of specification for this and other Divisions.

1.2 STANDARDS

- 1.2.1 Design, manufacture and test the dry type transformers in accordance with good industry practice and in accordance with the following Standards:
 - 1.2.1.1 CSA C22.2 No.47 and CSA C9 – Dry Type Transformers.
 - 1.2.1.2 CSA 802.2-12 Standard. – Minimum efficiency values for dry type transformer.
 - 1.2.1.3 NEMA- ST-20
 - 1.2.1.4 ANSI 57.12.01 General requirements of dry type distribution & power transformers.

1.3 PRODUCT DATA & SHOP DRAWINGS

- 1.3.1 Submit product data in accordance with Section 26 05 01 – Common Work Results – Electrical. This shall include dimensions, weight, electrical performance %Z, X/R, Inrush current, no load loss, load loss.

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1.4 SOURCE QUALITY CONTROL

1.4.1 Submit full production test data per CSA- C9 Standard for each KVA rating to engineer for review. Units shall not be shipped until this process is complete.

1.4.2 Owner reserves the right to verify test data at site by third party.

2 **PRODUCTS**

2.1 TRANSFORMERS

2.1.1 Transformers with primary windings shall have the following characteristics:

2.1.1.1 Voltage and kVA ratings as indicated.

2.1.1.2 Single or three phase as indicated.

2.1.1.3 Delta connected for three phase transformers as indicated.

2.1.1.4 1.2 kV insulation class with standard B.I.L.

2.1.1.5 Four 2 1/2% taps, 2 FCAN and 2 FCBN.

2.1.2 Transformers with secondary windings shall have the following characteristics:

2.1.2.1 Voltage rating as indicated.

2.1.2.2 Wye connected for three phase transformers as indicated on the drawing.

2.1.3 Provide full width electrostatic shield resulting in a maximum effective coupling capacitance between the primary and secondary of 33 picofarads. The shield shall be located in the windings to increase the electrical noise attenuation. Terminate the shields at an isolated terminal in the terminal connection area.

2.1.4 Transformers shall have the following characteristics:

2.1.4.1 Unless specifically noted otherwise, provide K-4 rated transformer as minimum.

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- 2.1.4.3 The transformers shall be K-13 rated transformers, where indicated.
- 2.1.4.4 Transformer windings shall be copper.
- 2.1.4.5 Transformers shall be specifically designed to supply 100% of the 60hz fundamental rated current, 33% of the fundamental current as third harmonic, 20% of the fundamental current as fifth harmonic, 14% of the fundamental current as seventh harmonic, 11% of the fundamental current as ninth harmonic, and lower proportional percentages of the fundamental current through the 25th harmonic.
- 2.1.4.6 Transformers shall be marked with a label stating 'Suitable for Non-Sinusoidal Current Load with K factor not to exceed 13.
- 2.1.4.7 Type ANN
- 2.1.4.8 Class 220 C insulation. Neither the primary nor the secondary temperature shall exceed the 220 C at any point in the coils while carrying their full load.
- 2.1.4.9 115 degree C temperature rise.
- 2.1.4.10 Vacuum impregnated polyester resin construction.
- 2.1.4.11 Transformer to be suitable for loads with crest factor up to 4.5 and capable to deliver full nameplate kVA for loads of up to K-factor of 13, without exceeding 115 C° temperature rise.
- 2.1.4.12 Standard hipot level.
- 2.1.4.13 A core constructed of laminations of high permeability silicon steel M6 or better grade and visibly grounded to the enclosure by means of a flexible grounding conductor, sized in accordance with applicable standards. It shall be designed with low hysteresis and eddy current losses.
- 2.1.4.14 No load excitation currents shall be less than 5% up to 75 kVA. & less than 4% above 75 kVA. No load losses can exceed 0.36% to 0.4% of nameplate rating.
- 2.1.4.15 Transformer Sound Level:
 - 2.1.4.15.1 Up to 9 kVA: 40 dB average
 - 2.1.4.15.2 10 kVA – 50 kVA: 45 dB average

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- 2.1.4.15.3 51 kVA – 150 kVA: 50dB average
- 2.1.4.15.4 151 kVA – 300 kVA: 55 dB average
- 2.1.4.15.5 Above 301 kVA: 60db average.
- 2.1.4.16 Transformer to withstand available short circuit level.
- 2.1.4.17 Impedance:
 - 2.1.4.17.1 3% min., 4.5% max. up to & including 112.5 kVA
 - 2.1.4.17.2 4% min, 5% max 150 to 225 kVA
 - 2.1.4.17.3 5% min, 6% max 300 & 500 kVA
- 2.1.4.18 Neutral Connections:
 - 2.1.4.18.1 Neutral connection to be rated at twice the ampacity of the secondary phase current.
 - 2.1.4.18.2 The 200% neutral ampacity to be established at the star point of the transfer coils and extended through to the neutral connection to the Contractor's field wiring.
- 2.1.4.19 Transformer Enclosures:
 - 2.1.4.19.1 CSA enclosure 1, sprinklerproof with removable front cover.
 - 2.1.4.19.2 Acid etch the enclosure, prime with zinc chromate primer and apply 2 finish coats of enamel. Transformers with manufacturer's standard grey.
 - 2.1.4.19.3 Manufacturer to provide quart of touch-up paint or several pressurized spray cans to touch-up small marred during installation.
 - 2.1.4.19.4 A front accessible terminal compartment at the bottom of the enclosure suitable for 90 degrees C rated conductors (ampacity corresponding to 75 degree).
 - 2.1.4.19.5 Vibration dampers between the frame and the core and coils assembly.
 - 2.1.4.19.6 Bolted type off load tap changer.
 - 2.1.4.20 A nameplate shall be affixed to the enclosure indicating, but not

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restricted to the following:

- 2.1.4.20.1 Voltage ratings
- 2.1.4.20.2 kVA rating
- 2.1.4.20.3 Impedance
- 2.1.4.20.4 Type
- 2.1.4.20.5 Insulation class
- 2.1.4.20.6 Temperature rise
- 2.1.4.20.7 Connection diagram
- 2.1.4.20.8 Serial number.
- 2.1.4.21 Transformer to comply with following energy efficiency requirements:
 - 2.1.4.21.1 A minimum efficiency per CSA-802.2-12.
 - 2.1.4.21.2 Energy efficiencies in compliance with NRCan 2019 requirements.

2.2 ACCEPTABLE MANUFACTURERS

- 2.2.1 Transformers shall be of one manufacturer. Acceptable manufacturers are:
 - 2.2.1.1 Hammond Power Solutions
 - 2.2.1.2 Schneider Electric
 - 2.2.1.3 Delta
 - 2.2.1.4 Rex Power Magnetics
 - 2.2.1.5 STI

3 **EXECUTION**

3.1 MOUNTING

- 3.1.1 Verify test reports, serial number and tag identification prior to installation.
- 3.1.2 The maximum size transformer that is permitted to be suspend

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mounted is 75 KVA.

- 3.1.3 Floor mount all dry type transformers over 75 KVA.
- 3.1.4 Ensure adequate clearance around the transformers for ventilation.
- 3.1.5 Install the transformers in a level and upright position.
- 3.1.6 Remove shipping supports only after the transformers have been installed and just before placing them into service.
- 3.1.7 Loosen the isolation pad bolts until no compression is visible.
- 3.1.8 Provide vibration mounting pads for all transformers regardless of mounting method.
- 3.1.9 The vibration isolation for transformers shall not be short-circuited by the installation of any rigid connections, such as taught flexible conduit.
- 3.2 CONNECTIONS
- 3.2.1 Make the primary and secondary wiring connections as shown.
- 3.2.2 Energize the transformers as soon as practicable after installation.
- 3.2.3 Adjust transformer taps as required to achieve suitable secondary voltage at loads.
- 3.3 EQUIPMENT IDENTIFICATION
- 3.3.1 Provide equipment identification nameplate in accordance with Section 26 05 53 - Identification for Electrical Systems.
- 3.4 SHOP DRAWINGS
- 3.4.1 Shop drawing for this section will not be reviewed prior to the short circuit, coordination and arc flash hazard studies being submitted and reviewed by the Consultant.

END OF SECTION

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- 1 **GENERAL**
- 1.1 RELATED SECTIONS
- 1.1.1 Section 26 05 01 – Common Work Results – Electrical
- 1.1.2 Section 26 – Commissioning for Electrical Systems
- 1.1.3 Section 26 – Identifications for Electrical Systems
- 1.1.4 Section 26 – Air Circuit Breakers
- 1.1.5 Section 26 – Moulded Case Circuit Breakers
- 1.1.6 Section 26 – Grounding – Secondary
- 1.1.7 Section 26 – Power Systems Studies
- 1.1.8 Section 26 – Surge Protective Devices
- 1.1.9 Conform to relevant sections of specification for this and other Divisions.
- 1.2 DESCRIPTION OF WORK
- 1.2.1 Supply, install and connect all switchboards as described hereinafter and in accordance with the requirements of the Contract Documents.
- 1.2.2 For service entrance switchboards make the utility service connections all as described.
- 1.2.3 The main switchboards shall comprise of main breakers, indicating instruments and outgoing breakers to provide a complete service and distribution system for the whole project.
- 1.3 SHOP DRAWINGS AND PRODUCT DATA
- 1.3.1 Submit shop drawings and product data in accordance with Division 1 and Section 26 05 01.
- 1.3.2 Indicate on shop drawings.
- 1.3.2.1 Dimensioned cable entry and exit locations.
- 1.3.2.2 Dimensioned position and size of bus.

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- 1.3.2.3 Overall length, height and depth.
- 1.3.2.4 Dimensioned layout of internal and front panel mounted components.
- 1.3.2.5 Include time-current characteristic curves for circuit breakers and fuses.
- 1.4 MAINTENANCE DATA
 - 1.4.1 Provide maintenance data for service entrance board for incorporation into manual specified in Division 1 and Section 26 05 01.
- 1.5 SOURCE QUALITY CONTROL
 - 1.5.1 Consultant to witness final factory tests.
 - 1.5.2 Notify Consultant in writing 5 days in advance that service entrance board is ready for testing.
 - 1.5.3 Submit two copies of certified test results.
- 2 **PRODUCTS**
 - 2.1 SERVICE ENTRANCE BOARD
 - 2.1.1 Rating: Refer to electrical distribution single line diagram.
 - 2.1.2 Short circuit current withstand rating: 65 kA (rms symmetrical).
 - 2.1.3 Cubicles: free standing, dead front, size as indicated.
 - 2.1.4 Barrier metering section from adjoining sections.
 - 2.1.5 Provision for installation of power supply authority metering in barrier section.
 - 2.1.6 Owners metering.
 - 2.1.7 Distribution section – Residential and Tenants.
 - 2.1.8 Distribution section – Building Services.
 - 2.1.9 Hinged access panels with captive knurled thumb screws.
 - 2.1.10 Bus bars and main connections: 99.3% copper aluminum.

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- 2.1.11 Bus from load terminals of main breaker main lugs of distribution section.
- 2.1.12 Identify phases with colour coding.
- 2.2 MOULDED CASE CIRCUIT BREAKERS
- 2.2.1 Refer to Section 26 28 16.01 Moulded Circuit Breakers.
- 2.2.2 Blanked off spaces and provisions for future units, including but not limited to cradle, wiring and line side connections.
- 2.3 GROUNDING
- 2.3.1 Copper ground bus extending full width of cubicles and located at bottom.
- 2.3.2 Lugs at each end for size 4/0 grounding cable.
- 2.4 GROUND FAULT UNIT
- 2.4.1 Copper ground bus extending full width of cubicles and located at bottom.
- 2.4.2 Lugs at each end for size 4/0 grounding cable.
- 2.5 GROUND FAULT EQUIPMENT PROTECTION
- 2.5.1 Refer to Section 26 28 18 Ground Fault Equipment Protection.
- 2.6 POWER SUPPLY AUTHORITY METERING
- 2.6.1 Separate compartment and metal raceway for exclusive use of power supply authority metering.
- 2.6.2 Mounting accessories and wiring for metering supplied by power supply authority:
 - 2.6.2.1 600V:120V potential transformers.
 - 2.6.2.2 Current transformers: sized to suit service rating. Provide as per the requirements of the local utility.
 - 2.6.2.3 Watthour meter.
 - 2.6.2.4 Demand meter with kWh register.
- 2.7 FINISHES

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2.7.1 Apply finishes in accordance with Section 26 05 01 – Common Work Results - Electrical.

2.7.1.1 Finish shall be manufacturer's standard gray.

2.8 MANUFACTURER

2.8.1 For list of acceptable manufacturers, refer to Section 26 90 00 – List of Acceptable Manufacturers.

3 **EXECUTION**

3.1 INSTALLATION

3.1.1 Locate service entrance board.

3.1.2 Connect main secondary service to line terminals of main breaker.

3.1.3 Connect load terminals of distribution breaker's to feeders.

3.1.4 Check factory made connections for mechanical security and electrical continuity.

3.1.5 Run one grounding conductor 4/0 AWG bare copper in 1" conduit from ground bus to building ground.

3.1.6 Check trip unit settings against co-ordination study to ensure proper working and protection of components.

END OF SECTION

Project Name: METRO HALL DAYCARE
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Section No.: **26 24 16**
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1 **GENERAL**

1.1 RELATED SECTIONS

- 1.1.1 Section 26 05 01 – Common Work Results - Electrical.
- 1.1.2 Section 26 05 03 – Nameplates.
- 1.1.3 Section 26 05 29 – Hangers & Supports.
- 1.1.4 Section 26 28 15.01 – Moulded Case Circuit Breakers.
- 1.1.5 Conform to relevant sections of specification for this and other Divisions.

1.2 SHOP DRAWINGS

- 1.2.1 Submit shop drawings in accordance with Section 26 05 01 – Common Work Results - Electrical.
- 1.2.2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

2 **PRODUCTS**

2.1 PANELBOARDS

- 2.1.1 Panelboards: product of one manufacturer.
 - 2.1.1.1 Install circuit breakers in panelboards before shipment.
- 2.1.2 For 208V receptacle and lighting panelboards, the bus, the main breaker and the branch breakers must be rated for a minimum of 14,000 A (symmetrical) interrupting capacity except as otherwise indicated.
- 2.1.3 For 208V distribution panelboards, the bus, the main breaker and the branch breakers must be rated to a minimum of 25,000 A (symmetrical) interrupting capacity except as otherwise indicated.
- 2.1.4 For 600 V panelboards, the bus, the main breaker and the branch breakers must be rated for a minimum of 35,000 A (symmetrical) interrupting capacity except as otherwise indicated
- 2.1.5 Provide a full size neutral.
- 2.1.6 Provide neutral with 200% the rating of mains, where indicated.

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- 2.1.7 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- 2.1.8 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- 2.1.9 Two keys for each panelboard and key panelboards alike.
- 2.1.10 Copper bus with neutral of same ampere rating as mains, unless indicated otherwise.
- 2.1.11 Mains: suitable for bolt-on breakers.
- 2.1.12 Trim with concealed front bolts and hinges.
- 2.1.13 Trim and door finish specified in Section 26 05 01 – Common Work Results - Electrical.
- 2.1.14 Enclosure shall be sprinkler-proof for indoor applications
- 2.1.15 Hot-dip galvanize the panelboard tubs after fabrication or acid etch, prime and apply two (2) finish coats.
- 2.1.16 Panelboards shall be finished with two coats of air dried ASA 61 or ASA 49 grey enamel to the panelboard tubs. Finish shall be over sprayed.
- 2.1.17 Provide doors with concealed hinges, locks and hardware for all panelboards
- 2.2 CUSTOM BUILT PANELBOARD ASSEMBLIES
 - 2.2.1 Provide custom fabricated replacement trims and doors for existing panels, as indicated on drawings.
 - 2.2.2 Replacement trim and door assembly shall be NEMA-4X type, and shall be coordinated with the architectural division to suit any modifications to the wall construction and/or finishes.
- 2.3 BREAKERS
 - 2.3.1 Breakers: to Section 26 28 21 - Moulded Case Circuit Breakers.
 - 2.3.2 Provide breakers as specified.
 - 2.3.3 Main breaker: separately mounted on top or bottom of panel to suit

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cable entry. When mounted vertically, down position should open breaker.

2.3.4 Lock-on devices for fire alarm, emergency, door supervisory, intercom, snow melting pipe tracing, stairway, exit and night light circuits.

2.4 EQUIPMENT IDENTIFICATION

2.4.1 Provide equipment identification in accordance with Section 26 05 01 – Common Work Results - Electrical.

2.4.2 Nameplate for each panelboard.

2.4.3 Complete circuit directory with typewritten legend showing location and load of each circuit.

2.5 MANUFACTURER

2.5.1 Panelboards shall be of one manufacturer. Acceptable manufacturers are as follows:

2.5.1.1 Schneider Electric

2.5.1.2 Eaton – Cutler Hammer

2.5.1.3 Siemens

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 block walls or plywood backboards. Where practical, group panelboards on common backboard.

3.1.3 Mount panelboards to height specified in Section 26 05 01 – Common Work Results - Electrical or as indicated.

3.1.4 Field-measure all existing panels and fabricate customized components to suit. Any and/or all work may take place during evenings and/or weekends and shall suit the Owner's schedule. No additional charges shall be incurred by the Owner for work required to take place during shutdowns after-hours.

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- 3.1.5 Connect loads to circuits.
- 3.1.6 Connect neutral conductors to common neutral bus, with respective neutral identified.

END OF SECTION

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Section Name: **Enclosed Bus Assemblies**
Section No.: **26 25 00**
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1 **GENERAL**

1.1 SHOP DRAWINGS AND PRODUCT DATA

1.1.1 Submit shop drawings and product data in accordance with Section 26 05 01.

1.1.2 Indicate in detail exact routing of busways throughout building and in relation to column lines and structural slabs and walls. Provide voltage drop test results for each size of bus duct.

1.2 STANDARDS

1.2.1 Design, manufacture and test the busways in accordance with good industry practice and in accordance with the following Standard:

1.2.1.1 CSA Standard C22.2 No. 27: Busways.

1.3 RELATED SECTIONS

1.3.1 Section 26 05 24 – Wiring Methods

1.3.2 Section 26 24 13 – Switchboards

1.3.3 Plug-in busway shall be provided for this project. All vertical riser plug-in busway shall be provided c/w plug-in port every 4' and complete with closing caps when not in use. Space the plug-in unit such that at least 2 units are provided on each floor.

1.4 SCOPE

1.4.1 This specification applies to the design and supply of the vertical plug-in busway of the size and rating as indicated on the plans.

2 **PRODUCTS**

2.1.1 **BUSWAYS CHARACTERISTICS**

2.1.2 A bus duct system shall be provided of the capacity and arrangements as shown on the plans and shall be weather-proof.

2.1.3 The bus duct shall carry full rated current when mounted in any position. The temperature rise shall not exceed 55EC above room ambient, at any point on the bus duct.

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- 2.1.4 Bus conductors shall be fabricated from round edge 98% conductivity copper. Bus bars shall be continuously insulated with PVC to a minimum of 20 mils. Insulated bars to be separated with Mylar providing double insulation.
- 2.1.5 Bus duct to be provided with 3-phase, 4-wire and 50% integral ground bus.
- 2.1.6 All bus bar joints are to be electro-tin plated, and of single bolt clamping type. The joint bolts shall be of high strength, hex-head steel, 1/2 inch in dia., and insulated from the live conductors. Belleville washers of 3 inch dia. shall be used to distribute the clamping load. Access to the joints shall be from one side only, enabling duct to be mounted close to the wall.
- 2.1.7 The complete bus duct installation shall be assembled neatly, with snug fitting covers. Covers to be provided at all joints. Covers to be gasketed.
- 2.1.8 Provide totally enclosed weather-proof busway in a steel housing.
- 2.1.9 Horizontal runs shall be suitable for supports at 10 ft. intervals. Vertical runs shall be supported with adjustable spring hangers and intermediate supports.
- 2.1.10 Provide a line to line voltage drop not exceeding 2.9V per 30 m at rated current with a concentrated load at one end at any system power factor.
- 2.1.11 Design the busways so that any length or fitting is removable without disturbing the rest of the installation. Routing of busways shown on drawings are diagrammatic only, provide actual design by manufacturer and submit for approval.
- 2.1.12 Provide internal fire barriers at penetrations of fire rated walls and floor slabs in horizontal and vertical runs. Provide wall and floor flanges at wall and ceiling penetrations. Provide 4" housekeeping pad where bus duct penetrate floor slabs.
- 2.1.13 Provide expansion joints on vertical busway runs at the locations recommended by the busway manufacturer. Provide expansion joints on horizontal busway runs at locations recommended by the manufacturer and where busways cross a building expansion joint.
- 2.1.14 Bus duct assembly shall be constructed to withstand a minimum of 65,000 amperes RMS 85,000 A.I.C. RMS symmetrical short circuit

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rating

- 2.1.15 Provide factory manufactured fittings to suit the type of busway including transformer tap-offs tap-off boxes elbows tees offsets enclosures flanged end connections, to switchboards and motor control centres.
- 2.1.16 Provide hangers to suit the mounting position and the type of busway, (edgewise, flatwise or vertical).
- 2.1.17 Provide cable tap box where required and where shown. Some cable tap box shall be for future use.
- 2.1.18 Design bus way to meet the requirements (accessibility, plug-in face interchangeable, etc.) on the drawings.

2.2 PLUG-IN BREAKER

- 2.2.1 Plug-in breakers shall meet the requirements of Section 26 28 16.01.
- 2.2.2 Provide quantity and size of the plug-in breakers as indicated on the Electrical Drawings.

2.3 MANUFACTURERS

- 2.3.1 Acceptable manufacturers are:
 - 2.3.1.1 Schneider Electric
 - 2.3.1.2 Eaton Cutler-Hammer
 - 2.3.1.3 Siemens

3 **EXECUTION**

3.1 INSTALLATION

- 3.1.1 Ensure that the final installation of the busway assembly is fully coordinated with all aspects of the building construction.
- 3.1.2 Install the busways and associated fittings, supports and accessories as indicated in accordance with the manufacturer's recommendations.
- 3.1.3 Space the hangers in accordance with the manufacturer's recommendations with a maximum spacing of 3000 mm.

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- 3.1.4 Tighten all busway joint bolts to the torque recommended by the busway manufacturer.
- 3.1.5 Cover all busways with a plastic envelope until the building is clean and the busways are ready to be meggered and energized.
- 3.1.6 Megger the busways in the presence of the Engineer and have the readings approved.
- 3.1.7 Torque each single bolt sandwich type busway joint as recommended by manufacturer.
- 3.1.8 Busways shown on drawings are diagrammatic only. Layout must be provided by electrical contractor and supplier for correct phasing and configuration. Include any additional cost in contract for phase transition, accessories, etc. As required to complete the installation.
- 3.1.9 Never expose busway to wet environment.
- 3.1.10 Provide 4" housekeeping pads where busway penetrate floor slabs. Openings were provided by base building. On ground, second and third floors, the opening may not be line up with the other floors. Division 16 contractor shall modify to ensure the bus duct shall be straight. Provide new curb as required and provide adequate support as recommended by manufacturer.

END OF SECTION

Project Name: METRO HALL DAYCARE
Project No.: 2021-0245
Section Name: **Wiring Devices**
Section No.: **26 27 26**
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1 **GENERAL**

1.1 RELATED SECTIONS

1.1.1 Section 26 05 01 – Common Work Results – Electrical.

1.1.2 Conform to relevant sections of specification for this and other Divisions.

1.2 SHOP DRAWINGS AND PRODUCT DATA

1.2.1 Submit shop drawings and product data in accordance with Section

1.2.2 26 05 01 – Common Work Results – Electrical.

1.2.3 Product data: Catalog cuts of specified devices upon request as well as field samples

1.2.4 Samples of specified devices upon request.

2 **PRODUCTS**

2.1 QUALITY ASSURANCE

2.1.1 Equipment and materials of type for which there are Underwriters Laboratories standard requirements, CSA Certified, listing and labels, shall be listed and labeled by Underwriters Laboratories.

2.1.2 Where equipment and materials have industry certification, labeling or standards (i.e., NEMA – National Electrical Manufacturers Association), this equipment shall be labeled as certified, or comply with standards.

2.1.3 Material and equipment shall be new and conform to grade, quality and standards specified. Equipment or materials of the same type shall be the product of same manufacturer throughout.

2.1.4 The Manufacturer's catalog numbers specified represented the minimum standards required.

2.2 WIRING DEVICES

2.2.1 General:

2.2.1.1 Commercial grade wiring devices shall be installed in all areas.

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- 2.2.2 GFCI Receptacle:
 - 2.2.2.1 GFCI receptacles shall be cUL Listed and CSA Certified. Meet cUL943 performance requirements.
 - 2.2.2.2 GFCI receptacles shall have recessed test and reset buttons to avoid accidental tripping from oversized molded plugs.
 - 2.2.2.3 Contacts shall be reinforced to assure maximum plug retention.
 - 2.2.2.4 Large, combination back and side wire terminals to accept up to #10 Wires.
 - 2.2.2.5 GFCI receptacles shall have LED Indicator Light which will flash red to indicate when device no longer has GFCI protection.
 - 2.2.2.6 Receptacles shall be Hubbell 15A (GF15LA), 20A (GF20LA)
- 2.2.3 Receptacles Decorative Series Spec Grade:
 - 2.2.3.1 Receptacles shall represent high quality performance.
 - 2.2.3.2 Receptacles shall be rated for 15 or 20 amperes as indicated on drawings.
 - 2.2.3.3 Receptacles shall be back and side wired. Decorator style, provide green base ground screw terminal, automatic ground clip, fully enclosed in a nylon face, and have wrap around steel bridge for installation strength, and high heat base.
 - 2.2.3.4 In general, all receptacles shall be of ampere, voltage and type as indicated on drawings or herein specified. The following listings and catalog numbers are for type and quality guideline:
 - 2.2.3.4.1 Receptacle shall be Hubbell 15A HBL2152, 20A HBL2162 series.
- 2.2.4 Switches Decorative Spec Grade:
 - 2.2.4.1 Switches shall be 15A or 20A rated and must have “framed” outline body to fit stylized plate.
 - 2.2.4.2 Switches shall have heat resistant thermo set base and 100% copper contact arm and nylon face.
 - 2.2.4.3 15A Hubbell Type Single Pole HBL2101, 3 WAY HBL2103, 4 WAY HBL2104.

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2.2.4.4 20A Hubbell Type Single Pole HBL2121, 3 WAY HBL2123, 4 WAY HBL2124.

2.2.5 Isolated Ground Receptacles:

2.2.5.1 Straight blade isolated ground receptacles, 15 or 20 amp 125 volt service shall have isolation method as an integral part of the device. Shall have nylon insulating barrier between grounding contacts and receptacle mounting strap.

2.2.5.2 All isolated ground receptacles (straight blade and twist lock) shall have impact resistant thermoplastic face and dimensionally stable base.

2.2.5.3 All isolated ground receptacles are required to have an orange triangle located on the face of the device. If the receptacle face is orange, a black triangle outline is required.

2.2.5.4 Provide isolated ground receptacles rated 15 amp 125 volt NEMA 5-15R configuration and manufactured by Hubbell, Inc., type IG2152.

2.2.6 Surge Suppression Receptacles:

2.2.6.1 Shall have 4 series parallel 150V (MOVs) and provide 210 joules of transient voltage suppression in all modes, i.e., Normal & Common.

2.2.6.2 Shall have visual and audible surge status indicators to alert user to surge suppression circuit condition. Visual indicator will be illuminated (red) when power is on and surge suppression circuit is fully functional. Visual indicator will not be illuminated when power is off. Visual indicator will be flashing when surge suppression circuit has been damaged. Audible indicator will be silent when surge suppression circuit is fully functional. Audible indicator will sound a constant alarm if surge suppression circuit has been damaged and can be silenced with muting screw feature on device face. (Audible alarm feature not available on all models.)

2.2.6.3 A line voltage rated fuse, specially calibrated to disconnect the surge suppression circuit in the event of catastrophic failure shall be used.

2.2.6.4 Provide receptacles which shall be rated 15 ampere 125 Volt with NEMA 5-15R configuration and manufactured by Hubbell Inc., type HBL5262S or approved equal.

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- 2.2.7 Twist – Lock Receptacles:
- 2.2.7.1 The approved manufacturer is Hubbell, Inc. or approved equal if they meet the design parameters set forth:
- 2.2.7.1.1 NEMA Twist – Lock Receptacles.
- 2.2.7.1.2 Face (top) shall be nylon with boss diameter of 1.56” on both 20 and 30 amp receptacles.
- 2.2.7.1.3 Face shall also have identifying colour coding feature (colour coding in accordance to IEC 309 standard) by voltage rating to assure proper mating of devices.
- 2.2.7.1.4 Terminal screws shall be #10 silicone bronze and accommodate back or side wiring. 20 amp receptacle terminal shall be capable of accepting #8 AWG wire and provide wire restraint non-loosening design.
- 2.2.7.1.5 Base shall be constructed of dimensionally stable, heat resistant material.
- 2.2.7.1.6 Contact arm shall be one – piece (no riveted assembly) and shall also provide oxide cutting feature for termination integrity.

Twist – Lock 30 Ampere Devices					
CATALOG NUMBERS					
Rating Body	Voltage	NEMA	Rec.	Male Plug	Conn.
2 Pole 3 wire	125 250	L5-30 L6-30	HBL2610 HBL2620	HBL2611 HBL2621	HBL2613 HBL2623
3 Pole 3 wire	125/250V AC 3Ø250V AC 3Ø480V AC 3Ø600V	L14-30 L15-30 L16-30 L17-30	HBL2710 HBL2720 HBL2730 HBL2740	HBL2711 HBL2721 HBL2731 HBL2741	HBL2713 HBL2723 HBL2733 HBL2743
3 Pole 4 wire	3ØY120 / 208V AV	L21-30	HBL2810	HBL2811	HBL2813
Twist – Lock 20 Ampere Devices					
CATALOG NUMBERS					
Rating Body	Voltage	NEMA	Rec.	Male Plug	Conn.

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2 Pole 3 wire	125 250 277V AC	L5-20 L8-20 L7-20	HBL2310 HBL2320 HBL2330	HBL2311 HBL2321 HBL2331	HBL2313 HBL2323 HBL2333
3 Pole 4 wire	125/250V AC 3Ø250V AC 3Ø480V AC	L14-20 L15-20 L16-20	HBL2410 HBL2420 HBL2430	HBL2411 HBL2421 HBL2431	HBL2413 HBL2423 HBL2433
4 Pole 5 wire	3ØY120	L21-20	HBL2510	HBL2511	HBL2513

2.2.8 USB Charging Convenience Receptacles:

2.2.8.1 Receptacles shall be compatible with USB 1.1/2.0/3.0 devices, including Apple Products.

2.2.8.2 Receptacles shall be rated for 15 or 20 amperes as indicated on drawings.

2.2.8.3 Receptacles shall be back and side wired.

2.2.8.4 Duplex Receptacles shall be complete with 2 USB charging ports.

2.2.8.5 In general, all receptacles shall be of ampere, voltage and type as indicated on drawings or herein specified. The following listings and catalog numbers are for type and quality guideline:

2.2.8.5.1 Receptacle shall be Hubbell USB15X series.

2.2.9 Wall Plates:

2.2.9.1 Device plates, dimmer switches plates, telecommunication outlet plates, and blank plates for junction boxes, etc. shall be as follow:

2.2.9.1.1 Vertically brushed stainless steel, cover plates 0.04" (1 mm) thick for wiring devices mounted in flush-mounted outlet boxes.

2.2.9.1.2 Galvanized sheet steel utility box covers for wiring devices installed in surface-mounted utility boxes.

2.2.9.1.3 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

2.2.9.1.4 Ceiling mounted devices cover plates shall match device colour.

2.3 FINISHES

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2.3.1 Wiring Devices:

2.3.1.1 General: Devices shall have manufacturer's standard white finish.

2.3.1.2 Service Rooms: Devices shall have manufacturer's standard black finish.

2.3.2 Cover Plate:

2.3.2.1 In Residential Suites: Provide Plastic/nylon cover plate of the same finish as the wiring devices.

2.3.2.2 In Offices: Provide Plastic/nylon cover plate of the same finish as the wiring devices.

2.3.2.3 In Corridor and Lobby: Provide Brushed Aluminum cover plates.

2.3.2.4 In Parking Garage and Services Rooms: Provide Stainless Steel cover plates.

2.4 MANUFACTURERS

2.4.1 Provide wiring devices and cover plates of one (1) manufacturer.

2.4.2 Hubbell Canada LP. Catalogue numbers are shown and indicate the quality of the wiring devices and cover plates required. Equivalent wiring devices and cover plates of other manufacturers may be used.

2.4.3 Acceptable manufacturers are as follows:

2.4.3.1 Hubbell Canada

2.4.3.2 Pass & Seymour

2.4.3.3 Leviton (Specification Grade only)

3 **EXECUTION**

3.1 INSTALLATION

3.1.1 Switches:

3.1.1.1 Install single throw switches with handle in "UP" position when switch closed.

3.1.1.2 Install switches in gang type outlet box when more than one switch is required in one location.

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- 3.1.1.3 Mount toggle switches at height specified in Section 26 05 01, Common Work Results – Electrical, or as indicated.
- 3.1.2 Receptacles:
 - 3.1.2.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - 3.1.2.2 Mount receptacles at height specified in Section 26 05 01 – Common Work Results - Electrical or as indicated.
 - 3.1.2.3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
- 3.1.3 Cover plates:
 - 3.1.3.1 Protect cover plate finish with paper or plastic film until painting and other work is finished.
 - 3.1.3.2 Install suitable common cover plates where wiring devices and/or dimmer switches are grouped.
 - 3.1.3.3 Do not use cover plates meant for flush outlet boxes on surface – mounted boxes.

END OF SECTION

Project Name: METRO HALL DAYCARE
Project No.: 2021-0245
Section Name: **Fuses - Low Voltage**
Section No.: **26 28 13**
Date: January 26, 2024

1 **GENERAL**

1.1 RELATED SECTIONS

1.1.1 Section 26 05 01 – Common Work Results - Electrical.

1.1.2 Section 26 28 23 – Disconnect Switches Fused & Non-Fused.

1.1.3 Conform to relevant sections of specification of this and other Divisions.

1.2 SHOP DRAWINGS AND PRODUCT DATA

1.2.1 Submit shop drawings and product data in accordance with Section 26 05 01 – Common Work Results – Electrical.

1.2.2 Submit fuse performance data characteristics for each fuse type and size above 60A. Performance data to include: average melting time-current characteristics, (for fuse coordination), and peak let-through current.

1.3 MAINTENANCE MANUALS

1.3.1 Three spare fuses of each type and size installed above 600 A.

1.3.2 Six spare fuses of each type and size installed up to and including 600 A.

1.4 DELIVERY AND STORAGE

1.4.1 Ship fuses in original containers.

1.4.2 Store fuses in original containers in storage cabinet and moisture free location.

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: product of one manufacturer.

2.2 FUSE TYPES

2.2.1 HRC-L fuses (formerly Class L).

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- 2.2.1.1 Type L1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
- 2.2.1.2 Type L2, fast acting.
- 2.2.2 HRCI-J fuses (formerly Class J).
 - 2.2.2.1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
 - 2.2.2.2 Type J2, fast acting.
- 2.2.3 HRCI-R fuses (formerly Class R). For UL Class RK1 fuses, peak let-through current and values not to exceed limits of UL 198E-1982, table 10.2.
 - 2.2.3.1 Type R1, (UL Class RK1), time delay, capable of carrying 500% of its rated current for 10 s minimum, to meet UL Class RK1 maximum let-through limits.
 - 2.2.3.2 Type R2, time delay, capable of carrying 500% of its rated current for 10 s minimum.
 - 2.2.3.3 Type R3, (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits.
 - 2.2.3.4 HRCII-C fuses (formerly Class C).
- 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 match mounting devices.
 - 3.1.2.1 Install Class R rejection clips for HRCI-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 Fuses protecting motor loads and transformers to be type J1 for up to and including 600 A and L1 for ratings above 600 A.

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- 3.1.6 Fuses protecting feeder circuits to be type J2 for up to and including 600 A, and type L2 for ratings above 600 A.
- 3.1.7 Fuses protecting other services or equipment shall be of the type required for that purpose.

END OF SECTION

Project Name: METRO HALL DAYCARE
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Section Name: **Moulded Case Circuit Breakers**
Section No.: **26 28 16.01**
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1 **GENERAL**

1.1 RELATED SECTIONS

- 1.1.1 Section 26 05 01 – Common Work Results - Electrical.
- 1.1.2 Section 26 05 53 – Identification for Electrical Systems.
- 1.1.3 Section 26 24 13 – Switchboards.
- 1.1.4 Section 26 24 16 – Panelboard.
- 1.1.5 Conform to relevant sections of specification for this and other Divisions.

1.2 STANDARDS

- 1.2.1 CAN/CSA-C22.2 No. 144-M91 (R2001): Ground Fault Circuit Interrupters.
- 1.2.2 CSA C22.2 No. 5-02: Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.
- 1.2.3 CSA C22.1-02-Canadian Electrical Code.
- 1.2.4 UL 489 (2002) Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.
- 1.2.5 ANSI C37.17 (latest) American National Standard for trip devices for AC and general purpose DC low voltage power circuit breakers.
- 1.2.6 NEMA-AB1-1993 Molded case circuit breakers and molded case switches.
- 1.2.7 ANSI C37.50 American National Standard for Switchgear – test procedures for low voltage AC power circuit breakers used in enclosures.
- 1.2.8 IEEE Standard 1015, specifically acceptance practice.
- 1.2.9 NETA –ATS Section 7.
- 1.2.10 Ontario Electrical Safety Code.
- 1.2.11 Section 26 05 10 – Short Circuit, System Coordination & Arc Flash Study.

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1.3 PRODUCT DOCUMENTATION

- 1.3.1 Submit shop drawings in accordance with Section 26 05 01. There will be details such as dimensions, clearances required, cable entries, tabulation of all devices including tags, wiring diagrams (power ,signals, control wiring). The notes will identify field wiring and factory installed wiring).
- 1.3.2 Include time-current characteristic curves for breakers with ampacity of 150A and over. In some cases due to critical nature of the equipment smaller size breaker may have to be verified for Time Current coordination as well.

2 **PRODUCTS**

2.1 BREAKERS GENERAL

- 2.1.1 Provide bolt-on molded case circuit breaker, quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient as indicated.
- 2.1.2 Circuit breakers that are 400 amps and higher that are part of the emergency distribution system shall be 100% rated.
- 2.1.3 Provide multi-pole breakers with a common-trip device and a single handle.
- 2.1.4 Provide 100% rated breaker where indicated.
- 2.1.5 All breakers 400 amps and higher shall be LSI solid state trip type.
- 2.1.6 Provide magnetic instantaneous trip elements in circuit breakers, to operate only when the value of the current reaches the setting, as indicated. For breakers with adjustable trips, provide a trip range of 3 to 10 times the rated current or as indicated.
- 2.1.7 Provide circuit breakers with interchangeable trips as indicated.
- 2.1.8 Provide pad locking devices on all breakers to lock the handle of a breaker in the "on" or "off" position with the trip units to remain free to function and protect the circuit from both overload and short circuit conditions.

2.2 THERMAL MAGNETIC BREAKERS (TMB)

- 2.2.1 Provide molded case circuit breakers to operate automatically by means of thermal and magnetic tripping devices to provide inverse

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time current tripping characteristic.

2.3 FUSED THERMAL MAGNETIC BREAKERS (FTMB)

2.3.1 Provide fused thermal magnetic breakers with current limiting fuses internally mounted. Coordinate the time vs current characteristics and the time current limiting characteristics of the fuses with the time vs current tripping characteristics of the circuit breakers resulting in the circuit interruption by the breaker of currents up to the interrupting capacity of the breaker and the circuit interruption by the fuses above the interrupting capacity of the breaker. Provide individually removable fuses interlocked with the breaker such that the removal of the fuse cover, the blowing of a fuse or the removal of a fuse will trip the breaker.

2.4 MAGNETIC BREAKERS

2.4.1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.

2.5 SOLID STATE TRIP BREAKERS

2.5.1 Provide moulded case circuit breakers to operate by means of a solid-state trip unit with associated current monitors and self-powered shunt trip devices to provide an inverse time vs current trip characteristic under overload conditions, and long-time short time instantaneous tripping for phase ground fault short circuit protection.

2.6 OPTIONAL FEATURES

2.6.1 Provide NEMA and UL rated enclosures for individual breakers as required.

2.7 MANUFACTURER

2.7.1 Provide breakers of one manufacturer. Breakers shall be of same manufacturer as the panelboards:

2.7.2 Acceptable manufacturers are as follows:

2.7.2.1 Schneider Electric

2.7.2.2 Eaton – Cutler-Hammer

2.7.2.3 Siemens

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3 **EXECUTION**

3.1 EXAMINATION

3.1.1 Examine the circuit breakers for compliance with installation tolerances and other conditions affecting performance. Proceed with installation only after satisfactory compliance.

3.2 INSTALLATION

3.2.1 Circuit breakers in panelboards shall be factory installed.

3.2.2 Install other individual breakers where indicated.

3.3 IDENTIFICATION

3.3.1 Identify all field installed conductors, wiring and components; provide warning signs as required by manufacturer and also CEC and Ontario Electrical Safety Code. Install engraved nameplates and lamacoid nameplates on enclosures.

3.4 CONNECTION

3.4.1 Install grounding connections, power wiring and indication devices. Verify the torque recommended by manufacturer.

3.5 TESTS

3.5.1 Test for continuity of phase and ground connections and insulation resistance (Megger) for each phase to phase and phase to ground.

3.5.2 Verify all acceptance tests as per NETA test procedure.

3.5.3 Any malfunctioning of the units shall be corrected and retested to demonstrate compliance.

3.6 SUBMITTALS

3.6.1 Field test reports: Include the test procedures and instruments used. Record test results for formal submission to consultant and owner for information.

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3.6.2 Final maintenance manual shall include all the routine maintenance requirements and complete information about each circuit breaker settings.

END OF SECTION

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1 **GENERAL**

1.1 RELATED SECTIONS

1.1.1 Section 16010 – Electrical General Requirements.

1.1.2 Conform to relevant sections of specification for this and other Divisions.

1.2 STANDARDS

1.2.1 IEEE Std C37.20.1 Metal Enclosed Low voltage power circuit breaker.

1.2.2 ANSI C37.13 Low voltage AC power circuit breakers used in enclosures.

1.2.3 ANSI C37.16 Low voltage AC power circuit breakers & AC power circuit protectors - preferred ratings, related requirements and application recommendation.

1.2.4 ANSI C37.50. AC power circuit breakers used in enclosures-Test procedures.

1.2.5 UL 1066 Low voltage AC power circuit breakers used in enclosures.

1.2.6 NEMA SG 3 Low voltage AC power circuit breakers.

1.3 SHOP DRAWINGS

1.3.1 Submit shop drawings in accordance with Section 16010 – Electrical General Requirements.

1.3.2 Include time-current phase protection co-ordination characteristic curves for breakers.

1.3.3 Include test reports and associated data.

2 **PRODUCTS**

2.1 AIR CIRCUIT BREAKERS

2.1.1 The circuit breaker shall be Square D Masterpact NW or Eaton Digitrip (DT 1150) Low Voltage Power Circuit Breaker, or equivalent, and listed to UL1066.

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- 2.1.2 All circuit breakers shall be of continuous current rating.
- 2.1.3 Circuit breakers shall be suitable for the required instantaneous rating without the use of current limiting fuses.
- 2.1.4 All circuit breakers shall have field interchangeable electrical accessories including shunt trip, spring release, electrical operator, auxiliary contacts, and Trip Unit.
- 2.1.5 All circuit breakers shall be motor operated type, stored energy Control voltage to be supplied within the switchgear assembly. Opening and closing contacts to be brought out to terminal blocks in control compartment
- 2.1.6 All available auxiliary (unused) contacts from each device to be brought to a terminal strip in control section. Provide dry contacts, indicating breaker status, position, spring charge c/w two (2) spare A/B and two (2) spare position contacts. If protection status cannot be communicated via software, provide dry contacts indicating this status as well as reason for trip. All contacts to be wired to terminal blocks in the nearest control section.
- 2.1.7 Spare breaker charged contact to be wired to control section in addition to dry contacts mentioned above.
- 2.1.8 Local LED style pilot lights at each breaker to include (breaker open-green) (breaker closed-red).
- 2.1.9 All secondary connections shall be made directly to the front of the circuit breaker cradle.
- 2.1.10 Each Circuit breaker shall have built in contact temperature and contact wear sensors.
- 2.1.11 Padlocking provisions shall be furnished to receive up to three padlocks when circuit breaker is in the disconnected position, positively preventing unauthorized closing of the circuit breaker contacts.
- 2.1.12 Provisions for up to two key locks shall be furnished allowing locking in the disconnected position. Provisions for locking in the connected, test and disconnected positions by padlock or key lock shall be available as an option.

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- 2.1.13 Located on the face of the circuit breaker shall be buttons, with optional lockable clear cover, to open and close the circuit breaker and indicators to show the position of the circuit breaker contacts, status of the closing springs, and circuit breaker position in the cell. An indicator shall show “charged–not OK to close” if closing springs are charged but circuit breaker is not ready to close. Circuit breaker racking system must have positive stops at the connected, test, disconnected and withdrawn positions.
- 2.1.14 Circuit breaker must be equipped with an interlock to discharge the stored energy spring before the circuit breaker can be withdrawn from its cell. Circuit breaker must provide a positive ground contact check between the circuit breaker and cell when the accessory cover is removed while the circuit breaker is in the connected, test or disconnected positions.
- 2.1.15 Circuit breaker shall provide long service life. The 3200 A circuit breaker frame and those of lower ratings must be certified to perform a minimum of 10,000 operations without maintenance. The 4000 A and 5000 A frames must be certified to 5,000 operations without maintenance.
- 2.1.16 The circuit breaker shall have 3 positions of the draw-out mechanism, namely service position where all main and auxiliary contacts are made, test position where main contacts are open but auxiliary contacts are closed and isolated position where all contacts are open.
- 2.1.16.1 Mechanical indication on the front of the ACB shall be provided to indicate:
- 2.1.16.1.1 Main contacts closed 'on'.
- 2.1.16.1.2 Main contacts open 'off'.
- 2.1.16.1.3 Springs charged.
- 2.1.16.1.4 Springs discharged.
- 2.1.16.1.5 Service position.
- 2.1.16.1.6 Test position.
- 2.1.16.1.7 Isolated position for drawout mechanism.

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- 2.1.17 Any attempt to withdraw or insert the breaker when it is 'on' shall trip the breaker automatically. An interlocking shall be provided to prevent insertion of a circuit breaker having a rating higher than the current rating of the ACB cradle.
- 2.1.18 Trip Units:
- 2.1.18.1 Circuit breaker trip system shall be a MICROLOGIC electronic trip unit or DT1150 trip unit with integral metering, or equivalent.
- 2.1.18.2 All trip units shall be removable to allow for field upgrades.
- 2.1.18.3 Trip Units shall incorporate “True RMS Sensing”, and have LED long-time pickup indications.
- 2.1.18.4 MICROLOGIC trip unit functions shall consist of adjustable long-time pickup and delay, short-time pickup and delay, instantaneous and ground-fault pickup and delay.
- 2.1.18.5 Adjustable long-time pickup (I_r) and delay shall be available in an adjustable rating plug that is UL Listed as field-replaceable. Adjustable rating plug shall allow for nine long-time pickup settings from 0.4 to 1 times the sensor plug (I_n). Other adjustable rating plugs shall be available for more precise settings to match the application. Long-time delay settings shall be in nine bands from 0.5–24 seconds at six times I_r .
- 2.1.18.6 Short-time pickup shall allow for nine settings from 1.5 to 10 times I_r . Short-time delay shall be in nine bands from 0.1–0.4 I 2 t ON and 0–0.4 I 2 t OFF.
- 2.1.18.7 Instantaneous settings on the trip units with LSI protection shall be available in nine bands from 2 to 15 times I_n . The Instantaneous setting shall also have an OFF setting when short-time pick-up is provided.
- 2.1.18.8 All trip units shall have the capability for the adjustments to be set and read locally by rotating a switch. Trip units shall have the capability to electronically adjust the settings locally to fine increments below the switch settings. Fine increments for pickup adjustments are to be one ampere. Fine increments for delay adjustments are to be one second.
- 2.1.18.9 Trip unit shall provide trip indication for local and remote reason for trip, i.e., overload, short circuit or ground fault.

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- 2.1.18.10 Trip units shall communicate on MODBUS ® networks.
- 2.1.18.11 Trip units shall be available to provide additional protection by offering adjustable inverse definite minimum time lag (IDMTL). IDMTL provides optimized coordination by the adjustment of the slope of the long-time delay protection.
- 2.1.18.12 Trip units shall be available to provide real time metering. Metering functions include current, voltage, power and frequency.
- 2.1.18.13 Supply the Trip Units as indicated in the following table.

Features	Micrologic Trip Unit Series			
	Basic	A	P	H
True RMS Sensing			X	
LI				
LSI			X	
LSIG/Ground –Fault Trip			X	
Ground Fault Alarm (no trip)				
Ground Fault Trip and Programming Alarm				
Adjustable Rating Plugs			X	
LED - Long-time Pickup			X	
LED - Trip indication			X	
Digital Ammeter			X	
Phase loading Bar Graph			X	
Zone Selective Interlocking			X	
Communications			X	
LCD Dot Matrix Display			X	
Advanced User Interface			X	
Protective Relay Functions			X	
Thermal Imaging			X	
Neutral Protection			X	
Contact Wear Indication			X	
Temperature Indication			X	
Incremental Fine Tuning of Settings			X	
Selectable Long-time Delay Bands			X	
Power Measurement			X	
Waveform Capture				
Data Logging				

- 2.1.18.14 A test set shall be available to provide automatic function testing of the circuit breaker. No disassembly of circuit breaker shall be required

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2.2 CONSTRUCTION

- 2.2.1 The air circuit breaker ratings shall be as indicated on the single line diagram.
- 2.2.2 All air circuit breakers main contact shall be encased in a reinforced polyester casing and offer double insulation from the operators on the breaker front face. The circuit breaker also shall offer total insulation between the control part and the power part.
- 2.2.3 All the models shall be available in the 3 and 4 pole versions both in the fixed and withdrawable versions;
- 2.2.4 The terminal box shall offer spring clamps
- 2.2.5 There shall be total segregation between power and front shield, using double insulation where suitable so as to guarantee maximum operator safety;
- 2.2.6 Total safety shall be guaranteed without the need of phases barriers till 1150V AC;
- 2.2.7 It shall be possible to install the electrical accessories without removing the cover shielding the command;
- 2.2.8 The whole range of air circuit-breakers shall be fitted with electronic protection releases.
- 2.2.9 The neutral position for the circuit breakers shall be modified in the field at any moment
- 2.2.10 Special points for draw-out type breakers:
 - 2.2.10.1 The positions (connected, test, isolated) of the moving part shall be clearly indicated- It shall be possible to fit the circuit breaker with:
 - 2.2.10.1.1 A device which permits the opening of the compartment door only when the mobile part is in racked-out position or test;
 - 2.2.10.1.2 A device which permits to freeze the mobile position when the door is open
 - 2.2.10.1.3 A device which is able to lock the superior and/or inferior shutters without inserting the hands into cassette.

2.3 OPERATING MECHANISM

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2.3.1 The operating mechanism shall be the O-C-O stored energy spring type motor/ manually operated as indicated on Design Drawings with a closing time of less than or equal 80msec.

2.3.2 Each breaker shall be provided with 3 nos. normally open and 3 nos. normally closed potential free spare auxiliary contacts rated 10A at 120V AC.

2.4 ARC CHUTES

2.4.1 Arc chutes shall be common on the whole range and removable on Site to allow inspection of arc chutes and main contacts.

2.5 ADDITIONAL FEATURES

2.5.1 Shunt trip with 120v power fed from the switchboard as required or shown on the drawings.

2.5.2 All wiring for Zone selective interlocking shall be completed in the factory within the switchgear prior to shipping .Test results shall be submitted to the consultant.

2.6 MANUFACTURERS

2.6.1 All breakers for this project shall be of single manufacturer.

2.6.2 Acceptable manufacturers:

2.6.2.1 Schneider electric

2.6.2.2 Eaton Electric.

2.6.2.3 Siemens

3 **EXECUTION**

3.1 INSTALLATION

3.1.1 Install as indicated and in accordance with manufacturer's instructions and recommendations. Fabricate and install steel frame where necessary to mount the switches. Locate switches adjacent to the motor or equipment requiring isolation for maintenance purpose.

3.1.2 Install circuit breakers as indicated.

3.1.3 Adjust trip settings in accordance with the coordination study

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report.

3.1.4 Leave all maintenance materials duly organized for the Owner.

3.2 TRAINING

3.2.1 The Contractor shall engage a factory-authorized service representative to provide startup services and to demonstrate and train for up to 5 No. Employer's representatives for 2 normal workdays at a job Site location determined by the Employer.

3.2.2 Upon successful completion of a demonstration of the automated sequences of operation by the manufacturer and acceptance by the customer, the manufacturer shall provide an 8-hour "hands-on" training course for the customer's operating personnel which shall cover the following topics:

3.2.2.1 Overall System Description and Theory of Operation.

3.2.2.2 Modes of Operation as listed in the Sequence of Operations to include at a minimum:

3.2.2.2.1 Automatic Operation.

3.2.2.2.2 Manual Operation.

3.2.2.3 Engine Safeties and Protective Relaying.

3.2.2.4 Recommended System Check Lists and Log Sheets.

3.2.2.5 Recommended Preventive Maintenance.

3.2.3 The training session shall be conducted by a manufacturer's qualified representative. Training program shall include instructions on the assembly, circuit breaker, protective devices and other major components.

3.3 FIELD QUALITY CONTROL

3.3.1 See Quality Controls section in Division 1 specifications for additional requirements.

3.3.2 Inspect and test in accordance with NETA ATS, except Section 4.

3.3.3 Perform inspections and tests listed in NETA ATS, Section 7.1.

3.3.4 Correct deficiencies and replace damaged or defective

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switchboards or associated components.

3.4 ADJUSTING

3.4.1 Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.4.2 Adjust alignment of switchboard covers and doors.

3.5 CLEANING

3.5.1 Clean dirt and debris from switchboard enclosures and components according to manufacturer's instructions.

3.5.2 Repair scratched or marred surfaces to match original factory finish.

3.6 COMMISSIONING

3.6.1 Field test reports: Include the test procedures and instruments used. Record test results for formal submission to consultant and Owner for information.

3.6.2 Final maintenance manual shall include all the routine maintenance requirements and complete information about each circuit breaker settings.

END OF SECTION

Project Name: METRO HALL DAYCARE
Project No.: 2021-0245
Section Name: **Ground Fault Equipment Protection**
Section No.: **26 28 18**
Date: January 26, 2024

1 **GENERAL**

1.1 RELATED SECTIONS

1.1.1 Section 26 05 01 –Common Work Results - Electrical.

1.1.2 Conform to relevant sections of specification for this and other Divisions.

1.2 SHOP DRAWINGS AND PRODUCT DATA

1.2.1 Submit shop drawings and product data in accordance with Section 26 05 01.

1.2.2 Ground fault protective equipment: product of one manufacturer.

2 **PRODUCTS**

2.1 EQUIPMENT

2.1.1 Provide ground fault protection on 2000A, 347/600 V, 4 wire, 3 phase service.

2.1.2 Ground fault unit to contain:

2.1.2.1 Ground sensing relay suitable for operation at 30 mA 2000 A factory set.

2.1.2.2 Three position sensitivity control switch to select value of leakage current at which relay will operate.

2.1.2.3 Switch:

2.1.2.3.1 SPDT contacts for alarm and trip.

2.1.2.3.2 Mechanical target indication.

2.1.2.3.3 Manually reset.

2.1.2.4 Reset button for contacts and target.

2.1.2.5 Suitable for panel mounting.

2.1.3 Zero sequence transformer rectangular type with 300 - 3000 mA range.

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2.2 FABRICATION

2.2.1 Install following components in equipment specified in other Sections and as indicated.

2.2.1.1 Zero sequence transformer.

2.2.1.2 Ground fault relay.

2.2.1.3 Ground resistor unit.

2.3 RELATED EQUIPMENT

2.3.1 Section 26 28 21 - Moulded Case Circuit Breakers

3 **EXECUTION**

3.1 INSTALLATION

3.1.1 Do not ground neutral on load side of sensor.

3.1.2 Install phase conductors including neutral through zero sequence transformer.

3.1.3 Install ground fault protection system.

3.1.4 Make connections as indicated and in accordance with manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

3.2.1 Perform tests in accordance with Section 26 05 01 – Common Work Results - Electrical.

3.2.2 Arrange and pay for field testing of ground fault equipment by ground fault equipment manufacturer before commissioning service.

3.2.3 Submit report of tests to Consultant and certificate that system as installed meets criteria specified.

3.2.4 Demonstrate simulated ground fault tests.

END OF SECTION

Project Name: METRO HALL DAYCARE
Project No.: 2021-0245
Section Name: **Disconnect Switches Fused & Non-Fused**
Section No.: **26 28 23**
Date: January 26, 2024

1 **GENERAL**

1.1 RELATED SECTIONS

- 1.1.1 Section 26 05 01 – Common Work Results - Electrical.
- 1.1.2 Section 26 05 53 – Identification for Electrical Systems.
- 1.1.3 Conform to relevant sections of specification for this and other Divisions.

1.2 PRODUCT DATA

- 1.2.1 Submit product data in accordance with Section 26 05 01 – Common Work Results - Electrical.
- 1.2.2 Standards: Design, manufacture and test all disconnect switches in accordance with good industry practice and in accordance with the following Standards and Codes:
- 1.2.3 CSA Standard C22.2 No. 4 Enclosed switches;
- 1.2.4 CSA Standard C22.2 No. 39 Fuseholder assemblies.

2 **PRODUCTS**

2.1 DISCONNECT SWITCHES

- 2.1.1 Provide fusible and non-fusible disconnect switches in CSA Enclosure to suit the environment where the switch is located.
- 2.1.2 Provide the provision for padlocking the switch in the ON and OFF switch position by using one lock via a multi-lock hasp.
- 2.1.3 Mechanically interlocked door to prevent opening when handle in ON position.
- 2.1.4 Fuses: size as indicated, to Section 26 28 14 - Fuses - Low Voltage.
- 2.1.5 Fuseholders: suitable without adaptors, for type and size of fuse indicated.
- 2.1.6 Provide a type A quick-make, quick-break switching action with arc chutes or arc snuffers.
- 2.1.7 Provide a vertically moving handle with an ON-OFF switch position

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indication on the switch enclosure cover with the ON position being the upper handle position.

- 2.1.8 Provide solderless neutral terminals where indicated.
- 2.1.9 Disconnect switches integrated rating must be rated to handle the design interrupting capacity for this project.
- 2.1.10 Ensure system coordination per Section 26 05 10 prior to ordering of the equipment.
- 2.2 EQUIPMENT IDENTIFICATION
 - 2.2.1 Provide equipment identification in accordance with Section 26 05 01 – Common Work Results - Electrical.
 - 2.2.2 Indicate name of load controlled on nameplate.
 - 2.2.3 If part of the emergency distribution system, it shall be finished in Sherwin Williams #F65E37.
- 2.3 ACCEPTABLE MANUFACTURERS
 - 2.3.1 Provide all disconnect switches of one manufacturer. Acceptable manufacturers are as follows:
 - 2.3.1.1 Schneider Electric
 - 2.3.1.2 Eaton – Cutler-Hammer
 - 2.3.1.3 Siemens
- 2.4 ENCLOSURE
 - 2.4.1 Individually mounted disconnect switch shall be installed in Sprinkler proof enclosure c/w drip shield.
- 3 **EXECUTION**
 - 3.1 INSTALLATION
 - 3.1.1 Install disconnect switches complete with fuses if applicable.

END OF SECTION

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Project No.: 2021-0245
Section Name: **Static Uninterruptible Power Supply**
Section No.: **26 33 53**
Date: January 26, 2024

1 **GENERAL**

1.1 RELATED SECTIONS

1.1.1 Section 26 05 01 - Common Work Results - Electrical

1.1.2 Conform to relevant sections of specification for this and other divisions.

1.2 REFERENCES

1.2.1 The UPS shall meet the requirements of the following standards:

1.2.1.1 CSA-C22.1:21 Canadian Electrical Code, Part I [25th Edition], Safety Standards for Electrical Installation

1.2.1.2 UL listed under 1778, Standards for Uninterruptible Power Supply Equipment

1.2.1.3 UL Canada (cUL)

1.2.1.4 IEEE 587-1980/ANSI C62.41 1980 Standards for Surge Withstand ability

1.2.1.5 ISO 9001 Quality Standard

1.2.1.6 FCC rules and regulations of Part 15, Subpart B

1.2.1.7 The UPS shall be designed in accordance with the applicable sections of the documents published by:

1.2.1.7.1 National Fire Protection Association (NFPA)/ National Electric Code (NEC)

1.2.1.7.2 National Electrical Manufacturer's Association (NEMA)

1.2.1.7.3 Occupational Safety & Health Administration (OSHA)

1.2.1.8 All components shall be listed by Underwriter's Laboratories, Inc. (UL) whenever such listings have been established.

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Section Name: **Static Uninterruptible Power Supply**
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1.3 SUMMARY

1.3.1 This specification describes a three phase, on-line, double conversion, continuous duty, solid state Uninterruptible Power System, hereafter referred to as the UPS. The UPS shall operate in conjunction with the existing building electrical system to provide precisely controlled power for critical equipment loads. The system shall consist of a solid state inverter, rectifier/battery charger, a dual string battery plant, an internal maintenance static bypass transfer switch, synchronization control circuitry, connection control circuitry, disconnection control circuitry, graphical status/control panel, system status indicators, system alarm annunciation circuitry, and accessories as specified herein. The system shall automatically ensure continuity of electric power within specified tolerances, without interruption, upon failure or deterioration of the normal power supply. Continuity of electric power to the load shall be supplied by the batteries, up to the specified maximum protection time or until restoration of the normal input AC power source, whichever occurs first.

1.3.2 Configuration and ratings of the UPS shall be as noted in the electrical drawings and specified in this specifications. Where discrepancies are present between the drawings and the specifications, the maximum provisions shall be assumed.

1.4 SUBMITTALS

1.4.1 Submittals shall contain the following documentation:

1.4.1.1 **Installation Package:** Complete electrical characteristics and connection requirements. Provide detailed equipment outlines with cabinet dimensions and spacing requirements; location of conduit entry/exit paths; location of floor/seismic mounting; available battery types/sizes; all cabinet weights; heat rejection and air flow requirements; single-line diagram; control, and external wiring.

1.4.1.2 **Product Data:** Provide catalog sheets and technical data sheets to indicate physical data and electrical performance, electrical characteristics, and connection requirements.

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- 1.4.1.3 **Manufacturer's Installation Instructions:** Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product. Include equipment installation outline, connection diagram for external cabling, internal wiring diagram, and written instruction for installation.
- 1.4.2 Shop drawings are due upon pre-tender submission.
- 1.4.3 Submit Shop drawings in accordance with Section 26 05 01 - Common Work Results - Electrical.
- 1.5 FINAL SUBMITTALS
- 1.5.1 Upon delivery of the UPS system, the following submittals shall be included:
- 1.5.1.1 A complete set of installation drawings showing all the information stated in Section 1.4.
- 1.5.1.2 An installation and user's manual showing safe and correct operation of all UPS functions.
- 1.6 QUALIFICATION AND QUALITY ASSURANCE
- 1.6.1 **Manufacturer's Certification:** The manufacturer shall specialize in manufacturing of on-line, double conversion three phase UPS modules specified in this document with a minimum of twenty years documented experience, and with a nationwide first party service organization. The manufacturer shall be ISO 9001 certified and shall design to internationally accepted standards.
- 1.6.2 **Factory Testing:** Prior to shipment the manufacturer shall complete a documented Factory test procedure to test all functions of the UPS module and batteries (via a discharge test), when supplied by the UPS manufacturer, and guarantee compliance with the specification. The manufacturer shall provide three (3) copies of the test report.

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1.6.4

1.6.5 **Materials and Assemblies:** All materials and parts comprising the UPS shall be new, of current manufacture, and shall not have been in prior service, except as required during factory testing. All active electronic devices shall be solid state and not exceed the manufacturer's recommended tolerances for temperature or current to ensure maximum reliability. All semiconductor devices shall be sealed. All relays shall be provided with dust covers. The manufacturer shall conduct inspections on incoming parts, modular assemblies and final products.

1.7 **DELIVERY, STORAGE, AND HANDLING**

1.7.1 All products shall be packaged in a manner to prevent penetration by debris and to allow safe delivery by all modes of ground transportation and air transportation where specified.

1.7.2 Prior to shipping all products shall be inspected at the factory for damage.

1.7.3 Equipment shall be protected against extreme temperature and humidity and shall be stored in a conditioned or protected environment.

1.7.4 Equipment containing batteries shall not be stored for a period exceeding three months without powering up the equipment for a period of eight hours to recharge the batteries.

1.7.5 Off-loading from the truck and setting in place of all equipment including batteries specified herein shall be responsibility of the installation contractor, including and all associated labour, parts, tools and equipment.

1.7.6 Installation and wiring of all equipment shall be the responsibility of electrical installation contractor under a separate contract.

1.8 **ENVIRONMENTAL REQUIREMENTS**

1.8.1 The UPS shall be capable of withstanding any combination of the following environmental conditions in which it must operate without mechanical or electrical damage, or degradation of operating characteristics.

1.8.1.1 **Temperature:**

1.8.1.1.1 **UPS Module Operating:** 0°C to 40°C

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- 1.8.1.1.2 **Non-operating:** -20°C to +45°C (-4° to 113°F)
- 1.8.1.2 **Relative Humidity (operating and storage):** 0 to 95% non-condensing
- 1.8.1.3 **Barometric Pressure:** Up to 1,000 meters above sea level / Up to 12,000 meters above sea level non-operating
- 1.8.1.4 **Audible Noise:** Maximum 69 dB "A" weighing @ three feet
- 1.9 WARRANTY
- 1.9.1 **UPS Module:** The UPS shall be covered by a full parts and labor warranty from the manufacturer for a period of twelve (12) months from date of commissioning or acceptance by customer, whichever occurs first.
- 1.9.2 Provide a separate price for additional one and two year of extended warranty. Identify separate prices on electrical tender form.
- 1.10 SERVICE AND SPARE PARTS
- 1.10.1 The manufacturer shall, upon request, provide spare parts kits for the UPS module in a timely manner; as well as provide access to qualified factory trained first party service personnel to provide preventative maintenance and service on the UPS module when required.
- 1.11 MAINTENANCE, ACCESSIBILITY, AND SELF DIAGNOSTICS
- 1.11.1 All UPS subassemblies, as well as the battery, shall be accessible from the front. UPS design shall provide maximum reliability and minimum MTTR (mean time to repair). To that end, the UPS shall be equipped with a self-test function to verify correct system operation. The self-test function shall identify the subassembly requiring repair in the event of a fault. The electronic UPS control and monitoring assembly shall therefore be fully microprocessor based, thus doing away with all potentiometer settings. This shall allow:
 - 1.11.1.1 Auto-compensation of component drift;
 - 1.11.1.2 Self-adjustment of replaced subassemblies;
 - 1.11.1.3 Extensive acquisition of information vital for computer-aided diagnostics (local or remote);

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1.11.1.4 Socket connection to interface with computer-aided diagnostics system.

1.11.2 The UPS shall be repairable by replacing standard subassemblies requiring no adjustments.

2 **PRODUCTS**

2.1 APPROVED MANUFACTURERS

2.1.1 Subject to compliance with specified requirements of this section, acceptable manufacturers of the equipment of this section will be as follows:

2.1.1.1 Eaton Power

2.1.1.2 APC by Schneider

2.1.1.3 Mitsubishi

2.2 SYSTEM DESCRIPTION

2.2.1 UPS Design Requirements:

2.2.1.1 Output Power Continuous Rating: The continuous output power rating of the UPS shall be 750 KVA / 750kW.

2.2.1.2 Rectifier Input Voltage: 600 VAC, +10%/-15%, 3-phase 3-wire plus ground.

2.2.1.3 Output voltage: 600 VAC, 3-phase, 3-wire plus ground (adjustable $\pm 5\%$)

2.2.2 AC Input Characteristics:

2.2.2.1 Voltage: 600 VAC, +10%/-15%, 3 phase, 3 wire plus ground

2.2.2.2 Frequency: 60 Hz ($\pm 5\%$)

2.2.2.3 Power Factor: Up to 0.99 at full load and nominal input voltage

2.2.2.4 Total Harmonic Distortion: Less than 5% at full load and nominal input voltage

2.2.2.5 Power walk-in: 0 to 100% over a 10 second period

2.2.2.6 Inrush Current: Less than 100% of nominal input current for less than one cycle

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- 2.2.2.7 Reactive Current: Not to exceed 15% of the UPS nominal input current
- 2.2.2.8 Input Surge Protection: The UPS is equipped with input MOVs to withstand surges per IEEE 587-1980/ANSI C62.41
- 2.2.3 AC Output Characteristics:
 - 2.2.3.1 Voltage: 600 VAC, 3 phase, 3 wire plus ground (adjustable $\pm 5\%$)
 - 2.2.3.2 Frequency: 60 Hz +1.0 Hz synchronized with bypass (selectable up to 4%), 60 Hz + 1.0 Hz free running
 - 2.2.3.3 Voltage Regulation:
 - 2.2.3.3.1 + 1 % from no load to full load for balanced load.
 - 2.2.3.3.2 +1.75% for 50% unbalanced load.
 - 2.2.3.3.3 +2.5% for 100% unbalanced load
 - 2.2.3.4 Voltage Distortion: Maximum of 2% THD, and single harmonics of 1% maximum over the entire linear load
 - 2.2.3.5 Voltage Transient (Step Load) Response:
 - 2.2.3.5.1 + 3% for 50% step load change
 - 2.2.3.5.2 + 5% for 100% step load change
 - 2.2.3.5.3 + 1% for loss or return of AC input power or manual transfer at full load
 - 2.2.3.6 Voltage Recovery Time: Return to within 1% of steady state within 16.67 milliseconds (one cycle).
 - 2.2.3.7 Phase Angle Displacement:
 - 2.2.3.7.1 $120^\circ + 1^\circ$ for balanced load
 - 2.2.3.7.2 $120^\circ + 3^\circ$ for 100% unbalanced load
 - 2.2.3.8 Non-Linear Load Capability: Output voltage total harmonic distortion (THD) shall be less than 4% when connected to a 100% non-linear load with a crest factor not to exceed 3.5%.
 - 2.2.3.9 Slew Rate: 1 Hz/second maximum (selectable up to 2 Hz/sec increments)

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- 2.2.3.10 Power Factor: between 0.8 power factor lagging and 0.9 power factor leading at the rated output power.
- 2.2.3.11 Inverter Overload Capability:
 - 2.2.3.11.1 25% of rated load for 1 minute
 - 2.2.3.11.2 150% for 60 seconds
- 2.2.3.12 Bypass Overload Capability: 212% for one cycle; > 150% for 60 seconds
- 2.3 MODES OF OPERATION
 - 2.3.1 The UPS module shall be designed to operate as an on line reverse transfer system in the following modes:
 - 2.3.1.1 **Normal:** The UPS module shall continuously supply 100% of the power to the critical load via the inverter. The rectifier/battery charger shall derive power from the utility AC source and supply DC power to the inverter while simultaneously float charging the batteries. The UPS module shall supply uninterrupted power to the total load during normal, emergency, or recharge operation.
 - 2.3.1.2 **Emergency:** Upon failure of the utility AC power source, the critical load shall be supplied by the inverter, which, without any interruption, shall obtain its power from the battery. There shall be no interruption to the critical load upon failure or restoration of the utility AC power source.
 - 2.3.1.3 **Recharge:** Upon restoration of the utility AC source (prior to complete battery discharge), the rectifier/battery charger shall power the inverter and simultaneously recharge the battery. This shall be an automatic function and shall cause no interruption to the critical load.
 - 2.3.1.4 **Bypass:** The static switch shall be used to transfer the load to the system bypass without interruption to the critical power load. This shall be accomplished by turning the inverter off. Automatic re-transfer or forward transfer of the load shall be accomplished by turning the inverter on.

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- 2.3.1.5 **Maintenance:** A manual make before break (overlap) system maintenance bypass switch shall be provided to isolate the UPS system output and system static switch for maintenance. This shall allow each UPS module to be tested or repaired without affecting load operation.
- 2.3.1.6 **Downgrade:** If the battery only is to be taken out of service for maintenance, it shall be disconnected from the rectifier/battery charger and inverter by means of a battery disconnect. The UPS shall continue to function as specified herein, except for power outage protection and high transient response characteristics.
- 2.4 PARALLELING OUTPUT BOARD
- 2.4.1 Rating: 1000A, 600V, 3 phase, 3 wire
- 2.4.2 Short Circuit Rating: 50kA rms symmetrical at 600VAC maximum.
- 2.4.3 Enclosure: Type 1 with drip hood.
- 2.4.4 Breakers shall be of the drawout type.
- 2.4.5 Provide kirk keys as shown.
- 2.4.6 The switchboard enclosure shall be painted on all exterior surfaces. The paint finish shall be manufacturer's standard gray, applied by the electro-deposition process over an iron phosphate pre-treatment.
- 2.4.7 All front covers shall be screw removable with a single tool and all doors shall be hinged with removable hinge pins.
- 2.4.8 Bus Composition: Shall be plated copper. Plating shall be applied continuously to all bus work. The switchboard bussing shall be of sufficient cross-sectional area to meet CSA C22.2 No 29 temperature rise requirements. The phase and neutral through-bus shall have an ampacity as shown in the plans. For 4-wire systems, the neutral shall be of equivalent ampacity as the phase bus bar. Tapered bus is not acceptable. Full provisions for the addition of future sections shall be provided. Bussing shall include all necessary hardware to accommodate splicing for future additions.
- 2.4.9 Bus Connections: Shall be bolted with Grade 5 bolts and conical spring washers.
- 2.4.10 Ground Bus: Sized per CSA C22.2 No.29 and shall extend the

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entire length of the switchboard. Provisions for the addition of future sections shall be provided.

- 2.4.11 Paralleling output board shall be sectioned such that maintenance on the following groups of breakers shall be possible at one time:
 - 2.4.11.1 Input breakers from output of UPS and output breaker on same side
 - 2.4.11.2 Tie breaker
 - 2.4.11.3 Maintenance bypass breaker and output breaker on same side

2.5 COMPONENT DESCRIPTION

- 2.5.1 Rectifier/Battery Charger: Incoming AC power shall be converted to a regulated DC output voltage by an IGBT (insulated gate bipolar transistor) power factor corrected (PFC) rectifier. The rectifier shall provide high quality DC power to charge the batteries and power the inverter and shall have the following characteristics:
 - 2.5.1.1 Input Power Factor Correction (PFC): The PFC rectifier shall be power factor corrected so as to maintain an input power factor of 0.98 lagging to unity at 75% or above load levels to ensure generator compatibility and avoid reflected harmonics from disturbing loads sharing the utility power.
 - 2.5.1.2 Input Harmonic Current Suppression: The PFC rectifier shall produce a sinusoidal input AC current on each phase with low harmonic content, limiting THD on the UPS input to below 3%. This shall eliminate the requirement for an input filter.
 - 2.5.1.3 Modular Assembly: The PFC rectifier assembly shall be constructed of modular design to facilitate rapid maintenance.
 - 2.5.1.4 Battery Charger Current Limiting: The UPS shall be equipped with a system designed to limit the battery recharge current (from 0.05 C10 to 0.1 C10).
 - 2.5.1.5 Charging Levels: The 'battery charging circuitry' shall be capable of being set for automatic battery recharge operation, float service, manual battery charge service, and equalizing or commissioning operation.

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- 2.5.1.6 Intermittent Charging: The battery charge level shall be maintained by an intermittent charging technique between two values V_{fmin} and V_{fmax} very close to the floating voltage. This technique shall be based on a cycle made up of a short charge period (a few seconds) from V_{fmin} to V_{fmax} followed automatically by a slow discharge period (a few minutes) from V_{fmax} to V_{fmin} . This cycle shall be repeated continuously to maintain the battery charge level. In this way the battery shall actually be charging only for a small part of the time, which considerably increases its service life.
- 2.5.1.7 Temperature Compensated Charging: The battery charger shall be equipped with a temperature probe to enable temperature compensated charging and adjust the battery float voltage to compensate for the ambient temperature using a negative temperature coefficient of 3 mV per cell per degree Celsius at a nominal temperature of 25°C.
- 2.5.1.8 Battery Capacity: The battery charger shall have sufficient capacity to support a fully loaded inverter and fully recharge the battery to 95% of its full capacity within 6-8 hours.
- 2.5.1.9 Inverter: The UPS output shall be derived from a Variable Frequency Pulse Width Modulated (PWM) IGBT inverter design. The inverter shall be capable of providing the specified precise output power characteristics (specified in section 2.2.C) while operating over the battery voltage range. The inverter assembly shall be constructed as a modular assembly to facilitate rapid maintenance.
- 2.5.2 Static Bypass – 100% Rated, Continuous Duty
- 2.5.2.1 The static bypass transfer switch shall be solid-state, rated for 100% continuous duty operation without mechanical contactor device in parallel for higher reliability and consistent response time and shall operate under the following conditions:
- 2.5.2.1.1 Uninterrupted Transfer: The static bypass transfer switch shall automatically cause the bypass source to assume the critical load without interruption after the logic senses one of the following conditions:
- 2.5.2.1.2 Inverter overload exceeds unit's rating

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- 2.5.3 Battery protection period expired and bypass current is available
- 2.5.4 Inverter failure
- 2.5.5 Interrupted Transfer: If the bypass source is beyond the conditions stated below, the UPS will make an interrupted transfer (not less than 100 msec. in duration).
- 2.5.6 Bypass voltage greater than + 10%, -10% from the UPS rated output voltage.
- 2.5.7 Bypass frequency greater than + 2 Hz from the UPS rated output frequency.
- 2.5.8 Automatic Uninterrupted Forward Transfer: The static bypass transfer switch shall automatically forward transfer power, without interruption, after the UPS inverter is turned "ON" after an instantaneous overload-induced reverse transfer has occurred and the load current returns the UPS's nominal rating or less.
- 2.5.9 Manual Transfer: A manual static transfer shall be initiated from the UPS Control Panel by turning the UPS inverter off.
- 2.5.10 Overload Ratings: The static bypass transfer switch shall have the following overload characteristics:
 - 2.5.11 1000% of UPS output rating for 0.016 seconds (one cycle)
 - 2.5.12 150% for 1 second
 - 2.5.13 125% of UPS output rating for 1 minute
- 2.5.14 Output Static Switch – 100% Rated, Continuous Duty
- 2.5.15 UPS output shall be equipped with a 100% rated output static switch without Mechanical Contactor device in parallel for higher reliability and consistent response time of 16.66 msec.
- 2.5.16 Microprocessor Controlled Logic

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- 2.5.17 The full UPS operation shall be provided through the use of microprocessor controlled logic. All operation and parameters are firmware controlled, thus eliminating the need for manual adjustments or potentiometers. The logic shall include a self-test and diagnostic circuitry such that a fault can be isolated down to the printed circuit assembly or plug-in power assembly level. Every printed circuit assembly or plug-in power assembly shall be monitored. Diagnostics shall be performed via a PC through the local diagnostics port on the UPS.
- 2.5.18 Standard Display, Control and Indicator Panel
- 2.5.19 The UPS will include a standard easy to use control and indicator panel. Included will be a backlit, color graphic animated LCD display and LED indicators. The UPS panel will include UPS “ON” and UPS “OFF” pushbuttons that will permit the user to safely command the UPS on or off without risk of load loss.
- 2.5.20 Display shall facilitate operation by offering the functions listed below:
- 2.5.21 Operating information supplied on the screens.
- 2.5.22 The graphic display shall assist the Owner by providing step-by-step help.
- 2.5.23 LED mimic diagram. The mimic diagram shall enable display of installation parameters, configuration, operating status and alarms and indication of operator instructions for switching operations (i.e., bypass).
- 2.5.24 It shall be possible to display the following measurements:
- 2.5.25 Inverter output phase-to-phase voltages.
- 2.5.26 Inverter output currents.
- 2.5.27 Inverter output frequency.
- 2.5.28 Voltage across battery bank.
- 2.5.29 Battery charge or discharge current.
- 2.5.30 Rectifier/charger input phase-to-phase voltages.

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- 2.5.31 Rectifier/charger input currents.
- 2.5.32 Active and apparent power.
- 2.5.33 Power factor of the load.
- 2.5.34 Battery temperature.
- 2.5.35 Display of status conditions and events.
- 2.5.36 It shall be possible to display the following indications:
- 2.5.37 Load on battery power.
- 2.5.38 Load on UPS.
- 2.5.39 Load on automatic bypass.
- 2.5.40 General alarm.
- 2.5.41 Battery fault.
- 2.5.42 Remaining battery back-up time.
- 2.5.43 Low battery warning.
- 2.5.44 Bypass AC source outside tolerances.
- 2.5.45 Additional information shall be provided in view of accelerating servicing of the system.
- 2.5.46 Log of time-stamped events. This function shall store in memory and make available, for automatic or manually initiated recall, time-stamped logs of important status changes, faults, and malfunctions, complete with an analysis and display of troubleshooting procedures. It shall be possible to time stamp and store at least 2000 events.
- 2.6 **SYSTEM CONTROLS AND INDICATORS**
- 2.6.1 Front Panel LCD Display: The UPS control panel shall provide a back-lit, color graphic display with choice of over 15 operating languages for indication of UPS status, metering, battery status, alarm/event log and advanced operational features. The display provides access to:

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- 2.6.2 An animated, color mimic diagram indicating UPS power flow
- 2.6.3 Measurements, status indications and events
- 2.6.4 Bar-graphs and waveforms of the measured values
- 2.6.5 Personalization menu protected by a password, used to make specific settings
- 2.6.6 Event log with time stamping
- 2.6.7 Access to all measurements
- 2.6.8 System Parameters Monitored: The visual display will display the following system parameters based on true RMS metering:
- 2.6.9 Measurements:
- 2.6.10 Input voltage (Ph-Ph)
- 2.6.11 Input current per phase
- 2.6.12 Bypass voltage
- 2.6.13 Bypass input frequency
- 2.6.14 UPS output voltage (Ph-Ph and Ph-N) (3 phase simultaneously)
- 2.6.15 UPS output current per phase (3 phase simultaneously)
- 2.6.16 UPS output frequency
- 2.6.17 UPS output % load
- 2.6.18 UPS output kVA
- 2.6.19 UPS output power factor
- 2.6.20 Battery voltage
- 2.6.21 Crest factor
- 2.6.22 Battery current
- 2.6.23 Battery backup time and remaining service life
- 2.6.24 Battery temperature

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- 2.6.25 Status Indications and Events:
- 2.6.26 Load on battery
- 2.6.27 Load on UPS
- 2.6.28 Load on automatic bypass
- 2.6.29 Low-battery warning
- 2.6.30 General alarm
- 2.6.31 Battery fault
- 2.6.32 Remaining back-up time during operation on battery power
- 2.6.33 Bypass source outside tolerances
- 2.6.34 Battery temperature
- 2.6.35 Additional indications shall provide maintenance assistance
- 2.6.36 Display of Operating Curves: The graphical display shall be capable of displaying curves and bar graphs of the above-mentioned measured values for significant periods.
- 2.6.37 Time-Stamped Historical Events: This function shall time-stamp and store all important status changes, anomalies and faults, and make this information available for automatic or user-requested consultation.
- 2.6.38 LED Status Indicators: The UPS control panel shall provide three LEDs that signal the following status conditions:
- 2.6.39 Green LED: Load protected
- 2.6.40 Yellow LED: minor fault
- 2.6.41 Red LED: major fault, load not protected

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- 2.6.43 On/Off Switch: The UPS shall provide the ON and OFF buttons to start and stop the inverter. The switch shall provide a built-in time delay to eliminate the risk of inadvertent operation (additional confirmation is requested). It is possible to remotely activate the OFF function via an isolated dry contact to create an emergency power off function resulting in:
- 2.6.44 Inverter shutdown
- 2.6.45 Opening of the automatic bypass
- 2.6.46 Opening of the input, bypass, output devices and battery circuit breaker
- 2.6.47 Opening of the isolated dry contact on the programmable relay card
- 2.6.48 Audible Alarm Reset: The UPS shall provide an audible alarm that can be stopped using the user interface. If a new alarm is sensed after the original alarm has been silenced, it will reactivate the audible alarm.
- 2.6.49 Emergency Power Off (EPO): The UPS shall be equipped with a local emergency power off button and dry contact input that can be used to command UPS shut down remotely. Activation of this command shall lead to the following actions:
 - 2.6.50 inverter shutdown
 - 2.6.51 opening of the static bypass switch and the battery circuit breaker
 - 2.6.52 opening of input and output devices
 - 2.6.53 opening of an isolated dry contact on the programmable relay board
- 2.6.54 DB-9 Connector: One DB-9 connector with serial output will be provided for field diagnostics.
- 2.6.55 Dry Contacts: The UPS shall be provided standard with a programmable input/output relay board. This board shall have 8 dry contacts, i.e., 6 for input signals and 2 for output signals. Contacts shall be programmed as:
 - 2.6.56 UPS on Line
 - 2.6.57 Load on Bypass

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- 2.6.58 UPS on Battery
- 2.6.59 UPS Battery Low
- 2.6.60 General Alarm
- 2.6.61 Battery Fault
- 2.6.62 Remote UPS on (input)
- 2.6.63 Remote UPS off (input)
- 2.6.64 The contacts will be normally open and will change state to indicate the operating status. The contacts will be rated at 2.0 A (250 VDC / 30 VDC).

2.7 MECHANICAL DESIGN AND VENTILATION

- 2.7.1 Enclosure: The UPS shall be housed in a freestanding enclosure with a dead front construction. The back of the UPS shall be capable of being mounted as close to a wall as practical. The UPS cabinet shall be designed for top cable entry with optional bottom entry cabinets available. Copper wire or bus shall be exclusively for all internal electrical connections excluding heat sink subassemblies. The sheet-metal elements in the structure shall be protected against corrosion by a suitable treatment, such as zinc electroplating, bichromating, epoxy paint or an approved equivalent.
- 2.7.2 Enclosure finish: manufacturer's standard.
- 2.7.3 Dimensions: The core UPS module enclosure dimensions shall not exceed the following:
- 2.7.4 Each UPS Module: 24.6" W x 78" H x 35.5" D / weight: 1,090 lb.
- 2.7.5 Each Transformer Cabinet: 31.5" W x 78" H x 35.5" D / weight: 2,600 lb.
- 2.7.6 Input/Output Cabinet: 67.1" W x 78" H x 35.5" D / weight: 2,315 lb.
- 2.7.7 Paralleling Output Board: 95.5" W x 90" H x 60" D / Weight: 2,000 lb.
- 2.7.8 Access: Front access only shall be required for installation and maintenance. All power connections and component removal shall be possible from the front only. Must be capable of being mounted

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against a wall with no need for side access.

2.7.9 Ventilation and Heat Rejection: The UPS shall be designed for forced air-cooling. Air inlets shall be provided from the front bottom of the UPS enclosure. Air exhaust shall be from the top rear portion of the unit. Full load heat rejection is 112,190 BTU/hour, not including transformers.

2.8 ACCESSORIES

2.8.1 Input Autotransformer: A 750 kVA, 600/480 Vac delta wye input dry-type autotransformer shall be provided inside a standard line-up and match cabinet to isolate the rectifier input and DC bus for ungrounded DC systems.

2.8.2 Two or Three Circuit Breaker External Maintenance Bypass in Matching Cabinet: The maintenance bypass option provides for two (2) or three (3) circuit breakers mounted in a matching, adjacent cabinet to provide a wrap-around bypass configuration for total UPS isolation during maintenance. Maintenance bypass transfers shall be without interruption and shall have mechanical keyed interlocks to protect the UPS from damage in the event of out of sequence transfers.

2.9 FACTORY TEST

2.9.1 Requirements for UPS factory acceptance test shall include but not be limited to, system transient response test, 4-hour 100% on-load test, battery discharge/re-charge performance test, warning and alarms test, static by-pass/manual bypass operation test.

2.9.2 Manufacturer shall provide batteries as required to complete factory load test.

2.9.3 Submit factory test report to the Consultant upon the completion of the test.

2.9.4 Submit a separate price to allow a consultant and owner witnessed factory test.

3 **EXECUTION**

3.1 VISUAL AND OTHER CHECKS

3.1.1 Visually inspect equipment for evidence of damage and verify that surfaces are ready to get all the units.

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- 3.1.2 Verify field measurements and ensure that they match the shop drawings.
- 3.1.3 Verify field measurements and ensure that they match the shop drawings.
- 3.1.4 Verify that required utilities (control voltage, heaters, etc) are available and they are operational.
- 3.2 INSTALLATIONS
- 3.2.1 Provide all tags and nameplates as required per CEC, OESC and these specifications.
- 3.2.2 Follow NETA ATS-2006 specification for complete record keeping.
- 3.2.3 Verify megger tests on all devices, equipment, and provide record of test to consultants and owner for information. This will be included in the manual.
- 3.2.4 Verify that the time current curves of the associated main and secondary protective devices have their characteristic curves set to match the approved curves of the project co-ordination study.
- 3.3 TESTING AND OWNER TRAINING
- 3.3.1 Facilitate the manufacturer provided on-site load testing.
- 3.3.2 Facilitate the manufacturer provided four (4) hours of training to the designated Owner's personnel.

END OF SECTION

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1 **GENERAL**

1.1 SCOPE

1.1.1 This section describes the materials and installation requirements for surge protective devices (SPD) for the protection of all AC electrical circuits.

1.2 RELATED SECTIONS

1.2.1 Section 26 05 01 Common Work Results - Electrical.

1.2.2 Conform to relevant sections of specification for this and other Divisions.

1.3 STANDARDS

1.3.1 The specified system shall be designed, manufactured, tested and installed in compliance with the following codes and standards:

1.3.1.1 Institute of Electrical and Electronic Engineers (ANSI/IEEE C62.11, C62.41, C62.45).

1.3.1.2 American National Standards Institute.

1.3.1.3 Federal Information Processing Standards Publication 94 (FIPS PUB 94).

1.3.1.4 National Electrical Manufacturer Association (NEMA LS-1 1992 All Tests).

1.3.1.5 MIL Standard 220A Method of Insertion Loss Measurement.

1.3.1.6 Underwriters Laboratories UL 1283 and UL 1449 (most recent edition).

1.3.1.7 Canadian Standards (CUL).

1.3.1.8 Canadian Standards Association (CSA) CSAC22.2-Latest Edition.

1.3.1.9 Ontario Hydro Electrical Safety Code Latest Edition.

1.4 PRODUCT SHOP DRAWING DATA

1.4.1 Product data shall be submitted in accordance with Section 26 05 01, Electrical General Provisions. This shall include schematic diagram and all options including indicating lights and dry contacts.

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1.4.2 Evidence of compliance to the certifications as per CSA and UL 1449 must be submitted. Manufacturer shall submit the NEMA LS-11992 test results. This will show actual test data as certified by UL and ANSI standard. Documentation must include copy of UL Listing Report. Manufacturer shall certify stating that tested product (UL tests) and delivered product both had same suppliers for raw materials and same processes to manufacture.

1.5 SUBMITTALS

1.5.1 Product Data: Provide catalogue sheets showing voltage, physical size, Measured Limited Voltage for each waveform listed, UL1449 latest revision, latest edition, suppressed voltage ratings, dimensions showing construction, lifting and support points, enclosure details, per mode and per phase peak surge current, modes of discrete suppression circuitry, warranty period and replacement terms, conductor size, conductor type and lead length.

1.5.1.1 Short Circuit Current Rating (SCCR)

1.5.1.2 Voltage Protection Ratings (VPRs) for all modes

1.5.1.3 Maximum Continuous Operating Voltage rating (MCOV)

1.5.1.4 I-nominal rating (I-n)

1.5.1.5 SPD shall be UL listed and labeled as Type 2 or Type 4 intended for Type 2 applications

1.5.2 Submit product data for all components and accessories.

1.5.3 Manufacturer's Installation Instructions: use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product. Indicate maximum size of circuit breaker or fuse to be connected for each unit.

1.5.4 List and detail all protection systems such as fuses, disconnecting means and protective features.

1.5.5 Provide verification that the SPD device complies with the required UL1449 latest edition, latest revision, and CSA approvals.

1.5.6 Provide actual let through voltage test data in the form of oscillograph results for the ANSI/IEEE C62.41 Category C3 & C1 (combination wave) and A1 (ringwave) tested in accordance with

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ANSI/IEEE C62.45.

- 1.5.7 Provide spectrum analysis of each unit based on MIL-STD-220A test procedures between 10 khz and 100 khz verifying the devices noise attenuation equals or exceeds 50 db at 100 khz.
- 1.5.8 Provide test report in compliance with NEMA LS1 from a recognized independent testing laboratory verifying the suppressor components can survive published surge current rating on both per mode and per phase basis using the IEEE C 62.41, 8x20 microsecond current wave. Test data must be on a complete SPD with internal fusing in place. Test data on an individual module is not acceptable.

1.6 QUALITY ASSURANCE

- 1.6.1 Manufacturer Qualifications: Engage a firm with at least 5 years experience in manufacturing transient voltage surge suppressors.
- 1.6.2 Manufacturer shall be ISO 9001 or 9002 certified.
- 1.6.3 The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of ten (10) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- 1.6.4 The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC.

1.7 DELIVERY, STORAGE, AND HANDLING

- 1.7.1 Handle and store equipment in accordance with manufacturer's Installation and Maintenance Manuals. One (1) copy of this document to be provided with the equipment at time of shipment.

2 **PRODUCTS**

2.1 MANUFACTURERS

- 2.1.1 Provide an internally mounted Surge Protective Devices (SPD) formally called Transient Voltage Suppressor (TVSS) by:
 - 2.1.1.1 Eaton.
 - 2.1.1.2 Schneider

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2.1.1.3 Siemens

2.2 ELECTRICAL DISTRIBUTION EQUIPMENT

2.2.1 Switchboards:

2.2.1.1 SPD shall be UL 1449 labeled as Type 4 intended for Type 2 applications, verifiable at UL.com, without need for external or supplemental overcurrent controls. Every suppression component of every mode, including N-G, shall be protected by internal over-current and thermal over-temperature controls. SPDs relying upon external or supplementary installed safety disconnectors do not meet the intent of this specification.

2.2.1.2 SPD shall be factory installed integral to electrical distribution equipment.

2.2.1.3 Type 4 SPD shall be UL labeled with 20kA I-nominal (I-n)

2.2.1.4 SPD shall be UL labeled with 200kA Short Circuit Current Rating (SCCR).

2.2.1.5 Standard 7 Mode Protection paths: SPD shall provide surge current paths for all modes of protection: L-N, L-G, L-L, and N-G for Wye systems; L-L, L-G in Delta and impedance grounded Wye systems.

2.2.1.6 SPD shall be connected to the buss of the distribution equipment with an appropriately sized 200kA SCCR rated disconnect.

2.2.1.7 SPD shall meet or exceed the following criteria:

2.2.1.7.1 Maximum 7-Mode surge current capability shall be 200kA or higher per phase.

2.2.1.7.2 UL 1449 - Third Edition Revision; effective September 29, 2009, where applicable either Type 2 or Type 4 Voltage Protection Ratings shall not exceed the following:

Voltage	L-N	L-G	N-G	L-L	MCOV
208/120V	800V	800V	800V	1200V	150V
480/277V	1200V	1200V	1200V	2000V	320V
600/347V	1500V	1500V	1500V	2500V	420V

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2.2.1.8 UL 1449 Listed Maximum Continuous Operating Voltage (MCOV)

System Voltage	Allowable System Voltage Fluctuation (%)	MCOV
208/120V	25%	150V
600/347V	20%	420V

2.2.1.9 SPD shall incorporate a UL 1283 listed EMI/RFI filter with minimum attenuation of - 50dB at 100 kHz.

2.2.1.10 Suppression components shall be heavy duty 'large block' MOVs, each exceeding 30mm diameter.

2.2.1.11 SPD shall include a serviceable, replaceable module.

2.2.1.12 SPD shall be equipped with the following diagnostics:

2.2.1.12.1 Visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.

2.2.1.12.2 Audible alarm with on/off silence function and diagnostic test function.

2.2.1.12.3 Form C dry contacts

2.2.1.12.4 Optional – Surge Counter

2.2.1.12.5 No other test equipment shall be required for SPD monitoring or testing before or after installation.

2.2.1.13 SPD shall have a response time no greater than 1/2 nanosecond.

2.2.1.14 SPD shall have a 10 year warranty.

2.2.2 Distribution Panels:

2.2.2.1 SPD shall be UL 1449 labeled as Type 4 intended for Type 2 applications, verifiable at UL.com, without need for external or supplemental overcurrent controls. Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal over temperature controls. SPDs relying

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upon external or supplementary installed safety disconnectors do not meet the intent of this specification.

- 2.2.2.2 SPD shall be factory installed integral to electrical distribution equipment.
- 2.2.2.3 Type 4 SPD shall be UL labeled with 20kA I-nominal (I-n)
- 2.2.2.4 SPD shall be UL labeled with 200kA Short Circuit Current Rating (SCCR).
- 2.2.2.5 Standard 7 Mode Protection paths: SPD shall provide surge current paths for all modes of protection: L-N, L-G, L-L, and N-G for Wye systems; L-L, L-G in Delta and impedance grounded Wye systems.
- 2.2.2.6 SPD shall be connected to the buss of the distribution equipment with an appropriately sized 200kA SCCR rated disconnect.
- 2.2.2.7 SPD shall meet or exceed the following criteria:
 - 2.2.2.7.1 Maximum 7-Mode surge current capability shall be 150kA or higher per phase
 - 2.2.2.7.2 UL 1449 - Third Edition Revision; effective September 29, 2009, where applicable either Type 2 or Type 4 Voltage Protection Ratings shall not exceed the following:

Voltage	L-N	L-G	N-G	L-L	MCOV
208/120V	800V	800V	800V	1200V	150V
480/277V	1200V	1200V	1200V	2000V	320V
600/347V	1500V	1500V	1500V	2500V	420V

- 2.2.2.8 UL 1449 Listed Maximum Continuous Operating Voltage (MCOV)

System Voltage	Allowable System Voltage Fluctuation (%)	MCOV
208/120V	25%	150V
600/347V	20%	420V

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- 2.2.2.9 SPD shall incorporate a UL 1283 listed EMI/RFI filter with minimum attenuation of - 50dB at 100 kHz.
- 2.2.2.10 Suppression components shall be heavy duty 'large block' MOVs, each exceeding 30mm diameter.
- 2.2.2.11 SPD shall include a serviceable, replaceable module.
- 2.2.2.11.1 SPD shall be equipped with the following diagnostics:
- 2.2.2.11.2 Visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.
- 2.2.2.12 Audible alarm with on/off silence function and diagnostic test function (excluding branch).
- 2.2.2.12.1 Form C dry contacts
- 2.2.2.12.2 Optional – Surge Counter
- 2.2.2.12.3 No other test equipment shall be required for SPD monitoring or testing before or after installation.
- 2.2.2.12.4 SPD shall have a response time no greater than 1/2 nanosecond.
- 2.2.2.12.5 SPD shall have a 10 year warranty.
- 2.2.2.13 Branch Panels:
- 2.2.2.14 The panelboard shall be CSA C22.2 No.29 certified and the SPD shall be UL 1449 labeled as Type 4 intended for Type 2 applications.
- 2.2.3 The unit shall be top or bottom feed according to requirements. A circuit directory shall be located inside the door.
- 2.2.3.1 SPD shall meet or exceed the following criteria:
- 2.2.3.2 Maximum 7-Mode surge current capability shall be 100kA or higher per phase.
- 2.2.3.3 UL 1449 - Third Edition Revision; effective September 29, 2009, where applicable either Type 2 for Canada (or Type 1 for US) or Type 4 Voltage Protection Ratings shall not exceed the following:

Voltage	L-N	L-G	N-G	L-L	MCOV

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208/120V	800V	800V	800V	1200V	150V
480/277V	1200V	1200V	1200V	2000V	320V
600/347V	1500V	1500V	1500V	2500V	420V

2.2.3.4 UL 1449 Listed Maximum Continuous Operating Voltage (MCOV) (verifiable at UL.com):

System Voltage	Allowable System Voltage Fluctuation (%)	MCOV
208/120V	25%	150V
600/347V	20%	420V

2.2.3.5 SPD shall incorporate a UL 1283 listed EMI/RFI filter with minimum attenuation of - 50dB at 100 kHz.

2.2.3.6 Suppression components shall be heavy duty 'large block' MOVs, each exceeding 30mm diameter.

2.2.3.7 SPD shall include a serviceable, replaceable module.

2.2.3.8 SPD shall be equipped with the following diagnostics:

2.2.3.8.1 Visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.

2.2.3.8.2 Audible alarm with on/off silence function and diagnostic test function.

2.2.3.8.3 Form C dry contacts

2.2.3.8.4 Optional – Surge Counter

2.2.3.8.5 No other test equipment shall be required for SPD monitoring or testing before or after installation.

2.2.3.9 SPD shall have a response time no greater than 1/2 nanosecond.

2.2.3.10 SPD shall have a 10 year warranty.

2.2.3.11 The unit shall have removable interior.

2.2.3.12 The main bus shall be copper or aluminum and rated for the load

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current required.

2.2.3.13 The unit shall include a 200% rated neutral assembly with copper neutral bus.

2.2.3.14 The unit shall be provided with a safety ground bus.

2.2.3.15 The field connections to the panelboard shall be main lug or main breaker.

2.2.3.16 The unit shall be constructed with flush or surface mounted trim and shall be in a Sprinkler proof enclosure.

3 **EXECUTION**

3.1 INSTALLATION

3.1.1 Install per manufacturer's recommendations and contract documents.

3.2 ADJUSTMENTS AND CLEANING

3.2.1 Remove debris from installation site and wipe dust and dirt from all components.

3.2.2 Repaint marred and scratched surfaces with touch up paint to match original finish.

3.3 TESTING

3.3.1 Check tightness of all accessible mechanical and electrical connections to assure they are torqued to the minimum acceptable manufacture's recommendations.

3.3.2 Check all installed panels for proper grounding, fastening and alignment.

3.4 WARRANTY

3.4.1 Equipment manufacturer warrants that all goods supplied are free of non-conformities in workmanship and materials for one year from date of initial operation, but not more than eighteen months from date of shipment.

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END OF SECTION

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1 **GENERAL**

1.1 RELATED SECTIONS

1.1.1 Section 26 05 01 – Common Work Results - Electrical.

1.1.2 Conform to relevant sections of specification for this and other Divisions.

1.2 REFERENCES

1.2.1 ANSI C82.4-1985, Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps.

1.2.2 CGSB 31-GP-103Ma, Heavy Phosphate Conversion Coatings for Iron and Steel (for Corrosion Resistance).

1.2.3 CGSB 31-GP-105Ma, Zinc Phosphate Conversion Coatings for Paint Base.

1.2.4 CGSB 31-GP-106M, Coating, Conversion, Iron Phosphate, for Paint Base.

1.3 SHOP DRAWINGS AND PRODUCT DATA

1.3.1 Submit shop drawings in accordance with Section 01 33 00 - Submittals.

1.3.2 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for approval and review by Engineer.

1.3.3 Photometric reports shall include lamp-type used, reflection values used, mounting height of all fixtures, and all associated light loss factors for each fixture type, along with the name and contact information of designer who prepared calculations.

1.3.4 Photometric data to include recommended spacing criterion.

1.4 JOB MOCK-UP

1.4.1 Submit mock-ups in accordance with Section 01400 - Quality Control.

1.4.2 Install sample fixtures of the type(s) indicated in the luminaire schedule, in mock-up ceiling. Do include cost of mock-up in project

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price. Locate mock-up on site.

1.5 WASTE MANAGEMENT AND DISPOSAL

- 1.5.1 Separate and recycle waste materials in accordance with section 26 05 10 – Electrical Demolition.
- 1.5.2 Place materials defined as hazardous or toxic waste in designated containers.
- 1.5.3 Ensure emptied containers are sealed and stored safely for disposal away from children.
- 1.5.4 Disposal of fluorescent lamps shall be in accordance with local regulations. Wherever possible, fluorescent lamps shall be recycled by authorized recycling company.
- 1.5.5 Disposal of old PCB filled ballasts (if still existing) on renovation jobs shall be in accordance with regulations of authorities having jurisdiction.

2 **PRODUCTS**

2.1 LAMPS

2.1.1 Fluorescent lamps

Lamp Design	Bulb Shape Wattage	Base	Type	Initial Lumens	Life Hrs.	Descrip.	Colour K
	T8-32W	md.bip	RS	2950	20000		
	T5-28W	min.bip	PRS	2900	20000	neutral	3500
	T5HO-54W	min.bip	PRS	5000	20000	white neutral white	3500

2.1.2 LED Systems

- 2.1.2.1 Luminaire photometric report published by manufacturer will be based on LM- 79-08 (IESNA).
- 2.1.2.2 Data pertaining to the temperature (such as solder joint temperature) for the LEDs when operated inside the luminaire in the intended application; and information about how the measured

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temperature relates to expected life of the system will be provided.

2.1.2.3 Any test data available about longer term performance of the LED luminaire, such as DOE CALiPER testing, manufacturer in-house testing, or field tests conducted by DOE, utilities, or other parties will be provided.

2.1.2.4 Life Rating will be based on LM-80-08 (IESNA) . It will be defined as number of hours of operation where at least 70% of initial lumens for LEDs is maintained.

2.1.2.5 CRI should be greater than 80 (chromaticity as per ANSI C78.377-2008).

2.1.2.6 Mock up should be done before execution of the project.

2.1.2.7 Power supplies and control interfaces should be suitable/compatible with the LED modules/luminaires.

2.1.2.8 Input voltage for power supply will be 120v.

2.1.2.9 Ambient temperature -20 deg C to +50 deg C.

2.1.2.10 FCC 47CFR Part 15 compliant.

2.1.2.11 LED systems to be RoHS compliant.

2.1.2.12 Wiring to be as per the manufacturer's data sheet and to comply with local codes/standards.

2.1.3 Environmental Impact

2.1.3.1 All lamps shall be recyclable and have low mercury content, as determined by the Federal Toxic Characteristic Leaching Procedure (TCLP) testing procedure.

2.2 BALLASTS

2.2.1 Fluorescent ballast: CBM and CSA certified, energy efficient type, IC electronic and IC electronic dimmable where required.

2.2.1.1 Rating: 347V, 60 Hz voltage as indicated, for use with 2-32 W, rapid start lamps.

2.2.1.2 RFI/EMI suppression circuit.

2.2.1.3 Totally encased and designed for 104°F (40°C) ambient

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temperature.

- 2.2.1.4 Power factor: minimum 95% with 95% of rated lamp lumens.
- 2.2.1.5 Crest factor: 1.7 maximum current, 2.0 maximum voltage.
- 2.2.1.6 Capacitor: thermally protected.
- 2.2.1.7 Thermal protection: [non-resettable] on coil.
- 2.2.1.8 Harmonics: 10% maximum THD, including 49th for electronic discrete and hybrid ballasts.
- 2.2.1.9 Operating frequency of fluorescent electronic ballast: 20kHz or greater.
- 2.2.1.10 Sound rated: A.
- 2.2.1.11 Mounting: integral with luminaire unless otherwise specified.
- 2.2.2 Metal halide ballast: design parallel
 - 2.2.2.1 Rating: 347 V, 60 Hz voltage as indicated, for use with 1-400 W metal halide lamp. Provide circuitry for standby light to provide light for starting and restart.
 - 2.2.2.2 Totally encased and designed for 104°F (40°C) ambient temperature.
 - 2.2.2.3 Power factor: minimum 95% with 95% of rated lamp lumens.
 - 2.2.2.4 Type: constant wattage auto-transformer.
 - 2.2.2.5 Input voltage range: plus or minus 10% of nominal.
 - 2.2.2.6 Minimum starting temperature: minus 84°F (29°) at 90% line voltage.
 - 2.2.2.7 Mounting: integral with luminaire, unless otherwise specified.
 - 2.2.2.8 Crest factor: 1.8 maximum current, 2.0 maximum voltage.
- 2.3 FINISHES
 - 2.3.1 Baked enamel finish:
 - 2.3.1.1 Conditioning of metal before painting:

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- 2.3.1.1.1 For corrosion resistance conversion coating to CGSB 31-GP-103Ma.
- 2.3.1.1.2 For paint base, conversion coating to CGSB 31-GP-105Ma, CGSB 31-GP-106M.
- 2.3.1.2 Metal surfaces of luminaire housing and reflectors finished with high gloss baked enamel or polyester powder coat to give smooth, uniform appearance, free from pin holes or defects.
- 2.3.1.3 Reflector and other inside surfaces finished as follows:
 - 2.3.1.3.1 White, minimum reflection factor 85%.
 - 2.3.1.3.2 Colour fastness: yellowness factor not above 0.02 and after 250 h exposure in Atlas fade-ometer not to exceed 0.05.
 - 2.3.1.3.3 Film thickness, not less than 0.03 mm average and in no areas less than 0.025mm.
 - 2.3.1.3.4 Gloss not less than 80 units as measured with Gardner 60 gloss meter.
 - 2.3.1.3.5 Flexibility: withstand bending over (12 mm) ½” mandrel without showing signs of cracking or flaking under ten (10) times magnification.
 - 2.3.1.3.6 Adhesion: (24 mm) 1” square lattice made of (3 mm) 1/8”-square cut through film to metal with sharp razor blade. Adhesive cellulose tape applied over lattice and pulled. Adhesion satisfactory if no coating removed.
- 2.3.2 Alzak finish:
 - 2.3.2.1 Aluminum sheet fabricated from special aluminum alloys and chemically brightened, subsequently anodically treated to specifications established by Alcoa, to produce:
 - 2.3.2.1.1 Finish for mild commercial service, minimum density of coating 7.8 g/m, minimum reflectivity 83% for specular, 80.5% for semi-specular and 75% for diffuse.
 - 2.3.2.1.2 Finish for regular industrial service, minimum density of coating 14.8 g/m, minimum reflectivity 82% for specular and 73% for diffuse.
 - 2.3.2.1.3 Finish for heavy duty service, minimum density of coating 21.8

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g/m, minimum reflectivity 85% for specular, 65% for diffuse.

2.4 LIGHT OPTICAL CONTROL DEVICES

- 2.4.1 Plastic for clear lenses and diffusers shall be manufactured from injection-molded clear virgin acrylic, unless otherwise noted.
- 2.4.2 Glass used for lenses, refractors, and diffusers shall be tempered for high impact and heat resistance. For exterior fixtures use tempered Borosilicate glass.
- 2.4.3 Generally, lenses shall be 0.125" (3.18mm) thick overall with 0.084" (2.13mm) maximum penetration in a K-12 pattern unless otherwise noted.
- 2.4.4 Provide ultraviolet inhibited lenses and shields over lamps as indicated.

2.5 LUMINAIRE CONSTRUCTION

- 2.5.1 Unless otherwise indicated, luminaire bodies shall be of minimum 20-gauge (0.0359" thick), cold rolled prime steel of rigid construction with knockouts as required.
- 2.5.2 Fixture rigidity shall permit any suspension method without sag. Fluorescent luminaires shall be suitable for either individual or continuous mounting.
- 2.5.3 Fixtures shall be finished in baked white enamel unless otherwise noted, with exposed surfaces matching the exposed tee bars specified in other sections and shall resist chipping, corrosion, and discoloration
- 2.5.4 Fixture lenses and diffusers shall be rigid enough to be self-supporting without sag, easily removable but not loose. Provide additional thickness of lens to prevent sag at no extra cost to the owner.
- 2.5.5 Where the architect is to select colours and finish of luminaires after award of contract, it shall be the responsibility of the contractor for Division 26 to obtain this information well in advance of installation schedule.
- 2.5.6 Where fixtures are specified to have two separate power sources within, provide all necessary barriers, etc., to isolate the two power sources as per the requirements of the authorities having jurisdiction.

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- 2.5.7 Where fixtures are located in sound-critical spaces including but not limited to theater, multi-purpose room, as described in noise section shall be mounted with rubber cushion or assemblies provide necessary isolation barrier.
- 2.5.8 Where fixtures are specified to be IP65 rated, rating shall be tested to IEC 60598 by a recognized independent testing authority.
- 2.6 MANUFACTURERS
- 2.6.1 The listing of a manufacturer as "acceptable" does not imply automatic approval. It is the responsibility of the contractor to ensure that any price quotations received and submittals made are for devices that meet or exceed the specifications included herein.
- 2.6.2 Refer to Luminaire Schedule for the acceptable manufacturers for the specific luminaire types.
- 2.7 LAMPS:
- 2.7.1 Sylvania, or Philips unless otherwise specified. The same manufacturer shall supply all lamps of a given type.
- 2.7.2 Ballasts:
- 2.7.2.1 Advance.
- 2.7.2.2 GE/Universal/Magnetek
- 2.7.2.3 Osram Sylvania
- 2.7.2.4 Fluorescent dimming ballasts shall be Lutron only.
- 2.7.2.5 Hatch electronics shall be equal on electronic metal halide ballasts.
- 2.7.3 Luminaires:
- 2.7.3.1 The catalog number, if provided, is for reference only and may not include all options and features required by the description. Manufacturer/supplier to ensure the submitted luminaire meet all requirements identified in each luminaire schedule.
- 2.7.3.2 Include cost for aiming and adjustment(s) of luminaires, programming, dimming setting, LV lighting control adjustment(s), etc. as part of this contract.
- 2.7.3.3 Where several manufacturers are shown, the first one named,

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accompanied by a model or catalog number, is the one on which the design is based.

2.7.3.4 The presence of a manufacturer's name as an acceptable alternate indicates acceptance of that manufacturer's level of quality, but does not imply that a comparable luminaire by that manufacturer necessarily exists and/or equivalent.

2.7.3.5 The products of the other named manufacturers may be used, provided that the product offered meets the specification, is visually similar to, and has photometric performance comparable to, the first-named product. The manufacturer/supplier shall be responsible to review the base luminaire and make the final determination as to whether the product of an alternative manufacturer meets the above criteria. In the event that such product is deemed not to meet those criteria, the manufacturer/supplier shall provide the product on which the design was based.

2.7.3.6 All luminaires will be specification grade. Do not provide luminaires that are not similar in shape and/or not equivalent. It is the responsibility of the manufacturer/ supplier to ensure compliance.

2.8 OWNER'S SPARE STOCK (ADDENDUM E-1)

2.8.1 Provide 2% of all luminaires, lamps, ballasts, and drivers as installed on this project for Owner's attic stock. The spare stock products shall be handed over to the Owner in their original packaging prior to the substantial completion of the project.

3 **EXECUTION**

3.1 INSTALLATION

3.1.1 Replace all lamps with new, if there is any rapid deterioration of lamps which the Consultant views as excessive in terms of the project warranty, at no cost to the Owner.

3.1.2 Replace all lamps with a colour shift which does not correlate to manufacturers published data.

3.1.3 Locate and install luminaires as indicated.

3.2 WIRING

3.2.1 Connect luminaires to lighting circuits:

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3.2.1.1 Through flexible conduit or modular wiring system.

3.3 LUMINAIRE SUPPORTS

3.3.1 For suspended ceiling installations, support luminaires independently of ceiling, duct work, or piping.

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.

3.4.3 Install pendant lighting fixtures plumb and at a height from the floor as specified on drawings/specifications. In cases where conditions make this impractical, refer to the Architect for decision. Use ball aligners and canopies on pendant fixtures unless noted otherwise.

3.5 CLEANUP

3.5.1 All lighting fixtures shall be thoroughly cleaned with materials and methods recommended by the manufacturers. All broken parts shall have been replaced and all lamps shall be operative.

END OF SECTION

Project Name: METRO HALL DAYCARE
Project No.: 2021-0245
Section Name: **Unit Equipment for Emergency Lighting**
Section No.: **26 52 01**
Date: January 26, 2024

1 **GENERAL**

1.1 RELATED SECTIONS

1.1.1 Section 26 05 01 Common Work Results - Electrical.

1.1.2 Conform to relevant sections of specification for this and other Divisions.

1.2 PRODUCT DATA

1.2.1 Submit product data in accordance with Section 01 33 00 – Submittals.

1.2.2 Data to indicate system components, mounting method, source of power and special attachments.

2 **PRODUCTS**

2.1 EQUIPMENT

2.1.1 Supply voltage: 120 V, ac.

2.1.2 Output voltage: 24V dc.

2.1.3 Operating time: 120 min.

2.1.4 Battery: sealed, maintenance free.

2.1.5 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01 V for plus or minus 10% input variations.

2.1.6 Solid state transfer circuit.

2.1.7 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.

2.1.8 Signal lights: solid state, for AC Power ON, and High Charge.

2.1.9 Lamp heads: integral on unit and remote as indicated on the floor plans, 345 horizontal and 180 vertical adjustment. Lamp type: LED 12W.

2.1.10 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy

Project Name: METRO HALL DAYCARE
Project No.: 2021-0245
Section Name: **Unit Equipment for Emergency Lighting**
Section No.: **26 52 01**
Date: January 26, 2024

access to batteries.

2.1.11 Finish: To be selected by the Architect from standard options.

2.1.12 Auxiliary equipment:

2.1.12.1 Ammeter.

2.1.12.2 Voltmeter.

2.1.12.3 Test switch.

2.1.12.4 Time delay relay.

2.1.12.5 Battery disconnect device.

2.1.12.6 Ac input and dc output terminal blocks inside cabinet.

2.1.12.7 Cord and duplex receptacle plug connection for ac.

2.1.12.8 RFI suppressors.

2.2 WIRING OF REMOTE HEADS

2.2.1 Conduit: To Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

2.2.2 Conductors: To Section 26 05 21 - Wires and Cables0 - 1000 V, sized in accordance with manufacturer's recommendations.

2.3 MANUFACTURER

2.3.1 Acceptable manufacturers are:

2.3.1.1 Beghelli

2.3.1.2 Emergi-lite

2.3.1.3 Lumacell

3 **EXECUTION**

3.1 INSTALLATION

3.1.1 Install unit equipment and remote mounted fixtures.

3.1.2 Direct heads.

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Project No.: 2021-0245
Section Name: **Unit Equipment for Emergency Lighting**
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3.1.3 Connect exit lights to unit equipment.

END OF SECTION

Project Name: METRO HALL DAYCARE
Project No.: 2021-0245
Section Name: **Exit Signs**
Section No.: **26 53 00**
Date: January 26, 2024

1 **GENERAL**

1.1 REFERENCE

1.1.1 Read and be governed by Section 26 05 01.

1.2 RELATED WORK

1.2.1 Comply with relevant Sections of this and other Divisions of this Specification.

1.3 PRODUCT DATA

1.3.1 Submit product data in accordance with Section 26 05 01.

1.3.2 Exit Signs based on CSA C22.2 No141

1.3.3 NRCAN/CSA C860 Certified.

2 **PRODUCTS**

2.1 PUBLIC AREAS TYPE

2.1.1 Edge lit type, either single face recessed wall mount, or recessed single or double faced ceiling mount.

2.1.2 Housing to have steel bevelled trim plate, with white finish.

2.1.3 Faceplate to have green pictogram on clear, white or mirrored background, complying to NBC 2010, with or without directional indicators as required.

2.1.4 Lamps to be high output LED, not exceeding 2W power draw, vertically aligned, and parallel proprietary lateral, acrylic lens, such that they are fully contained and not be visible or protruding.

2.1.5 Self-powered unit for 120V input with dust-tight relay transfer and maintenance free nickel cadmium battery. Include low voltage disconnect, short circuit, reverse polarity test switch, high charge, and brownout protection features.

2.1.6 Edgelit sign to be Beghelli GUIDA RM series or approved equal.

2.2 BACK OF THE HOUSE AND SERVICE AREAS TYPE

2.2.1 Thin line type with a maximum depth of 51 mm (2"), surface, single or double face, end or ceiling mounted.

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- 2.2.2 Housing to be fully extruded aluminum, with matt white finish.
- 2.2.3 Faceplate to be green pictorial sign complying to NBC 20 12 stand and with or without directional indicators as required.
- 2.2.4 Lamps to be high output LED not exceeding 2W power draw, vertically aligned, and parallel proprietary lateral, acrylic lens, such that they are fully contained and not be visible or protruding.
- 2.2.5 Pictorial exit sign shall be Beghelli QUADRA series or approved equal.

2.3 GENERAL

- 2.3.1 All exit lights shall have :
 - 2.3.1.1 Have no light leakage from joints and fittings.
 - 2.3.1.2 Have canopy and/or stem hangers to match housing.
 - 2.3.1.3 Meet the requirements of standard CSA C860.
 - 2.3.1.4 Must be 2010 NBC compliant

3 **EXECUTION**

3.1 INSTALLATION

- 3.1.1 Install exit lights where shown.
- 3.1.2 Connect exit lights to circuits as indicated.
- 3.1.3 Ensure that exit light circuit breaker is locked in ON position.
- 3.1.4 Ensure that nowhere, are exit lights mounted less than 2m (6'-6") between underside of unit and finished floor.
- 3.1.5 For ceiling mounting in areas with unfinished ceiling, mount unit alongside junction box, with or without canopy, and supply unit laterally with conduit (or with buried conduit, where allowed or specified, or by using the exit light canopy as a junction box where approved).

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3.1.6 Include in the Bid, for the installation of 5 (five) additional exit lights of each type X1 where directed on site.

END OF SECTION

Project Name: METRO HALL DAYCARE
 Project No.: 2021-0245
 Section Name: **List of Acceptable Manufacturers**
 Section No.: **26 90 00**
 Date: January 26, 2024

List of Acceptable Manufacturers

Refer to the Base Building Vendors List for Metro Hall in Part 3 of the City of Toronto’s General Specifications

SPECIFICATION SECTION	EQUIPMENT	ACCEPTABLE MANUFACTURERS
26 05 19 Low-voltage Electrical Power Conductors and Cables	Building Wires	<ul style="list-style-type: none"> • General Cable • SouthWire • Nexans • Canada Wire and Cable
	Type TECK90 Cable	<ul style="list-style-type: none"> • General Cable • SouthWire • Nexans • United Wire and Cable
	Armoured Cables	<ul style="list-style-type: none"> • General Cable • SouthWire • Nexans
	Mineral-Insulated Cables	<ul style="list-style-type: none"> • nVent - Pyrotenax
	Fire-Rated Power Cables	<ul style="list-style-type: none"> • nVent – Pyrotenax • Vitalink
	Control Cables	<ul style="list-style-type: none"> • General Cable • SouthWire • Nexans • United Wire and Cable • Belden • Delco
	Drive RX Cables for Variable Frequency Drives Application	<ul style="list-style-type: none"> • General Cable • SouthWire • Nexans

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 Section Name: **List of Acceptable Manufacturers**
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26 05 20 Wiring and Box Connectors 0-1000V	Standard Fixed Spring Type Connectors	<ul style="list-style-type: none"> • Thomas & Betts: Marrett Type II Winged • Ideal Industries
	Vibration Resistant and High Temperature Sleeve & Screw Type Connectors	<ul style="list-style-type: none"> • Thomas and Betts: Marrett Set Screw Vibration Proof/Visible Connector • Ideal Industries
	Weatherproof Fixed Spring Type Connectors	<ul style="list-style-type: none"> • Ideal Industries: Weatherproof Wire Connector
	Mechanical Wire Connectors	<ul style="list-style-type: none"> • Panduit: Pan-Lug Cast Copper Connectors • Blackburn
	Compression Wire Connectors	<ul style="list-style-type: none"> • Panduit: Pan-Lug Compression Connectors • Blackburn
	Mechanical Lugs	<ul style="list-style-type: none"> • Panduit: Pan-Lug Aluminum Mechanical Connectors • Blackburn
	Insulated Butt (Hypress) Splice	<ul style="list-style-type: none"> • Panduit: Pan-Term Butt splice • 3M • Blackburn
26 05 29 Hangers and Supports for Electrical Systems	Support Channels	<ul style="list-style-type: none"> • Unistrut of Canada Ltd. • Burndy Canada Ltd. • Electrovert Ltd. • Pilgrim Technical Products Limited
	Concrete Anchors	<ul style="list-style-type: none"> • Hilti Canada Ltd • Pilgrim Technical Products Limited • Electrovert Ltd. • Unistrut

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26 05 33.23 Surface Raceways for Electrical Systems	Surface Floor Raceway System	<ul style="list-style-type: none"> • Legrand: 4000 Series Multi-Channel Metal Raceway
26 05 36 Cable Trays for Electrical Systems	Cable Trays	<ul style="list-style-type: none"> • Thomas & Betts Canada • Cablofil • Canadian Electrical Raceways • Eaton B-Line
26 05 73 Short Circuit System Coordination & Arc Flash Study	Short Circuit System Coordination and Arc Flash Study	<ul style="list-style-type: none"> • Eastenghouse • Brosz and Associates • Enkompass • GT Wood • Pelikan • Schneider • Eaton
26 09 13 Power Monitoring	Power Monitoring	<ul style="list-style-type: none"> • Intellimeter Canada • Quadlogic Controls Corp • Carma Industries • Shneider Electric • Eaton Electric
26 09 23 Lighting Control Devices	General 0-10V Dimmers	<ul style="list-style-type: none"> • Lutron: DIVA or equivalent • Acuity: nLight • Leviton (Specification Grade)
	General Occupancy Sensors	<ul style="list-style-type: none"> • Lutron • Acuity: Sensor Switch • Watt Stopper • Leviton (Specification Grade)
26 09 43 Network Lighting Controls	Network Lighting Controls	<ul style="list-style-type: none"> • Acuity: nLight • Lutron • Douglas Lighting Control • Watt Stopper

Project Name: METRO HALL DAYCARE
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 Section Name: **List of Acceptable Manufacturers**
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26 12 16 Dry-Type Medium Voltage Power Transformers	Power Transformers	<ul style="list-style-type: none"> • Hammond Power Solutions • Rex Power Magnetics • Delta Transformers • Schneider Electric
26 13 23 Medium Voltage Metal-Enclosed Switchgear	Medium Voltage Metal-Enclosed Switchgear	<ul style="list-style-type: none"> • S&C Electric Canada • Schneider Electric • Eaton Cutler-Hammer • Siemens Canada
26 22 13 Dry Type Transformers up to 600V Primary	Dry Type Transformers	<ul style="list-style-type: none"> • Hammond Power Solutions • Schneider Electric – Square D • Rex Power Magnetics • Delta • STI
26 24 13 Switchboard	Switchboards	<ul style="list-style-type: none"> • Schneider Electric – Square D • Eaton – Cutler Hammer • Siemens
26 24 16 Panelboards	Panelboards	<ul style="list-style-type: none"> • Schneider Electric – Square D • Eaton – Cutler Hammer • Siemens
26 27 26 Wiring Devices	Wiring Devices	<ul style="list-style-type: none"> • Hubbell Canada • Pass & Seymour • Leviton (Specification Grade)
26 28 16.01 Moulded Case Circuit Breakers	Moulded Case Circuit Breakers	<ul style="list-style-type: none"> • Schneider Electric – Square D • Eaton – Cutler Hammer • Siemens

Project Name: METRO HALL DAYCARE
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 Section Name: **List of Acceptable Manufacturers**
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26 28 23 Disconnect Switches Fused & Non-fused	Disconnect Switches	<ul style="list-style-type: none"> • Schneider Electric – Square D • Eaton – Cutler Hammer • Siemens
26 32 13 Natural Gas Generator Set	Natural Gas Generator	<ul style="list-style-type: none"> • Caterpillar – Toromont • Cummins Eastern Canada • Kohler – Paramount • Generac – Total Power
26 36 23 Automatic Load Transfer Switch	Automatic Load Transfer Switch	<ul style="list-style-type: none"> • ASCO: 7000 Series • Eaton
26 41 13.13 Lightning Protection for Buildings	Lightning Protection	<ul style="list-style-type: none"> • Dominion Lightning Protection • Burchell Lightning Protection
26 43 13 Surge Protective Devices	Surge Protective Devices	<ul style="list-style-type: none"> • Schneider • Eaton • Siemens
26 52 01 Unit Equipment for Emergency Lighting	Unit Equipment for Emergency Lighting	<ul style="list-style-type: none"> • Beghelli • Emergi-Lite • Lumacell



City of Toronto - Commercial Facilities

Structured Cabling Systems

Design Guide For

Consulting Engineers, Architects, Designers

& Contractors

Revision: 1.0

January 2023

Corporate Services | Network Services

Information Technology

Standards & Procedures

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SECTION-1: INTRODUCTION

This design guide is to provide consulting engineers, architects and designers working for the City of Toronto (CoT) with a document for the design of commercial facilities (owned, controlled, or leased buildings) communications distribution and structured cabling systems that accurately reflects the City of Toronto (CoT) and industry standards in effect as of this publication. This document shall be referenced to develop project specification and tender documents, specifically extra costs, and Bell standard pricing.

Therefore, it is obligatory for consulting engineers, architects, and designers of telecommunications systems of City of Toronto (CoT) to follow and practice the most updated revision to reflect the methods, materials and standards that have been used for providing telecommunications services to the existing facilities. The updated document also reflects changes in industry practice as of this publication.

In general, it is the responsibility of the building communications distribution designer to coordinate with the other designers on a project (architect, structural, electrical, mechanical, etc.) to ensure that other systems are both compatible with and complementary to the communications cabling system. The City of Toronto (CoT) design philosophy is that it is critical to coordinate between disciplines during the design phase of a project, rather than attempting to make adjustments in the field during construction.

Communications distribution systems designed for the City of Toronto (CoT) commercial facilities are expected to support and integrate voice, data and video communications with common media (fiber optic and unshielded twisted pair copper cable).

DOCUMENT INTENT AND LIFE CYCLE

The purpose of this standard is to define the general guidelines and standards for the design, specification, installation, testing, troubleshooting, documentation and handing over of the commercial facilities (owned, controlled, or leased) communications distribution and structured cabling systems. This standard follows published industry standards and best practices applicable to the commercial buildings of City of Toronto (CoT). The life cycle of this document version is from January to December every year from 2023. Always consult City of Toronto (CoT) Network Services (IT) Division for the latest version of this standard guide.

This document addresses commercial buildings communications distribution and structured cabling system design as it relates to:

- Design guide, topology and methodology
- Communications Media – fibreoptics and copper unshielded twisted pair (UTP)
- Pathway System – cable trays, conduits, etc.
- Products

- Execution (installation)
- Testing and Commissioning
- Handing over (final acceptance)

This document should serve as a guide for making standards compliant project specification which, in due course, will be reflected in a master tender specification document. In addition to specifications for a telecommunications project, plan drawings and schematic diagrams will also need to be produced by the designer. The drawings should conform to the guidelines contained in this document. This document is to be used in conjunction with the latest edition of BICSI TDMM.

Though every attempt is made to cover unforeseen issues, every building and project has its own issues, therefore IT - Network Services and Telecommunication Services should be included right at beginning of the project and the communications specifications must be reviewed and approved by these groups within the City of Toronto (CoT).

TYPES OF CONSTRUCTION

Throughout this document, reference will be made to three types of construction as defined below: new, overbuild and basic construction. These definitions are applicable to the purposes of this document only. A new commercial building communications distribution and structured cabling system as well as the addition to and/or modification of existing cabling system is included in these construction projects. Tradeoffs between design standards and practicality will many times be dependent upon the type of construction. Different design approaches may be warranted for differing types of construction.

A- NEW CONSTRUCTION

New construction is defined as construction that results in a new (or new portion of an existing) commercial buildings communications distribution and structured cabling systems. For the most part, new pathway will be constructed, and new cabling will be installed in the pathway.

B- OVERBUILD CONSTRUCTION

Overbuild construction is defined as construction which may include demolition and/or abandonment of existing pathway and cabling, reuse of existing pathway for installation of new cabling and/or the addition of new pathway and/or cabling to existing pathway and/or cabling. Common terms referring to this type of construction include expansion, renovation, remodel, addition and retrofit, among others.

C- BASIC CONSTRUCTION

Basic construction is defined as construction that includes reuse of existing distribution pathway for the installation of new cabling. Demolition of existing cabling may be involved as well. Basic construction is focused on the installation of new cabling with no (minor) modifications to the existing pathway system.

CITY OF TORONTO AGREEMENT WITH BELL CANADA FOR COMMERCIAL FACILITIES

Effective January 10, 2010, the City of Toronto (CoT) has entered into a multiyear Voice and Data cabling agreement with Bell Canada. Bell Canada is to be used for all Data and Voice cabling for all owned and leased buildings of the City of Toronto.

A pricing table of services regarding this agreement having unit cost is available to share from CoT-IT with the permission to only authorized recipients.

Based on the agreement, current cabling vendor of record (VOR) shall be used. The cabling VOR shall be verified by CoT-IT Network Services at the time of proposed work or RFP.

Analog devices such as fax, POS (dialup), modems and other specialized monitoring lines are using Centrex. The voice cabling system for Centrex will be supplied and installed by Bell as part of an agreement between Bell and the City of Toronto. Bell will have ownership of the voice cabling system.

Please contact CoT-IT-Telecommunications Services, voice infrastructure group for more details.

CITY OF TORONTO TENDER DRAWINGS

This standard guide should be read in conjunction with the City of Toronto (CoT) standard drawings. The drawings shall typically be produced by the consulting engineers / designers and shall consist of (if applicable to the project) the followings but not be limited to:

1. Title Page and Drawing Index
2. Symbols (legends) and Notes General
3. Campus / Building Layout – Fibreoptics Backbone Network Layout (if applicable)
4. Fibreoptics Patch Panel Port Assignment (if applicable)
5. Campus / Building Layout – Voice (copper) Backbone Network Layout (if applicable)
6. Copper Patch Panel / BIX Blocks Port Assignment
7. Building Floor Plan
8. Serving Zone Floor Plan
9. Wireless Heatmap Plan
10. Entrance Facility Layout
11. Equipment Room Layout

12. Telecom Room Layout
13. Building Riser Layout – Horizontal / Backbone
14. Ceiling / Wall / Furniture / Floor Mounted Work Area Outlet Details and Bill of Materials
15. Telecom Enclosure Elevation and Bill of Materials
16. Telecom Enclosure Power Distribution Diagram
17. Telecom Enclosure UPS Panel Layout
18. Entrance Facility Backboard Elevation and Bill of Materials
19. Telecom Pathways (Cable Trays / Conduits) Layout
20. Typical Details of Cable Tray, Conduit / Sleeve, Fire-stopping, Horizontal/Backbone Labeling
21. Telecom Grounding and Bonding Layout (Riser and Floor Plan)
22. HVAC – Mechanical System Layout for Equipment Room / Telecom Room
23. Electrical / Power Layout for Equipment Room / Telecom Room / Work Areas
24. Demolition Drawings (all applicable drawings / layouts – if applicable)

SERVICES NOT PROVIDED BY THE CITY OF TORONTO

- The voice system technology (Bell Centrex etc.) shall be supplied and installed by Bell Canada.
- Entrance Facility and demarcation point shall be outlined in the specific design drawings. Service providers shall terminate the incoming copper cables on BIX and BIX cross-connect between the ISP and the OSP cabling at the Entrance Facility.
- Service providers shall terminate the incoming fibre cables in either wall mount or rack mount fibre enclosures between the ISP and the OSP cabling at the Entrance Facility.
- Witnessing field cable testing at site is NOT CoT's responsibility. The Contractor shall submit the test results to Consultant for their review, validation, witnessing and comment. Consultant shall forward the test results to CoT-IT/Network Services for further review (only if approved by the Consultant after their review). If there is no Consultant on the project, the contractor/cabling installer shall submit the test results to CoT's IT/Network Services for their review.
- BOQs/BOMs, layouts, elevations, drawings and schematics shall be prepared/reviewed by the Consultant.

MANDATORY DESIGNERS' QUALIFICATION REQUIREMENTS

- The standard is to be observed by the City of Toronto - IT Network Services Staff and Consultants involved with the design and implementation of structured cabling systems for data networks which include data networks, security networks, VoIP networks and any other networks that require a structured cabling system that is unified and connected to the City of Toronto network.
- The preparation and review of any network cabling system design, drawings and specification documents shall be conducted by a **Registered Communications Distribution Designer (RCDD)**. The credential holder shall be in good standing who have demonstrated knowledge in the design, integration and implementation of telecommunications and data communications transport systems and related infrastructure.
- All consultant design drawings and specification document shall be sealed / stamped by RCDD.
- All cabling is to be provided from the manufacturers noted with the following sections. Cabling provided by alternate manufacturers is not acceptable.

In addition, the RCDD shall have the following qualifications:

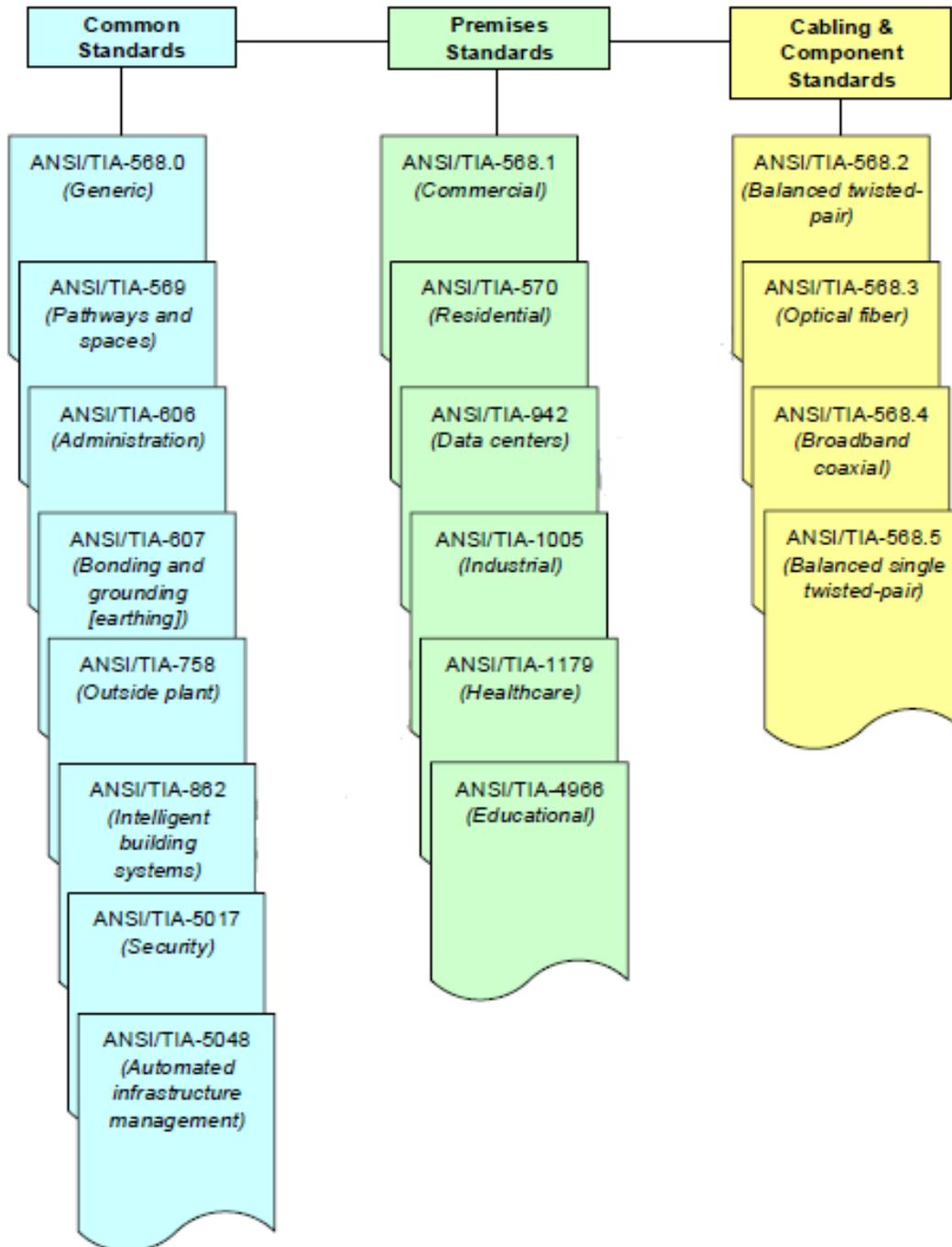
- The RCDD shall demonstrate a minimum of 5 years of experience in the design of commercial buildings communications distribution systems. Experience not directly related to the design and installation of commercial buildings communications distribution systems, such as sales and/or marketing, is not acceptable.
- The RCDD shall demonstrate that he/she has designed or has had personal design oversight of a minimum of five projects similar in size and construction cost to the current CoT project.
- The RCDD consultant must have verifiable design experience with products and solutions from **Belden**.

Before commencing any work for or on behalf of the City of Toronto, the RCDD shall provide a copy of their RCDD certificate showing up to date registration in accordance with the **Building Industry Consultant Services International (BICSI)** policies and guidelines.

MANUFACTURERS

In addition to the standards listed below, the City of Toronto has selected **Belden** as a manufacturer of communications cabling infrastructure products for commercial buildings. The manufacturer is identified in the Product Section. The commercial building communications distribution designer is required to incorporate only this manufacturer into the design and to design a communications distribution structured cabling system that will be suitable for the use of products from the manufacturer.

ANSI/TIA RELATIONSHIP DIAGRAM



Relationships between ANSI/TIA Standard Documents

DESIGN AND REFERENCE STANDARDS

It is required that the designer be thoroughly familiar with the content and intent of these references, standards, and codes and that the designer be capable of applying the content and intent of these references, standards, and codes to all commercial communications system designs executed on behalf of the City of Toronto.

Listed in the table below are references, standards, and codes applicable to commercial communications systems design. If questions arise as to which reference, standard, or code should apply in a given situation, the more stringent shall prevail. As each of these documents is modified over time, the latest edition and addenda to each of these documents is considered to be definitive.

Standard	Title	Date
TIA-568.0-E	Generic telecommunications cabling for customer premises	2020
TIA-568.1-E	Commercial Building Telecommunications Cabling Standard	2020
TIA-568.2-D	Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted- Pair Cabling Components	2018
TIA-568.3-E	Optical Fibre Cabling Components Standard	2022
TIA-568.4-E	Broadband Coaxial Cabling and Components Standard	2022
TIA-568.5	Balanced Single Twisted-pair Telecommunications Cabling and Components Standard	2022
TIA 606-D	Administration standard for telecommunications infrastructure	2021
TIA- 607-D	Generic telecommunications bonding and grounding (earthing) for customer premises	2019
TIA-569-E	Telecommunications Pathways and Spaces	2019
TIA-758-B	Customer-Owned Outside Plant Telecommunications Infrastructure Standard	2012
TIA-942-B	Telecommunications Infrastructure Standard for Data Centers	2017
TIA-598-D	Optical Fibre Cabling Coding	2014

Standard	Title	Date
TIA-862-C	Structured Cabling Infrastructure Standard for Intelligent Building Systems	2022
TIA-1152-A	Requirements for field test instruments and measurements for balanced twisted-pair cabling	2016
TIA-1005-A	Telecommunications infrastructure standard for industrial premises	2012
TIA-526-14-C	Optical Power Loss Measurement of Installed Multimode Fiber Cable Plant; Modification of IEC 61280-4-1 edition 2, Fiber-Optic Communications Subsystem Test Procedures- Part 4-1: Installed Cable Plant-Multimode Attenuation Measurement	2015
TIA-526-7-A	Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant, Adoption of IEC 61280-4-2 edition 2: Fibre-Optic Communications Subsystem Test Procedures – Part 4-2: Installed Cable Plant – Single-Mode Attenuation and Optical Return Loss Measurement	2015
TIA-TSB-162-B	Telecommunications Cabling Guidelines for Wireless Access Points	2021
TIA-TSB-184-A	Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling	2017
TIA-604-10-C	FOCIS 10 Fiber Optic Connector Intermateability Standard- Type LC	2021
BICSI TDMM	Telecommunications Distribution Methods Manual, 14th Edition	2020
ANSI/BICSI 002-2019	Data Center Design and Implementation Best Practices	2019
ANSI/BICSI 007-2020	Information Communication Technology Design and Implementation Practices for Intelligent Buildings and Premises	2020
ANSI/BICSI 008-2018	Wireless Local Area Network (WLAN) Systems Design and Implementation Best Practices	2018

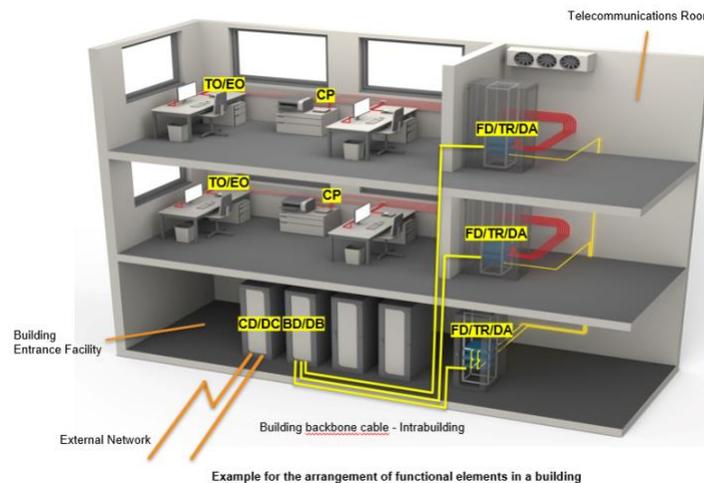
DEVIATION FROM STANDARDS

It is the intent of City of Toronto (CoT) to rigidly impose standards on every aspect of a commercial building communications system design. However, each design is unique and may be subject to situations in which deviations from the standards are warranted.

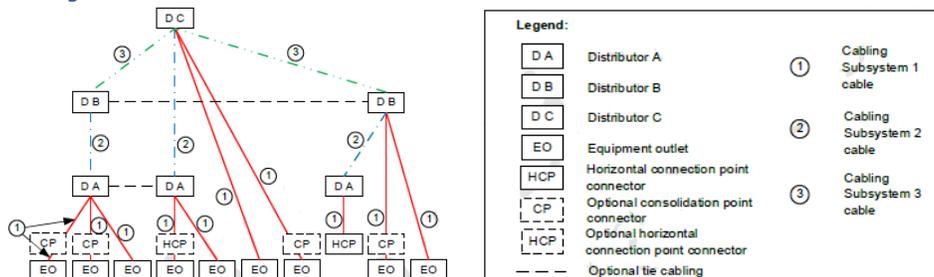
If the designer feels that deviation from a given standard is warranted, the designer shall submit a written deviation request to City of Toronto (CoT-IT). The request will, at a minimum, indicate the standard from which there is a proposed deviation, the substitution being proposed in place of the standard, the reason of the request being made, and an explanation of the justifications (economic, technical or otherwise) for the deviation. The designer may, upon written approval from CoT-IT, incorporate the design deviation into the overall design. The City of Toronto (CoT) approval is required on a project-by-project basis. The designer should not assume that a deviation approval for one project means that the deviation will necessarily be approved for a subsequent project.

GENERIC TOPOLOGY

The figure below is an illustration of a generic cabling topology for Cabling Subsystem 1, Cabling Subsystem 2, Cabling Subsystem 3, Distributor A, Distributor B, Distributor C, an optional consolidation point and the equipment outlet. Elements of Generic Cabling Topology in both Standards are as below:



ANSI/TIA-568.0 Terminologies

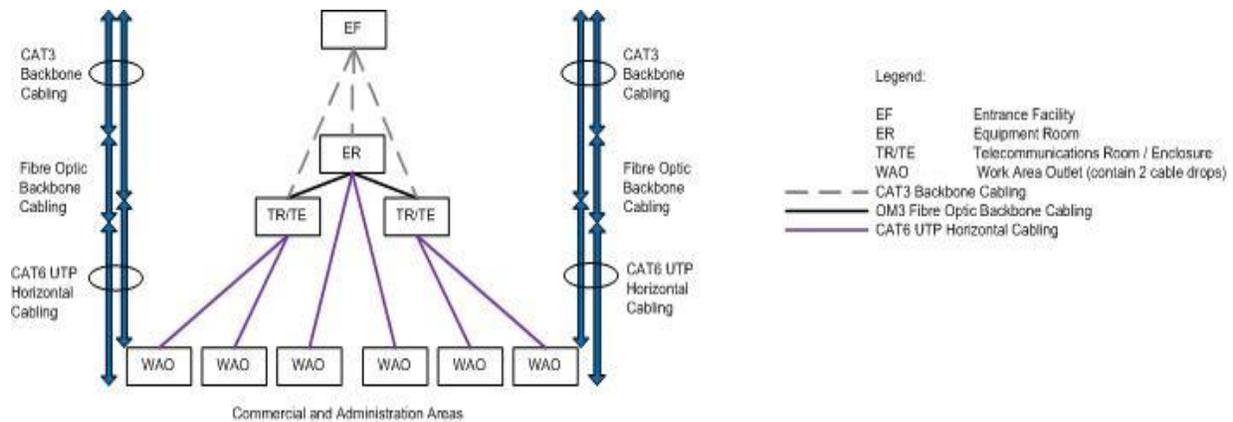


CITY OF TORONTO - STRUCTURED CABLING SYSTEM - DESIGN CONSIDERATIONS

This section highlights design considerations of particular importance to City of Toronto (CoT). It also discusses different CoT construction arrangements (new, overbuild, or basic) for a particular project.

CITY OF TORONTO - COMMERCIAL BUILDING CABLING TOPOLOGY

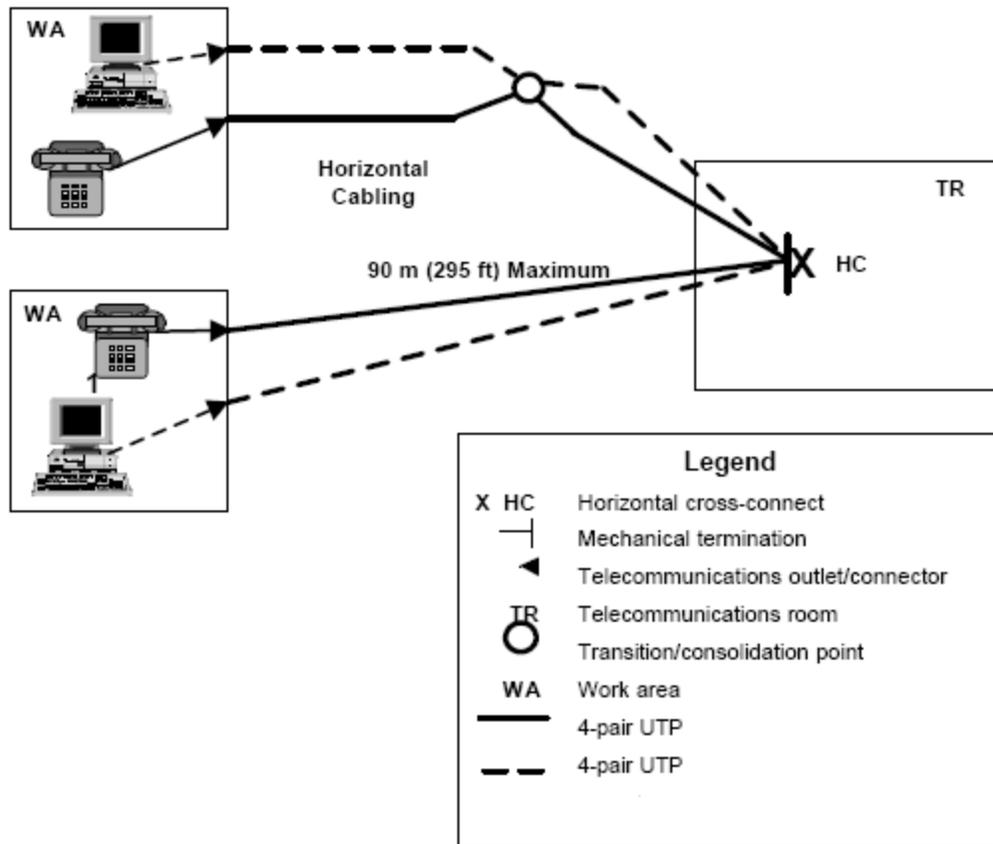
The figure below is an illustration of the City of Toronto commercial building cabling topology. Some of the cabling system such as CAT3/5e backbone, may or may not be applicable to the project.



Elements of the City of Toronto Standard Topology for Commercial Facilities

DESIGN SUMMARY

- The network shall be a distributed star topology network.
- All horizontal copper cables shall connect to the TE/TR from the WAO and fibre backbone cable shall connect to the ER (Server Room) from the TR/TE. The CAT3/5e backbone cabling from the TR/TE to the ER, may or may not be applicable to all the CoT projects.
- The specified copper network cables for all commercial buildings shall be Belden.
- The horizontal copper cable shall be U/UTP Category 6/6A and shall be in accordance to this specification.
- Length of the patch cables from WAO to the end device shall be in compliance to the Ethernet and structured cabling applicable standards.



- The backbone copper multi-pair (minimum 25 pairs) cable shall be U/UTP Category 3/5e and shall be in accordance to this specification. The multipair backbone, may or may not be applicable to all the CoT projects.
- The containment system for the voice and data network shall be as per the specified material mentioned in this document, unless specified otherwise on the design drawings/project scope. The approved conduit system is EMT type, appropriately sized as per TIA-569 standard. The cable tray shall be basket wire mesh type, corrosion resistant, standard sized as per TIA-569.
- The horizontal copper cables shall be permanently terminated at the patch panel in the Telecommunications Enclosure (TE) on one end, to a work-area outlet on the other end located on the walls of a commercial building.
- Horizontal cables in the commercial buildings shall always be collated of two (2) cables per work area outlet (WAO) located on the wall/furniture of the closed office or a cubicle.
- Office cubicles shall contain 1 WAO with 4 ports (1 Voice/VoIP, 1 Data and 2 Blank ports).

- Closed offices shall contain 1 WAO with 4 ports (1 Voice/VoIP, 1 Data and 2 Blank ports), shall be provided to every 10m² (100ft²) of office space (i.e. if the office is 10m² then it shall have 1 WAO). If the office is larger than 10m² (100ft²), then 2 WAOs shall be provided (with 2 Data and 2 Blank ports for the 2nd WAO).
- Each group of horizontal cables shall be associated with a single 4-port, work-area outlet on the wall/furniture and a 4-port, snap-in faceplate in the Telecommunication Enclosure patch panel.
- Approval for additional ports per cubicle or office must be granted by CoT IT/Network Services Technical Representative before proceeding with this work.
- Containment pathways shall be designed and sized for a minimum of four (4) horizontal cables, unless otherwise mentioned differently in the design drawings.
- The Fibre Optic Backbone is defined as the fibre optic segments radiating out from the Network Core Closet to the Telecommunications Enclosure/Room.
- The fibre allocation within the fibre optic backbone cable is as follows:
 - 12 Core fibre backbone: Multimode (OM4) and/or Singlemode (OS2)
 - City of Toronto LAN — 4 fibre strands active (2 primary, 2 redundant and 8 reserved)
 - All fibre cables shall be terminated and tested bi-directionally to the appropriate wavelengths (850/1300nm | 1310/1550nm) using calibrated certified testing equipment
- All passive network components shall be from a single manufacturer (Belden).
- The term "free-issue" refers to equipment supplied by the City. All the Network Switching and Routing Equipment will be freely issued by the City. The network equipment will be configured, tested and installed by City of Toronto IT/Network Services group.

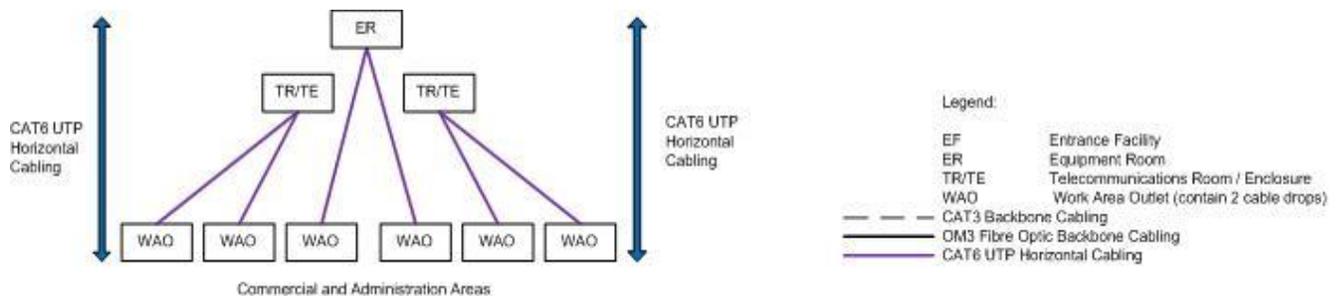
DESIGN DETAILS OF HORIZONTAL CABLING SYSTEM (CABLING SUBSYSTEM – 1)

Horizontal cabling includes installation cable, telecommunications connector/jack/module at the work area outlet (WAO), and mechanical terminations at both ends. Patch cords are required at WAO and TR/TE. Horizontal cabling length limitation requirements as specified in the ANSI/TIA-568.0-E and ANSI/TIA-568.1-E standards apply unless otherwise specified in this Standard.

TOPOLOGY

The horizontal cabling shall meet the star topology requirements of ANSI/TIA-568.0 and ANSI/TIA-568.1. Each telecommunication work area outlet (WAO)/connector/module shall be connected to the

horizontal cross-connect (HC) located at the TE/TR as shown in figure below. The horizontal installation cable shall be terminated on a jack/module (balanced twisted pair) at one or both ends.



Horizontal Cabling Topology

LENGTH

The horizontal cable length extends from the termination of the media on a patch panel at the TE/TR to the telecommunications connector/jack/module at the work area outlet (WAO). For balanced twisted-pair cabling the max permanent link length in the office/administration areas shall be 90m (295ft).

The length of the cross-connect/inter-connect jumper or patch cord at the cross-connect facility, including TE/TR, shall not exceed 5m (16ft) in the office/admin work area and 5m (16ft) in the TE/TR.

RECOGNIZED MEDIA

The recognized media, which shall be used individually or in combination, are:

- Minimum 4-pair 100 ohm balanced twisted-pair cabling, category 6 or higher
- 4-pair 100 ohm balanced twisted-pair cabling, category 6A (as per ANSI/TIA-568.2-D, preferred)

The Recognized media and associated connecting hardware, jumper, patch cord, equipment cord, and work area cord shall meet the requirements specified in this document.

CHOOSING MEDIA

Cabling specified by this Standard is applicable to different requirements within the commercial premises. Depending upon the characteristics of the individual application, choices with respect to transmission media should be made. In making this choice, factors to be considered include:

- Environmental classifications;
- Mitigation such as separation, protection or isolation;

- Cabling performance enhancements in accordance with performance test requirements;
- Applications to be supported by the cabling system;
- Equipment vendor recommendations or specifications;
- Configuration of cabling components;

The recognized cable has individual characteristics that make it suitable for a myriad of applications such as voice, data, video, automation and building controls, security, fire alarm, HVAC and audio visual (AV).

DESIGN DETAILS OF BACKBONE CABLING SYSTEM (CABLING SUBSYSTEM – 2 AND 3)

Backbone cabling is the portion of the commercial building telecommunications cabling system that provides interconnections between Entrance Facility (EF), Equipment Room/Server Room (ER) and Telecommunications Room/Enclosure (TR/TE). Primary and redundant, 12 strands in each cable shall run between the equipment room and the telecom room. Total of 2 x 12 strands shall run with diverse pathways between the equipment and telecom rooms. As such, the backbone cabling shall meet the requirements of ANSI/TIA-568.0, ANSI/TIA-568.2 and ANSI/TIA-568.3 for Cabling Subsystem 2 and Cabling Subsystem 3.

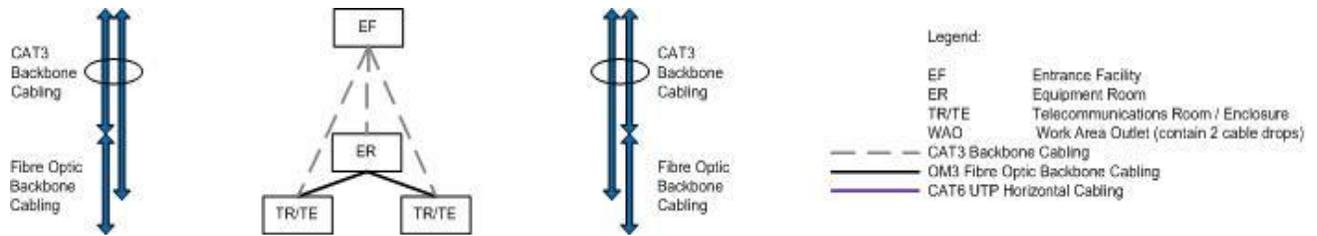
Backbone cabling consists of the multipair copper/fibre cable(s), intermediate and main cross-connect mechanical terminations and patch cords or jumpers used for backbone-to-backbone inter-connection. The cabling should be planned to accommodate future equipment needs, diverse user applications, ongoing maintenance, service changes and relocation.

TOPOLOGY

The backbone cabling shall meet the hierarchical star topology requirements of ANSI/TIA-568.0, unless otherwise specified by this Standard.

There shall be no more than two hierarchical levels of cross-connect in the backbone cabling. From the Horizontal Cross-Connect (HC) or Telecommunications Enclosure/Room (TE/TR), no more than one cross-connect shall be passed through to reach the Main Cross-Connect (MC) or Equipment Room (ER) depending on configuration. Therefore, connections between any two HCs shall pass through three or fewer cross-connect facilities.

NOTE – The topology required by this specification has been selected because of its acceptance and flexibility in meeting a variety of application requirements. The limitation to two levels of cross-connects is imposed to limit signal degradation for passive systems and to simplify moves, adds and changes. This limitation may not be suitable for facilities that have a large number of buildings or those that cover a large geographical area.



Backbone Cabling Topology

COMMERCIAL FACILITIES

The incoming fibre cable from the service provider enters the building Entrance Facility (EF) and spliced to ISP fibre at EF if the distance from the EF to the ER exceeds 15m (50ft). The ISP service provider cable runs from EF and terminates at Equipment Room (ER).

The multipair copper cable (if applicable to the project) for centrex voice runs from the ER/TR/TE to EF.

SMALL COMMERCIAL SITES

In small commercial buildings of City of Toronto, there is no ER. The TE/TR acts as an ER. The incoming fibre cable from the service providers enters the facility and spliced to ISP fibre if the distance from the facility entrance to the TE/TR exceeds 15m (50ft). The ISP service provider cable runs from entrance point and terminates at Telecom Enclosure (TE)/Telecom Room (TR)/Equipment Room (ER).

LENGTH

The backbone cable length extends from the termination of the media at the EF (Entrance Facility) to an IC (Equipment Room) or HC (Telecommunications Enclosure/Room). To minimize cabling distances, it is often advantageous to locate the EF near the center of the premises. Cabling installations may be divided into areas, which can be supported by backbone cabling within the scope of this Standard.

Cabling length is dependent upon the application and upon the specific media chosen (see ANSI/TIA-568.0 and the specific application standard). The backbone length includes the backbone cable, patch cords and cross-connect/inter-connect jumpers.

The length of the cross-connect/interconnect jumpers and patch cords in the EF or IC should not exceed 20m (66ft). The length of the cord used to connect telecommunications equipment directly to the EF or IC should not exceed 30m (98ft). For backbone link length less than 150m (492ft), OM4 multimode fibreoptics cable shall be used. More than 150m (492ft), OS2 singlemode fibreoptics cable shall be used.

BACKBONE RECOGNIZED MEDIA

Recognized cables with associated connecting hardware, jumpers, patch cords, and equipment cords shall meet the requirements specified in this document. The recognized media of backbone shall be:

- For Data, the fibre allocation within the fibre optic backbone cable is as follows:
 - 12 Core fibre backbone: Multimode (OM4) and/or Singlemode (OS2) as per backbone cable link length requirements mentioned above
- For Centrex Voice:
 - CAT3/5e multipair U/UTP cabling (if applicable), 25 pair (or higher pair count)

CHOOSING MEDIA

Backbone cabling specified by this Standard is applicable to a wide range of different user requirements. Depending upon the characteristics of the individual application, choices with respect to transmission media have to be made. In making this choice, factors to be considered include:

- Link length [$\leq 150\text{m}$ (492ft) is OM4 multimode, $> 150\text{m}$ (492ft) is OS2 singlemode]
- Useful life of backbone cabling
- Site size, user population and environmental conditions

Each recognized cable has individual characteristics that make it useful in a variety of situations. A single cable type may not satisfy all user requirements. It is then necessary to use more than one media in the backbone cabling. In those instances, the different media shall support the same facility architecture.

CABLING DIRECTLY BETWEEN TELECOMMUNICATIONS ROOMS / TELECOMMUNICATIONS ENCLOSURES

Cabling directly between HCs (Telecommunication Enclosures/Rooms) is not permitted. All backbone cabling must follow the star topology specified in ANSI/TIA-568.0 by connecting back to the IC (Equipment Room/Server Room).

DESIGN CONSIDERATIONS FOR SPACES, ENCLOSURES AND ROOMS

SPACES

- Spaces in commercial premises shall meet the requirements of ANSI/TIA-569-E.
- Spaces shall comply with local codes and regulations.

- Spaces should be designed to be compatible with the worst-case environment to which they will be exposed (see ANSI/TIA-568.0 and TIA/TSB-185 for information on environmental classifications).
- Temperature and humidity shall meet the requirements for Class 4 as per ANSI/TIA-569-E, unless stated otherwise.
- Perform additions and modifications to the existing Local Area Network as shown on the Contract Drawings.

DESIGN GUIDE OF EQUIPMENT ROOM / NETWORK / SERVER ROOM (ER)

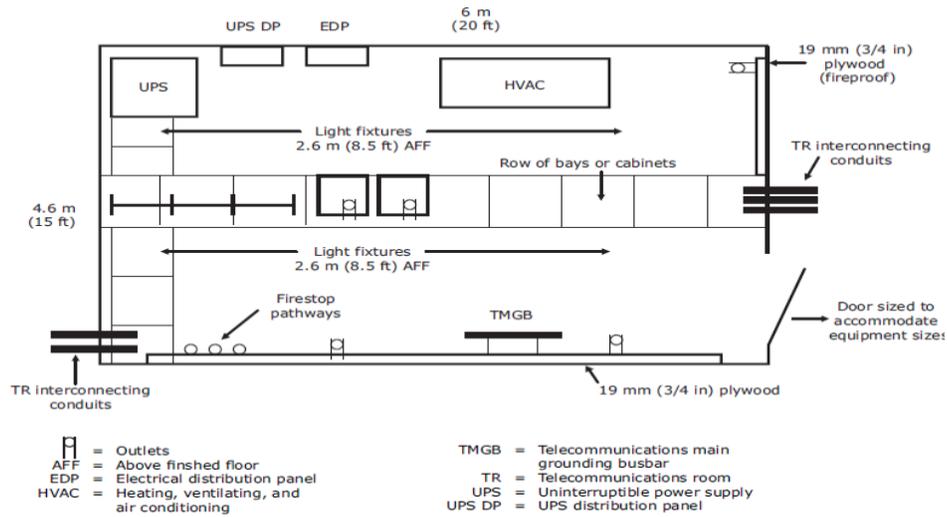
- If designing ER, consult this standard as a reference guide for Equipment Room (ER). Follow architectural/engineering drawings and project specifications as a design guide.
- The ER shall be strategically located to minimize the size and length of the backbone, especially in multiple-backbone situations.
- The ER shall accommodate the delivery of large equipment.
- The doors and hallways shall be sized appropriately for the movement of large equipment.
- Elevator or hoist and loading docks shall be available for large equipment movement.
- The weight capacity of the floors must be rated for large equipment.
- Any potential difficulties in scheduling and use of access routes and facilities for moving large equipment during installation and future changes shall be considered.
- Present and future needs shall be considered in properly locating and designing the ER.
- The ER telecommunications infrastructure shall be sized as required and capable of supporting a broad range of telecommunications applications required by the building or campus.
- Infrastructure shall be present for a large volume of cable between main distribution equipment and server racks.
- The ER telecommunications infrastructure shall be capable of supporting existing telecommunications equipment and/or cabling.
- The length of electrical power feeds from the electrical service entrance to the ER shall be minimized to aid in an optimal bonding and grounding arrangement.
- Access Card Reader should be added to access ER. Refer to CoT CORP SEC Standard for ACR/Sys.

- The distance (no closer than 3m [10ft]) to potential EMI and RFI sources shall be considered. These include transformers, motors, generators, radio transmitters, induction heating devices, photocopier, arc welding equipment, etc.
- The ER shall not be located in any place that may be subject to:
 - Water infiltration
 - Steam infiltration
 - Humidity from nearby water or steam
 - Heat (e.g. direct sunlight)
 - Corrosive atmospheric or adverse environmental conditions
 - Locations below water level unless infiltration preventive measures are employed.
- The ER shall not be located in any space in or adjacent to:
 - Mechanical rooms
 - Washrooms
 - Custodial closets
 - Storage rooms
 - Loading docks
 - Any area that contains sources of excessive EMI, hydraulic equipment, heavy vibration, steam pipes, plumbing, and cleanouts
- The ER must provide space for all planned equipment and access to all equipment for maintenance, administration and growth.
- The ER must meet the space requirements specified by equipment providers. Space and layout requirements for different telecommunications applications (e.g. voice, data) must be taken into account.
- For voice and data, provide 0.07m² (0.75ft²) of ER space for every 10m² (100ft²) of usable work area space.
- The minimum ER size shall be based on the known number of work areas as shown on the table below and not on usable floor area:

Equipment outlets served	Minimum floor space m ² (ft ²)	Typical dimensions m (ft)
Up to 100	9 (100)	3 X 3 (10 X 10)
101 to 200	13.5 (150)	3 X 4.5 (10 X 15)
201 to 800	36 (400)	6 X 6 (20 X 20)
801 to 1600	72 (800)	6 X 12 (20 X 40)
1601 to 2400	108 (1200)	9 X 12 (30 X 40)

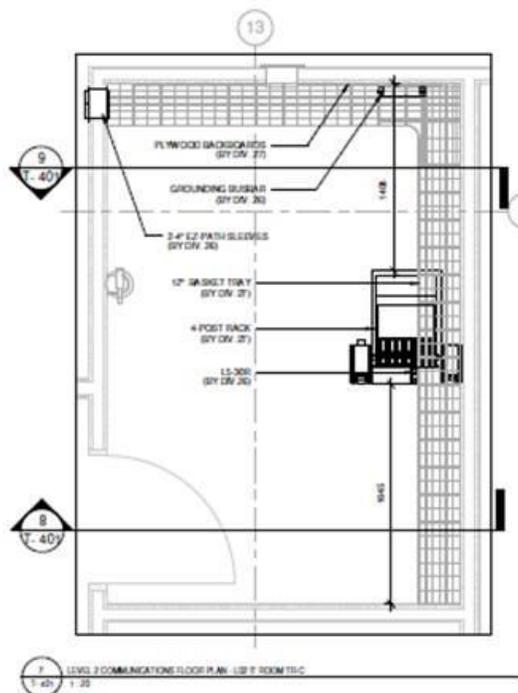
- The guidelines for other support equipment, such as power distribution, conditioner systems, and UPS up to 100kVA shall be permitted in the ER. UPS larger than 100kVA should be located in a separate room.
- The ER layout and floor plan shall comply with TIA-568, TIA-569 and BICSI TDMM latest edition.
- A minimum ER space of 3m (10ft) by 4.5m (15ft) shall be allocated.
- The ER shall include adequate space to support equipment changes with minimal disruption. Sizing shall include projected future as well as present requirements.
- Equipment not related to the support of the ER (e.g. piping, ductwork, pneumatic tubing, etc.) shall not be installed within, pass through, or enter the ER.

Typical equipment room layout



- The ER shall include space for environmental control equipment, power distribution/conditioners, and uninterruptible power supply (UPS) systems that may be installed.
- The ER shall be designed and comply with the City of Toronto (CoT) Security requirements.

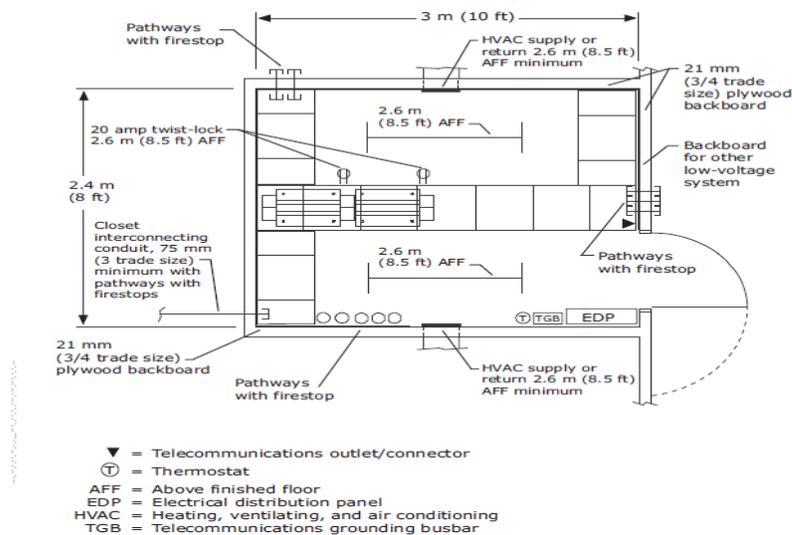
- The ER shall include barriers to protect sensitive network equipment from dust including door seals and air filtration.
- The ER shall include equipment and systems (grounding straps) to protect sensitive network equipment from static electricity.
- The ER shall be designed to comply with local zoning requirements for earthquakes and other natural disasters.
- The ER shall be designed to comply with NFPA-75 and include a pre-action fire protection system and hand-held fire extinguishers.
- The ER shall be designed for flood prevention and include a minimum of one floor drain for every 100m² (1075.84ft²).
- The ER shall attenuate ambient room noise to acceptable Acoustic Noise level limits in accordance with applicable standards.
- There shall be no attachment of pull boxes or any type of panel/enclosure onto the surface of the Telecom Enclosure/Cabinet/Rack. It is strictly prohibited and shall not be allowed in any circumstances to have a box or enclosure attached/fixed on the surface of a Telecom Enclosure/Cabinet/Rack.

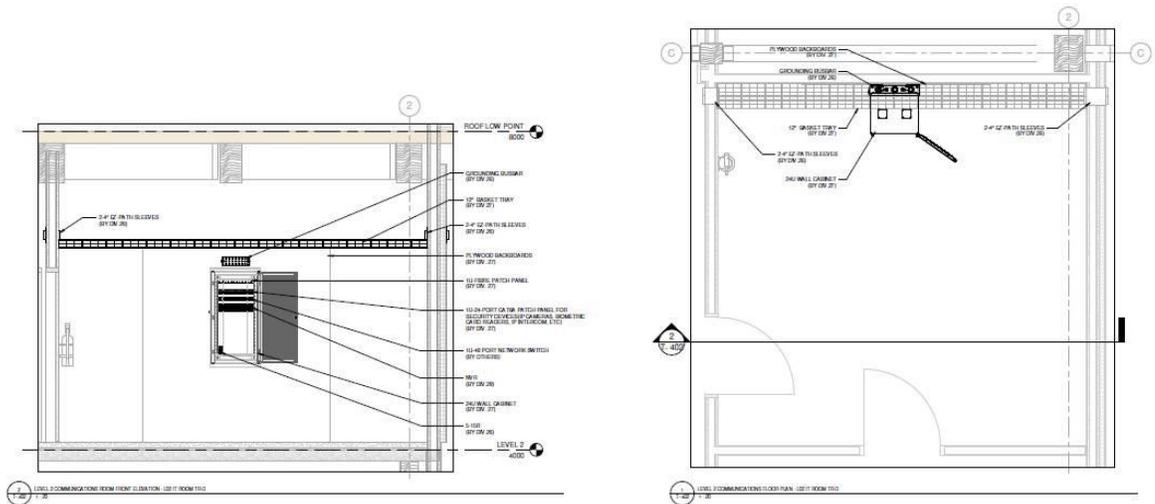


DESIGN GUIDE OF TELECOMMUNICATIONS ROOM (TR)

- If designing TR, consult this standard as a reference guide for Telecommunications Room (TR). Follow architectural/engineering drawings and project specifications as a design guide.
- A properly designed TR includes an HC (FD) that provides a floor-serving distribution facility for horizontal cabling. This cross-connect is capable of providing horizontal cabling connections to floor-serving telecommunications equipment and backbone cables from other TRs|TEs|ERs|EFs.
- Access Card Reader should be added to access ER. Refer to CoT CORP SEC Standard for ACR/Sys.
- The TR should be provisioned to house telecommunications equipment. In some cases, it may be necessary to combine the building and floor-serving functions of the ER and TR in one room. Instances where the two may be combined include smaller buildings (i.e., less than 500 m² [5400 ft²]) and those with limited space for distribution facilities.
- There must be at least one TR per floor. Multiple rooms are required if the cable length between the HC (FD) and the telecommunications outlet location, including slack, exceeds 90m (295ft) or if the usable floor space to be served exceeds 929m² (10,000ft²). For TRs that serve areas with an office density of less than one work area per 9.3m² (100ft²) of usable floor space, a TR may serve larger areas, provided the horizontal cable length requirements are met.
- Figure below shows a typical layout of a full-size TR, suitable for a maximum of 480, 4 twisted-pair cable terminations. The drawing illustrates architectural, mechanical, electrical, and telecommunications requirements on a single plan view perspective for purposes of showing coordination issues. Actual design documents will typically separate requirements by discipline.

Typical telecommunications room layout

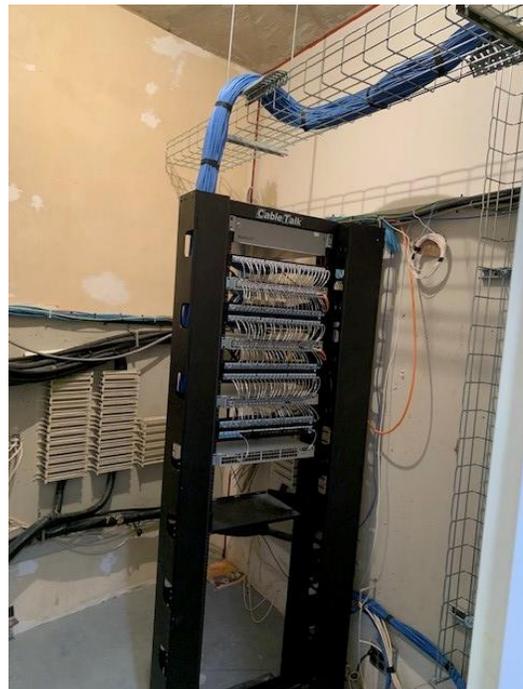
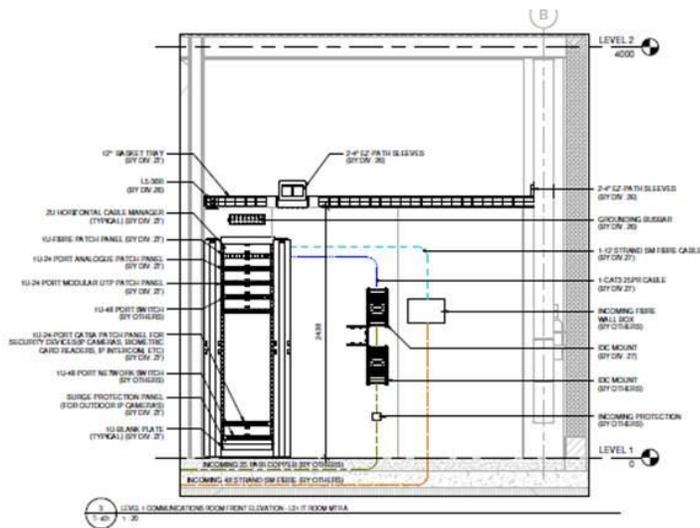




ENTRANCE FACILITY REQUIREMENTS (EF) | SHARED LAN/NETWORK ROOMS

- If designing EF, follow architectural/engineering drawings and project specifications as a design guide.
- Where functions of an entrance facility (EF) are combined with functions of the ER in the same space, the ER may house equipment dedicated to the Access Provider (AP). Requirements specified by the AP must be considered.

- As per ANSI/TIA-569-E, in shared LAN/Network Rooms between CoT-IT and other Agency/Third Party, individual spaces should be segregated by means of partitions using full size lockable cabinets or collocate cabinets. In extreme conditions, partitions may be comprised of cages, architectural assemblies or wire mesh walls.
- Where access providers and service providers share space (shared LAN/Network Rooms), individual spaces should be segregated by means of partitions. Partitions may be comprised of wire mesh walls or architectural assemblies.
- If separate AP space is required, it shall be adjacent to the EF. The design may require a mesh partition or locked cabinet. Space size at least 1.2m x 1.83m (4ft x 6ft) should be allocated for each AP.

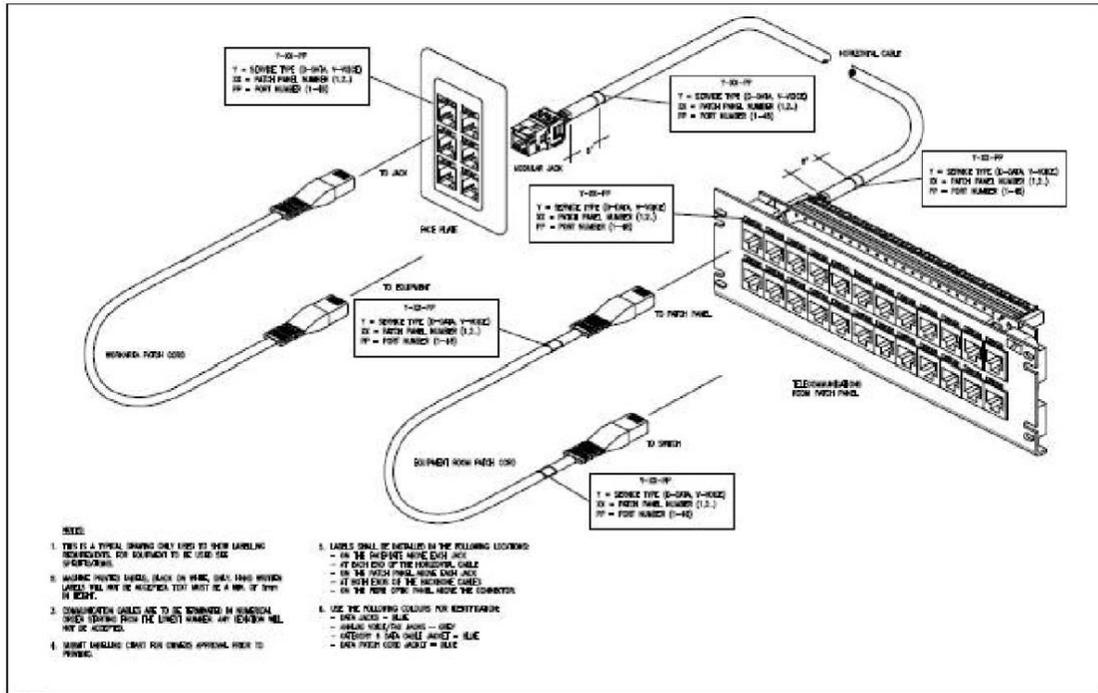


WORK AREA OUTLET (WAO)

- The work area outlet (WAO) components extend from the telecommunications outlet/connector end of the horizontal cabling system to the work area equipment. The telecommunications outlet/connector shall meet the requirements of this Standard. To simplify relocations, consider a single style of outlet/connector for all work area outlets of the same media type.

WORK AREA OUTLET (WAO) FOR OFFICE AREAS

- Provide one 4-ports, single-gang, work area outlet in each work area for termination of the horizontal CAT6/6A cables. Faceplate or decora module frame shall be from Belden.
- One 4-port, work-area outlet shall be associated with as many ports necessary (in groups of 2 or 4) on the snap-in faceplate installed in the patch panel of the Telecommunication Enclosure.
- In the majority of cases the 4-port, work-area outlet shall be installed within the cubical partitions. In some situations, the work-area outlet shall be installed directly on the wall in office areas.
- All UTP connectors in the office area shall be unshielded modular jacks and wired for a T586A wire-map.



U/UTP PATCH CORD FOR WAO IN OFFICE AREAS

- Patch cords used in the WAO shall meet the requirements of ANSI/TIA-568.2. WAO cabling may vary in form depending on the application. When application-specific adaptations are needed at the WAO, it shall be external to the telecommunications outlet/connector.
- Supply two (2) 5-metres or less, CAT6/6A U/UTP patch cords for each work area outlet.
- The contractor is responsible for certifying that the supplied patch cords shall meet or exceed the requirements for U/UTP patch cords as described in the ANSI/TIA-568.0 standard.

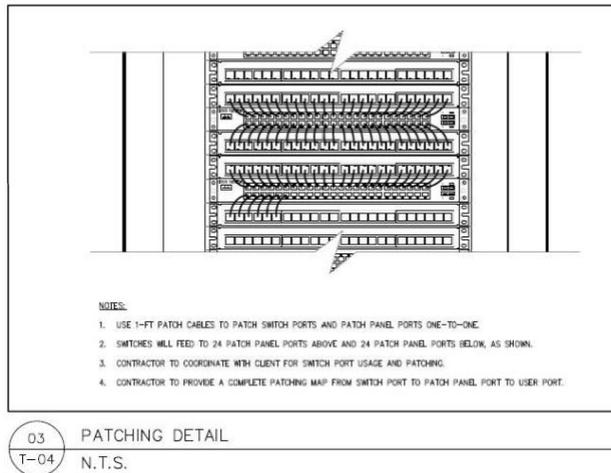
WORK AREA OUTLET (WAO) FOR WIRELESS ACCESS POINT (WAP)

- Provide one (1) 4-port, single-gang, work-area outlet, connectors and accessories for termination of the horizontal UTP cables (2 for each WAP) dedicated for Wireless Access Point (WAP). Where ever, it is possible to connect to the closest TR, additional and separate WAO may not be required.
- CAT6/6A modular jacks shall populate two (2) modules/jacks in a 4-port WAO for each WAP.
- Each 4-port, work-area cable outlet shall be associated with a 4-port, snap-in faceplate installed in the Telecommunication Enclosure patch panel.

- WAP Heatmaps are required for accurate location of WAOs. Sample heatmaps are in Appx-C.

UTP PATCH CORD FOR TE/TR/ER

- Supply minimum of 0.5 metre (2ft) CAT6/6A U/UTP patch cord for each data/VoIP drop (jack/module) to patch at TE/TR/ER.



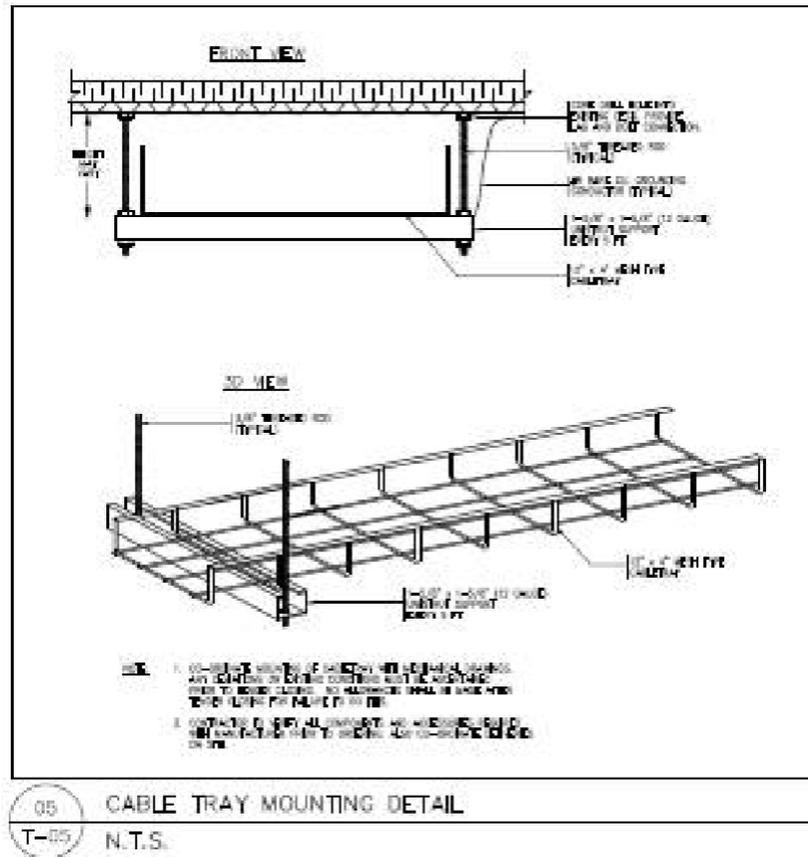
DESIGN CONSIDERATION OF PATHWAYS AND CONTAINMENT SYSTEM

- Pathways in commercial premises shall meet the requirements of latest ANSI/TIA-569 standard.
- Pathways should be designed to be compatible with the worst-case environment to which they will be exposed (see ANSI/TIA-568.0 for information on environmental classifications).
- Pathways in commercial premises shall comply with local codes and regulations.

DESIGN GUIDE OF CABLE TRAY SYSTEM

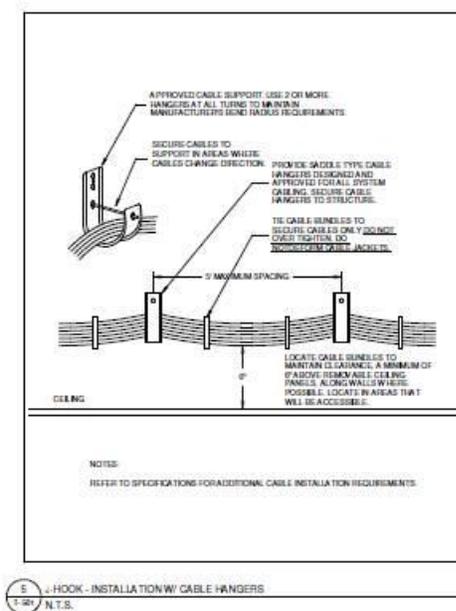
- All cable trays shall be either a ventilated trough, wire-mesh or ladder-rack type, pre-fabricated structure 300mm (12 inches) in width or greater.
- Ventilating trays shall be equipped with two side rails with a maximum height of 150mm (6 inches) and consisting of a light, rugged and tubular steel or aluminum construction.
- Should aluminum trays be specified (CoT approval is mandatory), the engineer is to ensure that, during the grounding or bonding aspects of the installation, the contractor uses tin plated or zinc coated ground connectors.

- Install the ventilated cable tray in the horizontal cable distribution system such as hallways and under floor.
- A cable ladder rack system is to be installed within the Equipment/Server Room (ER) and Telecom Rooms (TR). Refer to the project specifications/drawings or reference in this document for the type of ladder rack to be used in the horizontal cable distribution system and within the applicable ER/TR's. Spine type and improperly centre hung cable trays will not be accepted.
- All metal cable trays shall be bonded together to the TMGB/PBB or a TGB/SBB.
- All metal cable trays shall be coated to prevent rust or galvanic action.
- Accessories and fittings such as elbows and reducers shall be manufactured by the cable tray manufacturer.
- Install cable trays at least 300mm (12in) away from fluorescent luminaries and cross power cables at right angles.
- The minimum clearances for cable trays shall be in accordance with Canadian Electrical Code C22.1-09.
- Allow 300mm (12in) vertical clearance excluding the depth of cable trays, between cable trays installed in tiers.
- 300mm (12in) vertical clearance from the top of cable trays to all ceilings, heating ducts and heating equipment.
- 600mm (24in) horizontal clearance on one side of cable tray mounted adjacent to one another or to walls or other obstructions.
- All cable trays/ladders shall be labeled at regular intervals. The distance separating labels shall not exceed 15 metres (50ft).
- The design fill ratio of a cable tray is 25% to a maximum fill ratio of 50% as per ANSI/TIA-569 standard.



DESIGN GUIDE OF CONDUIT SYSTEM

- All telecommunications cables shall be installed in home run EMT conduits originating from the outlet to the cable tray system, Telecommunications Enclosure, or Telecommunications Room. The use of J-hooks, brackets and other attachments are not preferred but acceptable. Only Velcro ties are allowed. Plastic cable ties are not allowed in any condition.



- The inside radius of a bend in a conduit shall be not less than six times the internal diameter when the conduit is less than 50mm (2in) in diameter and ten times the internal diameter when conduit is 50mm (2in) in diameter or larger.
- All zone conduits shall be identified and labeled at both ends and at regular intervals not to exceed 10 metres (32.8ft). Tags shall identify start and finish of conduit runs. Pull boxes shall be labeled on the exposed exterior.
- All conduits shall originate and be physically connected to the telecom backboards in the Equipment Room, Telecommunications Room, cable tray and pull box.
- All metallic parts of the cable distribution supporting system shall be bonded together mechanically inclusive of all transition points (i.e. cable tray and distribution conduit not mechanically connected) using a 6 AWG green jacketed stranded copper ground wire. The metallic components of the cable distribution system shall be bonded together at the ER and TRs and then bonded to their respective telecom ground busbars.
- All fittings, connectors and couplings shall be of the same material as the conduit used on site.
- All conduits/sleeves that enter the ER or any TR shall be fitted with an approved ground bushing with ground lug and bonded together mechanically (one continuous piece preferred). This shall be connected to the approved building ground by means of a No. 6 AWG to the grounding busbar.

- Cable fill capacities of conduit shall not be greater than 40%.
- All conduits entering or existing through the ceiling or walls of the ER or TR shall protrude into the room 25-50mm (1-2in).
- Riser sleeves in the Equipment Room/Server Room and Telecommunication Rooms shall protrude through the floor 50-75mm (2-3in) above finished floor (AFF).
- All conduit runs shall follow building grid lines and shall be concealed where possible.
- All conduits shall be EMT, reamed and bushed at both ends and bonded to the distribution system unless installed in areas deemed chemically hazardous in which cases PVC coated or Aluminum conduit shall be used. Approval from the City of Toronto is required in such instances.
- All conduit runs shall be a maximum of 30 meters (100ft) in length with a maximum of two 90 degree bends between pull points, unless otherwise specified.
- Conduits ending in the vicinity of a cable tray shall be terminated at a height of no less than 100mm (4in) and no more than 150mm (6in) from the top of the cable tray. Conduit runs shall not be punched through the side of the tray. Conduit ends shall be bonded to the cable tray.
- The use of LB, LL, LR, C and T type fittings are not permitted. Only LBs designed and manufactured for communications systems are allowed where applicable.
- Conduit fittings shall not be used in place of pull boxes or bends.

DESIGN GUIDE OF PULL BOX

- A pull box shall be placed in conduit runs where the sum of the bends exceeds 180 degrees, where the overall length of the conduit run is more than 30m (100ft), or if there is a reverse bend in the run.
- Pull boxes shall be constructed and sized in accordance with Canadian Electrical Code, TIA and BICSI standards of code gauge steel and shall have a rust resistant finish.
- In all instances pull boxes shall be placed in straight sections of conduit run and shall not be used in lieu of a bend. Corresponding ends of the conduit are to be aligned with each other. Conduit fittings shall not be used in place of pull boxes or bends.
- Conduit must enter the outlet boxes from the top or bottom.
- Pull boxes shall be installed at a reasonable height, in an exposed location and such that access for installation of cables is not prohibited. Pull boxes shall not be placed in a fixed false ceiling

space, unless immediately above a suitably marked and hinged access panel. Provide indicator decals on ceiling T-bar rail or ceiling tiles showing location of pull box or splice box.

- All conduits shall be installed in accordance with Canadian Electrical Code, Part 1 Section 12, applicable building codes and ANSI/TIA 569.
- The minimum size (inside diameter) for conduit running between the Equipment Room or a Telecommunications Room and the Telecommunications outlet at an outlet location is 25mm (1in).
- The maximum horizontal cable run distance shall not exceed 90 metres (295ft).
- The cable length from the mechanical termination in the TR and ER to the telecommunications outlet, where the horizontal distance exceeds 90m (295') provided additional rooms as required.
- Future requirements for additional cables to each outlet shall be considered.
- A pull cord shall be installed in all conduits.
- The telecommunications outlet conduit system shall be labeled green.
- Place pull boxes in readily accessible locations only.
- The use of LB, LL, LR, C and T type fittings are not permitted. Only LBs designed and manufactured for communications systems are allowed where applicable.
- There shall be no attachment of pull boxes or any type of panel/enclosure onto the surface of the Telecom Enclosure/Cabinet/Rack. It is strictly prohibited and shall not be allowed in any circumstances to have a box or enclosure attached/fixed on the surface of a Telecom Enclosure/Cabinet/Rack.

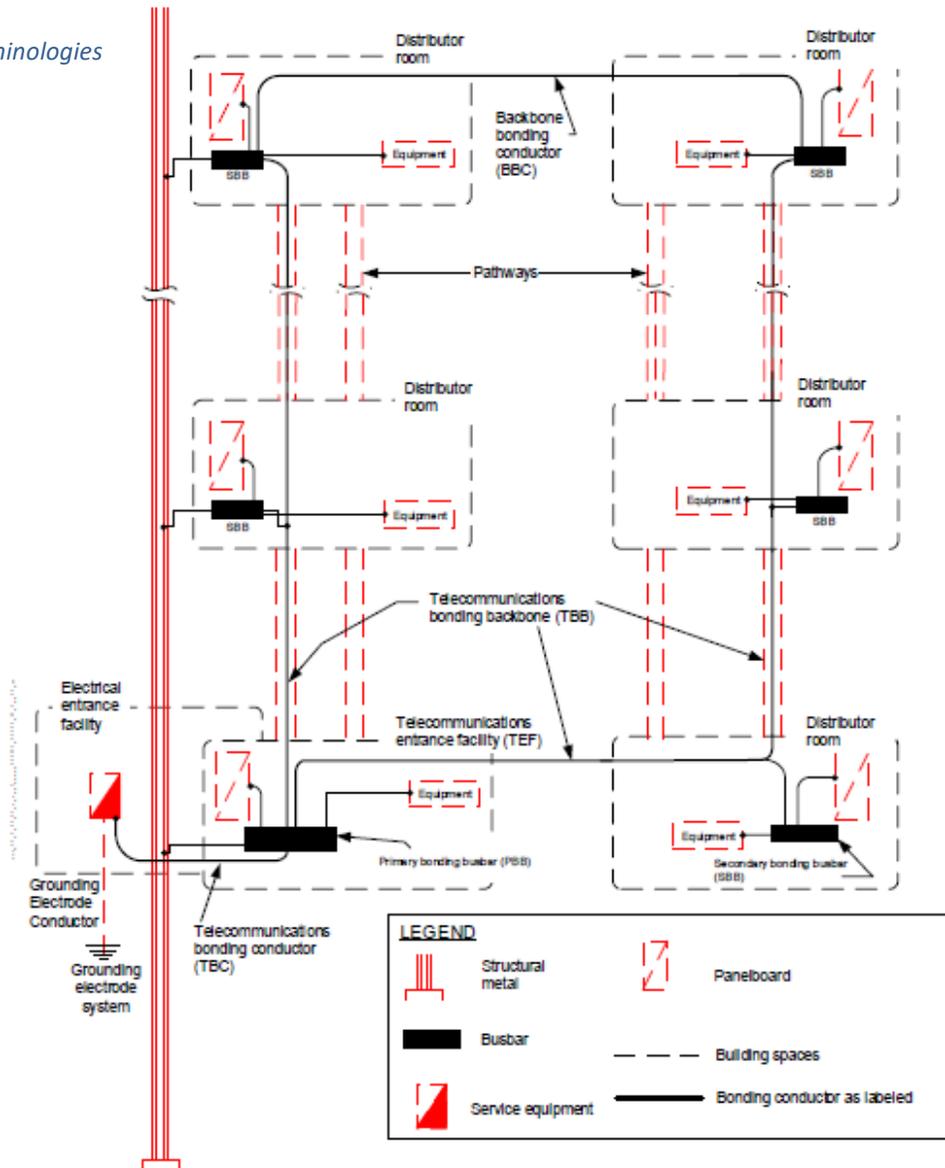
DESIGN GUIDE OF TELECOMMUNICATIONS BONDING AND GROUNDING SYSTEM

In general, a telecommunications grounding system contains the following components:

- Primary Bonding Busbar (PBB) or Telecommunications Main Grounding Busbar (TMGB)
- Telecommunications Bonding Backbone (TBB)
- Secondary Bonding Busbar (SBB) or Telecommunications Grounding Busbar (TGB)
- Telecommunications Bonding Conductor (TBC)

- The Telecommunications Bonding Backbone (TBB) consists of green jacketed stranded copper conductors and insulated copper busbars. The system extends from the Building Grounding Electrode Conductor through the ER to the TR’s, within the building. The construction of the TBB is a requirement of the latest version of the ANSI/TIA-607. This standard shall be used in the design, installation, management and administration of the TBB systems in CoT facilities.

TIA--607-Terminologies



- All metallic parts shall be bonded together mechanically and attached to the approved building ground in accordance with applicable CEC, TIA and CSA standards. In all cases, the CEC shall be met or exceeded.

- Bonding conductors shall be continuous and routed in the shortest possible straight-line path. Any bends placed in the conductor shall be sweeping bends.
- Aluminium wires, clamps or terminal connectors are not acceptable for grounding and bonding.
- The following general requirements shall apply when constructing the TBB system:
 - An insulated pre-drilled, electro tin plated copper busbar, minimum dimensions of 6mm thick x 100mm wide and variable in length, shall be installed on the wall of the ER/EF adjacent to the cable entrance conduits, 150mm from the corner of the ER/EF and 150mm AFF. This busbar is known as the Primary Bonding Busbar (PBB) or Telecommunications Main Grounding Busbar (TMGB) and shall be insulated from its support by a minimum of 50mm.
 - An insulated pre-drilled, electro tin plated copper busbar, minimum dimensions of 6mm thick x 50mm wide and variable in length shall be installed on the wall of each TR (formally known as a Telecom Closet - TC), adjacent to the cable entrance sleeves, 150mm from the corner of the TR and 300mm AFF. These busbars are known as the Secondary Bonding Busbar (SBB) or Telecommunications Grounding Busbars (TGBs) and shall be insulated from its support by a minimum of 50mm.
 - A green jacketed stranded copper ground wire sized to maintain a voltage drop of less than 40 Volts under maximum short time rating. This wire shall be sized no smaller than No. 6 AWG nor larger than a 3/0 and shall be installed from the service equipment ground (main building ground) to the PBB/TMGB in the ER/EF. This ground wire is known as the Telecommunications Bonding Conductor (TBC). The Telecommunications Bonding Conductor (TBC) may be secured to the surface of the building if not subject to physical and mechanical damage, or installed in non-ferrous conduit. If ferrous conduit, such as EMT is used, the conductors shall be bonded to each end of the conduit with a conductor minimum sized as a No. 6 AWG green jacketed stranded copper ground wire.
 - The TBC shall be connected to the Primary Bonding Busbar (PBB)/Telecommunications Main Grounding Busbar (TMGB). The connection to the PBB/TMGB shall be done using a 2-hole electro tin plated compression lug. All joints to the TBC shall be done using irreversible compression-type connectors, exothermic welding, or equivalent.
 - The Telecommunications Bonding Conductor (TBC) shall be connected to the service equipment ground (main building ground) by qualified personnel and in accordance with the CEC and ANSI/TIA-607.
 - A green jacketed stranded copper ground wire sized the same as the Bonding Conductor for Telecommunications, shall be installed from the farthest TR, through each TR to the

Bonding Conductor for Telecommunications located in the ER/EF. This ground wire is known as the Telecommunications Bonding Backbone (TBB). The TBB may be fastened to the underside of open cable tray or installed in non-ferrous conduit. If ferrous conduit, such as EMT is used, the conductors shall be bonded to each end of the conduit with a conductor sized as a No. 6 AWG minimum.

- The TBB in each TR shall be connected to the SBB/TGB. All joints to the grounding wires shall be done using irreversible compression-type connectors, exothermic welding, or equivalent. The connection to the SBB/TGB shall be done using 2-hole compression connectors.
 - The PBB/TMGB in the ER/EF and the SBB/TGB in the TR/TE(s) shall be bonded to the closest electrical panel using a No. 6 AWG green jacketed stranded copper ground wire.
 - The metallic components of the horizontal distribution supporting infrastructure (conduits, cable trays and ducts) shall be bonded to the to the telecommunications busbars of the ER/EF or TR/TE in which they originate using a No. 6 AWG green jacketed stranded copper ground wire.
- A No. 6 AWG green-jacketed stranded copper ground wire shall be installed from each telecommunications busbar to the metal frame (structural steel) of buildings that are effectively grounded and whose structural steel is accessible.

SEPARATIONS FROM EMI

- Copper cables shall not be installed at a distance less than 300mm from lighting ballasts, less than 1 meter from electric motors or at a separation distance from source of 480V or less.
- Where electric power cable is not installed in EMT conduit, telecommunications cable shall not be run in parallel with it for more than 10 meters if the separation is less than 300mm.
- Electrical protection must be provided for copper cables entering the building. Protection shall be in accordance with the Canadian Electrical Code CSA C22.1-2006 and BICSI practices.

DESIGN GUIDE OF TAGGING CONVENTION (IDENTIFICATION AND LABELING)

- The requirements of this section shall take precedence over other sections.
- The labeling of the City of Toronto network components, structured cabling and cable routing/containment shall comply with the ANSI/TIA-606 standard

- The codification of network components, cables and cable routing shall follow the identification standards detailed in this standard.
- For example:
 - Building Location: YDE – 30 Dee Ave
 - Floor and Room Location: ER – Equipment Room / Server Room / Main Communications Room
 - TRA – Telecom Room - A
 - TRB – Telecom Room – B
 - EF - Entrance Facility
 - Service Provider / Network Cabinet Label in ER: COT-IT-YDE-0100
Network Closet
 - Network Cabinet Label in ER: COT-IT-YDE-0200
Network Closet
 - Server Cabinet Label in ER: COT-IT-YDE-0300
Server Closet
 - Patch Panel:
 - A – Data Patch Panel A (A,B,C, etc ...)
 - FP01 – Fibre Optic Patch Panel
 - TP01 – Telephone/Voice Patch Panel
 - Patch Panel Port: 01 – Patch Panel Port (01, 02, 03, ..., 24)
 - Work Area Number: 125 – Work Area number associated in the admin/office areas of the facility
 - Work Area Outlet:
 - WA01 – Work area outlet (01, 02, 03, etc...)
 - 1 – Port number (1, 2, 3, 4)

EQUIPMENT / NETWORK / SERVER ROOM CABINETS IDENTIFICATION AND LABELING

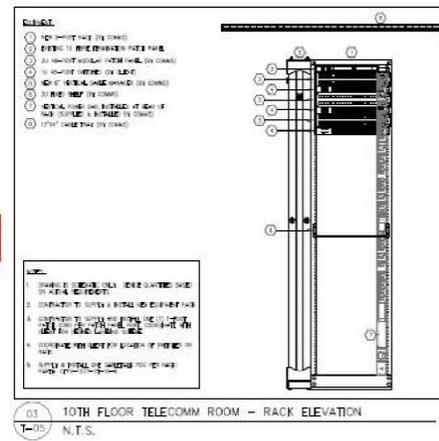
- Equipment Room/Server Room network enclosure contains active network components, including: Network Core Closet, Server Closet and Telecommunications Enclosure.
- All Network Closets/Cabinets related to the Equipment Room (ER) shall be tagged as follows.

- COT-IT-XYZ-XX00, where:
 - XYZ = Site three-character code name
 - XX00 = First two numbers (XX) identify the closet
- For all closets/enclosures/cabinets in the Equipment Room, the last two numbers are always zero (00).
- For Closets/Cabinets in the Equipment Room, they are numbered from (0100) to (1000).
- Network Core Closet and Server Closet nameplate shall conform as follows:
 - Provide nameplate for each enclosure on the bottom-center of the door, front and back.
 - Use engraved gravoply laminate nameplates using black letters on a white background.
 - The laminate nameplates shall have a dimension of 210mm W x 50mm H.
 - Minimum character height shall be 12mm. Character lettering shall be centered on each line.
 - Mount nameplates with two stainless steel machine screws.
 - Include device identification (tag) number as well as a descriptive name.
 - For example: the tag name: COT-IT-XYZ-0100 followed by the description: Sample nameplate diagram is as below:



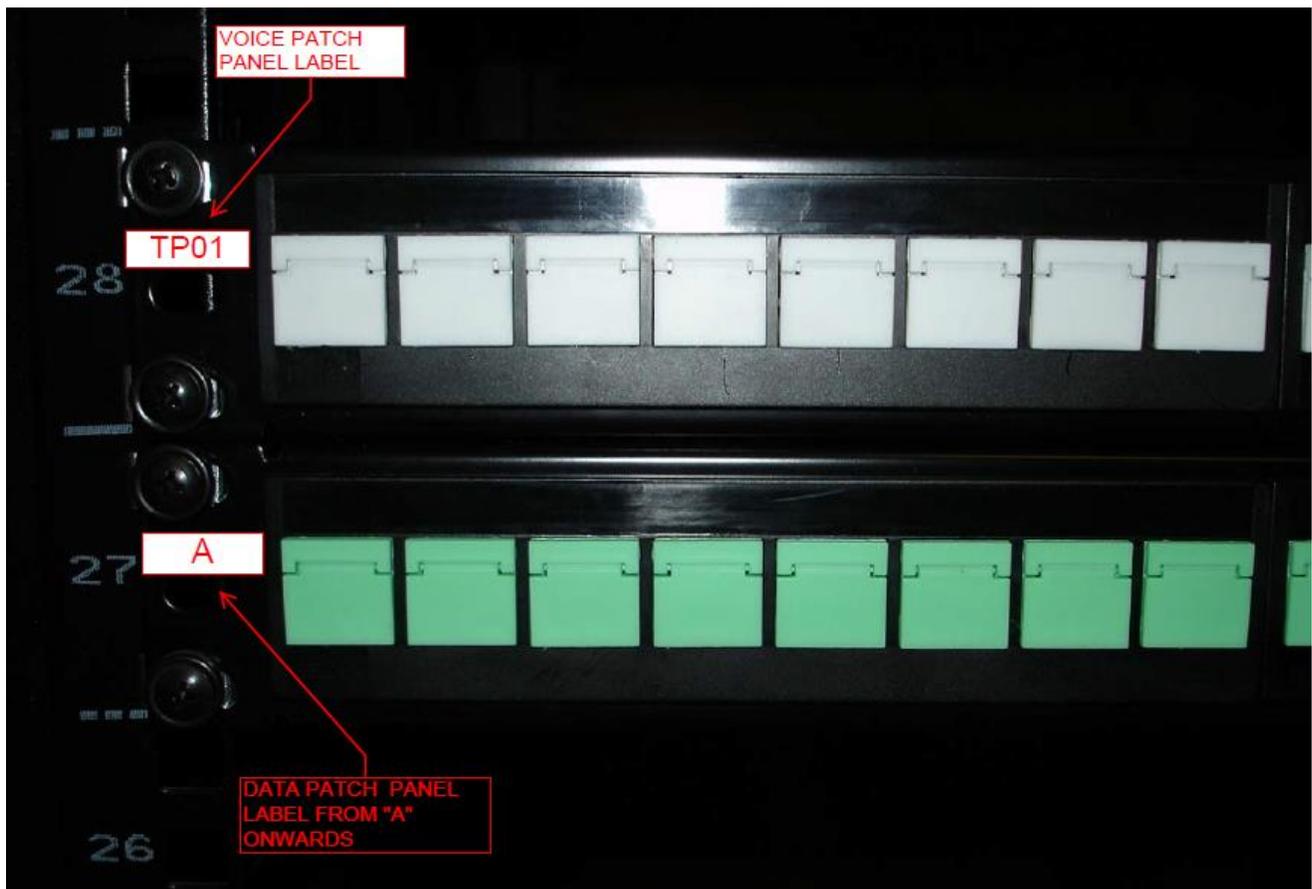
COT-IT-YDE-0100
NETWORK CLOSET

(Lamacoid label on the cabinet shall be at the bottom. IT will provide lamacoid spec standard)

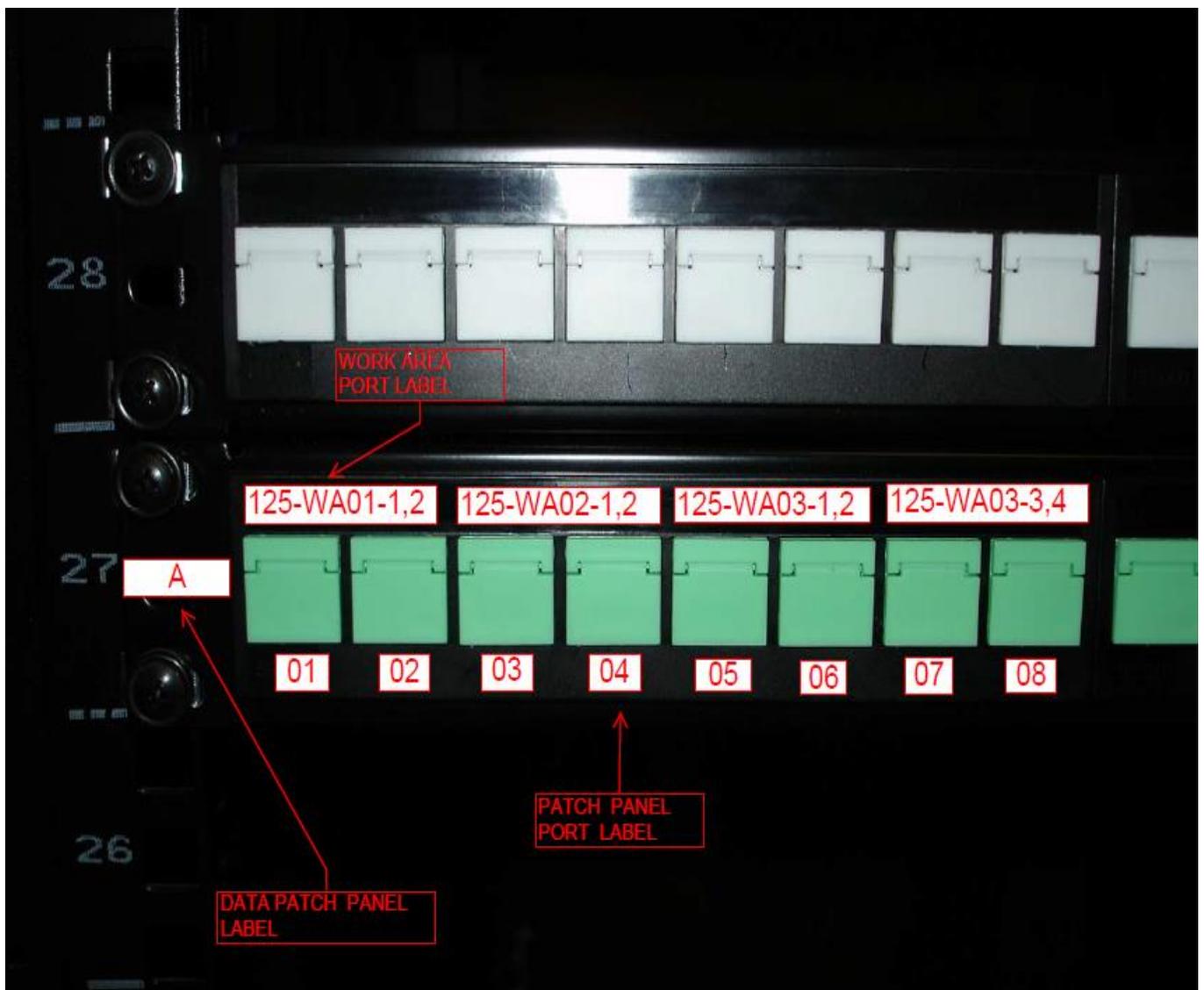


COPPER PATCH PANEL (CP) & WORK AREA OUTLET (WA) IDENTIFICATION AND LABELING

- The copper data patch panels in a Telecommunications Enclosure/Closet shall employ one character A, B, C, ..., Z. The rack shall be populated with patch panel(s) as necessary and labeled in sequential order from top to bottom.
- For example, the first copper data patch panel from the top of the rack shall be labeled A, the second shall be B, and so on.
- Each 24-port patch panel shall have six (6) snap-in faceplates that group four terminations. For office areas, the minimum number of ports associated with a work area outlet shall be a group of two (2) ports.
- Labels shall be applied to patch panels in such a manner as to be readily visible and not obscured by structured cabling or patch cords.



- Labels for each 4-port or 2-port, snap-in faceplate shall be laser printed, self-laminating, adhesive, polyester or polyolefin. Hand-written labels shall not be accepted.
- Lettering shall be black on a white background. Characters are a minimum of 4mm high.
- Apply a label on the top of each group of 4-ports or 2-ports on the snap-in faceplate to indicate the destination of the cables terminated on the data ports (RJ).
- For office areas, the label 125-WA01 would be applied on the patch panel for a group of 2 ports with destination cables to work area outlet 125-WA01. Whereas, 125 represents the room number of the facility and WA01 represents the work area 01.



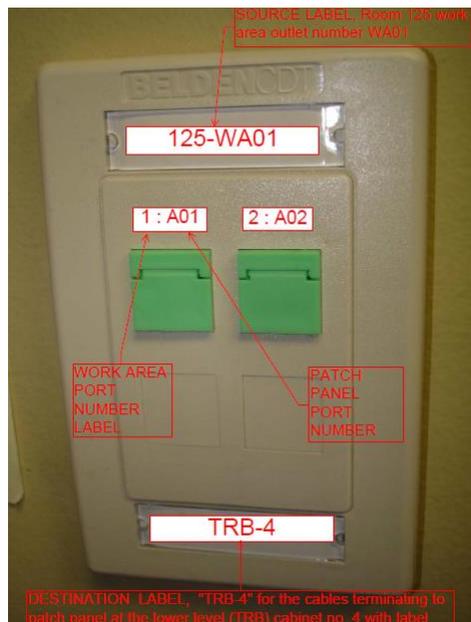
- Apply a two-digit label immediately above each data port (RJ) indicating its destination port number on the work area outlet. For example, a group of four consecutive ports on a 24-port patch panel whose destination is port numbers 1 to 4 on a WAO would have the ports labeled 1, 2, 3, 4. Provide color-coded, snap-in icons for each data port (RJ).

FIBREOPTICS PATCH PANEL (FPP) IDENTIFICATION AND LABELING

- Lettering shall be black on a white background. Characters are a minimum of 4mm high.
- Terminate all 12 fibres of each fibre optic cable in Fibre Enclosures (Telecommunications Enclosure or Network Core Closet).
- The fibre cable for all even-numbered Telecommunications Enclosures shall terminate at Network Core Closet 02 (XYZ-0200) while odd-numbered shall terminate at Network Core Closet 01 (XYZ-0100).
 - For cases where Network Core Closet 01 and Network Core Closet 02 are located in different Equipment Rooms, Telecommunications Rooms / Telecommunications Enclosures shall have fibre terminating in both Network Core Closets.
- The ordering and color of individual fibres shall be the same for each fibre cable and compliant with the latest ANSI/TIA-568.3 and ANSI/TIA-598 standards.
- Labels for patch panels shall be laser printed, self-laminating, adhesive, polyester or polyolefin. Hand-written labels shall not be accepted.
- Labels shall be applied to patch panels in such a manner as to be readily visible and not obscured by structured cabling or patch cords.
- A label shall be applied to the top of the LC duplex adapter modules associated with a single fibre cable indicating the destination of the cable.
- For example, the adapter modules that terminate the fibre cable whose destination is Telecommunications Enclosure 1400 would be labeled as XYZ-1400.
- The fibre patch panel label shall be labeled as follows FPXX where XX is the fibre patch panel sequence i.e. 01, 02, 03...etc. The rack shall be populated with patch panels as necessary and labeled in sequential order from top to bottom.
- For example, the first patch panel from the top of the rack would be labeled as FP01, the second is FP02 and so on.

WORK AREA OUTLET (WAO) IDENTIFICATION AND LABELING

- Labels for each 4-port, work area outlet shall be laser printed, self-laminating, adhesive, polyester or polyolefin. Hand-written labels shall not be accepted.
- Lettering shall be black on a white background. Characters shall be a minimum of 4mm high.
- A label shall be applied to the top of each 4-port, work-area outlet indicating the source of the Horizontal cables.
- For example, WAO port 1 connected to patch panel A port 1 would be labelled as A01. WAO port 2 to patch panel A port 2 is labelled A02 and so on.



CABLE IDENTIFICATION AND LABELING

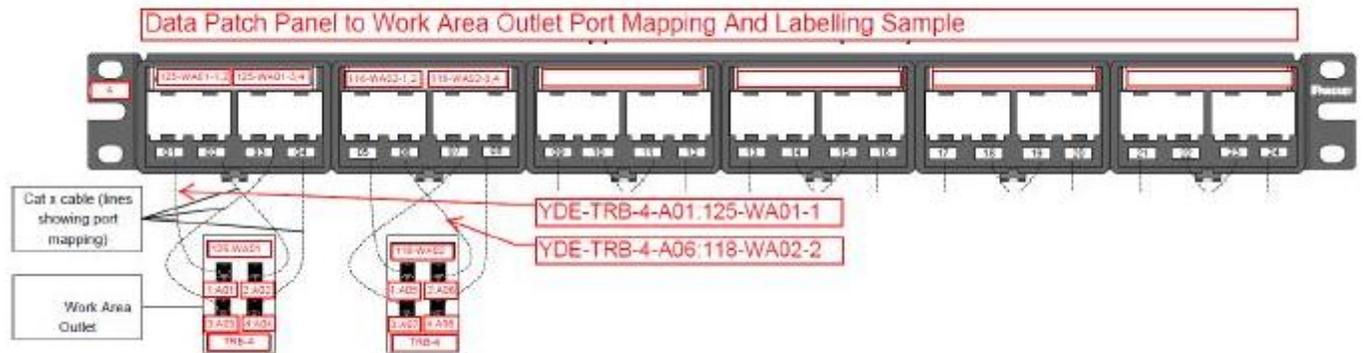
- Use durable non-fading sleeve type wire markers to identify all network cables.
- Labels for cabling shall be laser printed, self-laminating, adhesive, polyester (indoor/outdoor). Hand-written labels will not be accepted.
- Lettering shall be black on a white background. Characters shall be a minimum of 4mm in height.

FIBREOPTICS BACKBONE CABLE IDENTIFICATION AND LABELING

- As a minimum, all fibre optic backbone cables shall be labeled at both ends of the cable, within every pull box and every 15 metres.
- In addition, the fibre backbone cables shall be labeled at each transition. A transition is defined as: a change in ducting (e.g. cable tray to conduit), a change in direction of more than 45 degrees, or an entrance and exit of ducting through a wall or floor.
- If the fibre cable is run in conduit then the transition labels shall be applied to the conduit.
- The tagging convention for identification of fibre optic backbone cables shall indicate the source and destination of the cable separated by a colon.
- For example, a fibre optic backbone cable whose source is Network Core Closet 2 (XYZ-0200), Fibre Patch Panel 01, adapter panel A and terminates in Telecommunications Enclosure 1400 (XYZ-1400) on the fibre patch panel 01 adapter panel A would have the following tag: 0200-FP01-A.01: 1400-FP01-A.01. The last "01" digits represent fibre strands.
- The Telecommunications Enclosure fibre optic patch panel must be labeled. For example: Telecommunication Enclosure 1400 with two fibre optic patch panels would be labeled "FP01" and "FP02", where "FP01" is the first patch panel from the top.

HORIZONTAL COPPER CABLE IDENTIFICATION AND LABELING

- As a minimum, all horizontal CAT6/CAT6A cables shall be labeled at both ends of the cable, within every pull box and every 15 metres.
- In addition, the cables shall be labeled at each transition. A transition is defined as: a change in ducting (e.g. cable tray to conduit), a change in direction of more than 45 degrees, or an entrance and exit of ducting through a wall or floor.
- If the cable is run in conduit then the transition labels shall be applied to the conduit.
- The tagging convention for identification of Horizontal cables shall indicate the source and destination of the cable separated by a colon.
- Example 1: a horizontal cable whose source is Telecommunications Enclosure TRB-4, Patch Panel A, port 01 and whose destination is port 1, Work-Area Outlet 01, in room number 125 would have the following tag: YDE-TRB-4-A01:125-WA01-1.



VOICE BACKBONE COPPER CABLE IDENTIFICATION AND LABELING

- As a minimum, all voice backbone cables shall be labeled at both ends of the cable, within every pull box and every 15 metres.
- In addition, the voice backbone cables shall be labeled at each transition. A transition is defined as - a change in ducting (e.g. cable tray to conduit), a change in direction of more than 45 degrees, or an entrance and exit of ducting through a wall or floor.
- If the voice cable is run in conduit then the transition labels shall be applied to the conduit.
- The tagging convention for identification of voice cables between the voice block and the Telecom Closet/Enclosure patch panel in the building shall be VFFA-CC : XYZ-A-TP01 (indicate the source and destination of the cable separated by a colon), where V indicates voice, FF indicates the floor number, EF indicates telecommunications entrance facility ID, CC indicates 2-digit voice cable number, and XYZ-A is telecommunications closet/enclosure ID.
 - For example, voice cable 01 whose source is entrance room EF and terminates in Telecommunications Room B (YDE-TRB) on patch panel TP01 would have the following tag: V01EF-01 : YDE-TRB-TP01.

PATCH CORD IDENTIFICATION AND LABELING

- As a minimum, all Contractor installed CAT6/CAT6A or fibre optic patch cords shall be labeled at both ends of the cable.
- The tagging convention for identification of patch cords shall indicate the source and destination of the cable separated by a colon. The source is the switch port and the destination is the patch panel, termination point.

CABLE PATHWAYS IDENTIFICATION AND LABELING

- All ducting (cable tray or conduit) carrying fibre optic and multi-pair voice backbone cables shall be tagged as "LAN BACKBONE ".
- All ducting (cable tray or conduit) carrying Horizontal cables shall be tagged as "LAN HORIZONTAL" with the source and destination network panels.
- All ducting shall be labeled at each transition. A transition is defined as - a change in ducting (e.g. cable tray to conduit), a change in direction of more than 45 degrees, or an entrance and exit of ducting through a wall or floor.
- Use engraved gravoply laminate nameplates using black letters on white background.
- The laminate nameplates shall have a dimension of 210mm W x 50mm H.
- Minimum character height shall be 12mm. Character lettering shall be centered on each line.

FIRE STOPPING

- Fire stop systems in commercial premises shall meet the requirements of latest ANSI/TIA-569.
- Fire stop systems should be designed to be compatible with the worst-case environment to which they will be exposed (refer to ANSI/TIA-568.0 for information on environmental classifications).
- Provide EZ PATH solution where conduit penetrates fire rated walls, floors, partitions and ceilings to ensure that the fire rating is maintained. Abandoned penetrations shall be properly fire stopped. Provide EZ PATH system.
- The required fire rating is minimum 2 hours.

SUBMITTALS

- Comply with the requirements of Section 01300 - Submittals.
- Shop Drawings shall be submitted to the City of Toronto IT staff for final review before proceeding with any works.

- The shop drawings and all submissions shall be reviewed and sealed by the RCDD Contractor's PM and re-reviewed and sealed by the Consultant's RCDD before reaching the City for final review.
- Final design drawings/construction drawings shall be submitted to the City of Toronto IT staff for final review and before proceeding with any works. These drawings shall be reviewed by PM RCDD Contractor and re-reviewed and approved by RCDD Consultant before reaching to the City for final review.
- The CADD drawings shall meet the City's CADD standards. Any non-compliance shall be at the Consultants own expense.
- Submit proposed cable and enclosure tag labels to the Contract Administrator and the City of Toronto IT Technical Representative for approval before proceeding with this work.
- Submit red-lined Site Drawings identifying the proposed location of all enclosures including Telecommunication Enclosures, Termination Panels and Work Area Outlets prior to installation and as part of shop drawing submittals.
- Submit site drawings identify the fibre optic backbone cable routes and horizontal cabling routes to be used prior to installation and as part of the shop drawing submittals.
- Prior to x-raying and coring access holes submit red-lined Site Drawings showing the proposed location of the holes.
- Submit red-lined annotated working Drawings to the Contract Administrator, to clearly document the as-built network including details related to: location (closets, work area outlets), cabling (size, length, type, routing), tagging (cable ducting, cabling, closets and work area outlets).
- Submit all submissions in both a hardcopy and electronic native format. Handwritten submissions are not acceptable. Also, submit electronic files in a PDF digital format that is indexed and searchable.
- Submit the following documentation prior to starting the site acceptance test:
 - City of Toronto IT/Network Services — Cable Test Results
 - Operations and Maintenance Manual of any and all electronic equipment to or is installed.
 - Revise and annotate Contract Drawings, to clearly document the as-built network including details related to: location (closets, terminations panels) cabling (size, length,

type, routing), tagging (cable ducting, cabling, closets and termination panels) final as built drawings, cabling schematics, pathways and conduits drawings (containment system), any other documents, reports and drawings needed by the City of Toronto during or after work is completed.

- Consultants shall review and approve all submissions prior to final review by the City.
- Consultant is responsible to submit the final as-built drawings of the project / facility to the City.

END OF SECTION

SECTION -2: PRODUCTS

Products and part numbers often change without notice. The Consultant shall verify all parts specified and used are current and available.

Consultant shall practice the procedure of shop drawings / products approval as stated in this section. Shop drawings shall be submitted by the Contractor to the Consultant. The Consultant / Designer shall review and approve the shop drawings submittal before sending it to the City of Toronto IT for final review. After receiving the submittal from the City IT, the Consultant / Designer shall send the final approval or approval with comments / notes to the Contractor.

APPROVED MANUFACTURERS

- All backbone fibreoptic cables, connectors, patch cords, patch panels, cassettes and adaptors shall be from Belden.
- All CAT6/CAT6A modular jacks, faceplates, U/UTP patch cords and Category 6/6A cables shall be from Belden.
- Where cross connect punch down is required at Entrance Facility for termination of all voice backbone cables, it shall be from Belden.
 - www.belden.com
- All wall mount Telecommunication Enclosures shall be from Hammond Manufacturing.
 - www.hammondmfg.com
- All free standing Paramount Telecommunication Enclosures in the Equipment Room / Telecom Room shall be from Chatsworth Products.
 - www.chatsworth.com
- All fire-stopping EZ-PATH components shall be from Specified Technologies Inc.
 - www.stifirestop.com
- For UPS and Power Distribution Unit, Liebert - Emerson and APC shall be the manufacturers.
 - www.emersonnetworkpower.com ; www.apc.com
- Manufacturer Substitution of any part other than those specified in this standard is strictly prohibited without the written consent of the City of Toronto Information Technology (IT) Network Services Division.

ENTRANCE FACILITY PROTECTION

- Indoor voltage protector to protect entrance terminal to provide voltage and current protection and a disconnect facility at building entry points.
- Integral, 28 AWG (0.32 mm), non-replaceable fuse link wire between the incoming pairs and the protector modules.
- 25-pair connector for single-pair terminations (one pair "IN", one pair "OUT"), compatible with 22 to 26 AWG.
- The protected entrance terminal shall comply with CSA specification C22.2, No. 226-92, "Protectors in Telecommunication Networks," including the high-voltage fault test.
- Protectors to be included with supplied assembly.
- Consultant to use Belden data sheet to specify correct part number for the application.

FIRE RATED BACKBOARD PLYWOOD

- In the Entrance Facility, Equipment Room and Telecom Room Fire Rated plywood shall be provided on the walls or struts such that there is proper cable penetration from behind.
- Plywood shall be void-free and either fire-rated or treated on all sides with at least two coats of fire-retardant light-colored paint.
- Have at least two walls lined with A/C grade or better, 2.4 m (8 ft) high with a minimum thickness of 19 mm (3/4 in). To reduce warping, plywood should be kiln-dried to maximum moisture content of 15 percent. Mount plywood 200 mm (8 in) AFF to avoid damaging the plywood. Have the plywood with the grade A surface exposed. The plywood should be securely fastened to wall-framing members to ensure that it can support attached equipment.
- All joints screw and nail holes are to be caulked and / or covered.
- The plywood is to be provided for cross-connect fields, security panels, power supplies etc. as may be required and is not intended for cabinet installation.

NETWORK CABINETS (CORE AND SERVER CLOSETS)

- 44U Floor Standing Cabinets
 - Cabinets shall be supplied and installed complete with all accessories to provide a complete cabinet as indicated below.

- Cabinets shall be floor mounted, freestanding and have the ability to be ganged together.
- Cabinets shall have a capacity of 44U with mounting holes as per EIA-310-E.
- Each server cabinet shall be black with square hole rails.
- Each network / service provider cabinet shall be black with round hole rails.
- Specified Product:
 - W762mm X D1067mm X H2133mm Cabinet
 - Front Door
 - Rear Split Door
 - Solid Side Panels
 - Rackmount rails (square for server and round for network cabinets)
 - Top Panel
 - 483 mm (19") Mounts with cage nuts
 - 10-32 Cage nuts and screws (square for server and round for network cabinets)
- Electrical
 - Contractor is to provide the electrical distribution for each IT Network and Server cabinet as per the related Electrical Distribution drawings and relevant City standards.
 - Bond each 19" cabinet to ground.
 - Provide each Core and Server cabinet with two (2) 20A, 120 VAC, receptacles for UPS circuits. Terminate each UPS circuit at a 3-wire, duplex receptacle mounted to the rail of the 19" cabinet.
 - The duplex receptacles shall be mounted in such a manner as not to interfere with access to or removal of other equipment within the enclosures.
 - Power distribution within the enclosure shall be via vertically mounted metered power bars.
 - Redundant power supplies, within the same device, shall not be connected to the same UPS circuit.

- Power Distribution Unit (PDU – Power Bar)
 - The Liebert MPH rack PDU shall be managed three-phase power distribution unit that shall be monitoring along with receptacle control.
 - Liebert MPH units shall be available for mounting in either vertical, zero-U configuration and rack-mounting in standard, network enclosures.
 - The output receptacles support equipment requiring connection with NEMA 5-20R and IEC60320-C13 plugs.
 - Remote monitoring shall be enabled by the included communication card, the Liebert RPC™, which permits managing the Liebert MPH over a secure Web page and SNMP-based network management system.
 - The Liebert RPC shall permit interconnecting multiple Liebert MPH and / or Liebert MPX units for monitoring and management.
 - A Liebert MPH shall be monitored locally with an RPC BDM™, an optional display module that connects directly to the communication card. The display module can be handheld, mounted in or on the rack or mounted on a nearby wall.
 - Multiple Liebert MPHs can be centrally managed with Liebert Nform™, which adds group-based receptacle management.

TELECOMMUNICATIONS ENCLOSURE (TE)

- Unless otherwise specified all indoor enclosures containing network components are to be NEMA 12.
- A lockable double hinged door allows front and rear access to rack-mounted components.
- All screws, bolts, fasteners etc. shall be corrosion resistant stainless steel.
- All wall-mounted panels shall be separated from the wall by stainless steel spacers or galvanized steel struts.
- Doors shall have continuous hinges with removable pin and oil resistance cellular neoprene gasket secured by gasket retainers. Front door handles shall be recessed type (freestanding enclosures) or 3-point external latch (wall mount), complete with key locks.
- Provide locking mechanism for rear door. All key locks shall be identically keyed.
- Key number shall be provided.

- Cable bundles shall be neatly laced, run in ducting or approved cable managers and secured to 19" cabinet or mounting back-panel.
- All enclosure doors shall open through 180 degrees without restriction from front and the back.
- Enclosure layout and equipment spacing shall be constructed to allow for device removal, calibration and maintenance without disassembly of adjacent devices.
- All enclosures shall have sufficient structural reinforcements to ensure a limited plane surface vibration and to provide rigidity during shipment, installation and operation without distortion or damage to the enclosure, mounting panel or mounted instruments.
- All enclosure seams shall be continuously welded and ground smooth to be undetectable after painting.
- Devices shall be installed on the enclosure back-panel or 19" cabinet only.
- There shall be no devices installed on the side plates of the enclosure.
- Conduit accessibility shall be per manufacturer's guidelines with conduit egress through the bottom and sides but not the top of the enclosure.
- There are three sizes of TE, 12U, 19U and 26U. All provided by Hammond Manufacturing.
- Minimum items in the TE shall include but are not limited to one fibre termination panel (1U), three 24 port (1U) patch panels (1 x Telephone and 2 x Data), two (2) 24 ports or one (1) 48 ports Cisco switch, two (2) 2U Horizontal Cable Manager, one (1) 1U monitored PDU and other optional equipment as may be requested by CoT-IT such as UPS or other equipment.
- All TEs shall be bonded to the Telecommunications Bonding System as per the standard.
- The bonding cable shall be sized according to distance and terminated at the nearest Telecommunications Grounding Busbar and run within conduit.
- The TE shall be CSA approved and sealed.
- Provide the enclosure electrical distribution as per the Telecommunication Enclosure (Typical) - Electrical Distribution drawing.
 - The Telecommunication Enclosure shall be powered by two separate 15 A, 120 VAC supplies (Utility and Network). The Utility Supply is to power non-critical components (enclosure lighting and power bar). The Network Supply (UPS) is to power the critical network components (Ethernet Switch) and environmental controls (ventilating fans).

Contractor shall provide the Utility Supply from the nearest lighting panel as per the TE Installation drawings. The Network Supply is to be provided by others. Where applicable, the Contractor shall provide a 15A Supplementary DIN rail mounted breaker for termination of the Network Supply. In addition, the Contractor shall provide a knockout for the Network Supply conduit as per the Access Closet Installation drawings. All power distribution installation shall be mounted to the top rear side of the TE.

- Provide 120 VAC, 3-wire, duplex receptacles, circuit breakers, surge suppressor, wire duct and grounding bar per the Telecommunication Enclosure Layout drawing and associated Component Schedule. The Contractor shall provide rigid-steel conduit and wiring to provide the 15 A, 120 VAC Utility Supply as per the Access Closet Installation drawings. The Utility Supply shall be terminated at a 15 A, DIN rail mounted, circuit breaker and surge suppressor. Distribution of the Utility Supply is as documented in the Telecommunications Enclosure – Electrical Distribution drawing.
- All power distribution installation shall be mounted to the top rear side of the TE.
- A rack mount UPS shall be supplied that will power the Telecommunication Enclosure Network Supply. The Contractor shall be responsible for the distribution of the Network Supply within the TE and for providing a 15 A supplemental breaker for termination of the supply by others.
- Power Distribution Unit (PDU - APC)
 - The APC rack mount PDU/transfer switch shall be managed three-phase power distribution unit that monitoring along with receptacle control.
 - The APC units shall be available for rack-mounting in standard, network enclosures.
 - The output receptacles support equipment requiring connections (10) with NEMA 5-15R.
 - Remote monitoring shall be enabled with a secure Web page and SNMP-based network management system.
 - The APC PDU shall permit interconnecting multiple units for monitoring and management.

WORK AREA OUTLETS FOR OFFICE AREA

- All modular jacks, faceplates and furniture inserts shall be Belden and performance rated to Category 6/6A.

- Provide one 4-port, single-gang, work area outlet in each work area for termination of the horizontal CAT6/6A cables with faceplates or decora module frames.
- For new construction, it is recommended that the outlet boxes be 100mm X 100mm X 54mm deep, complete with a mud ring cover specifically designed for single gang faceplates intended for flush mounting to the wall. This single gang outlet box aids in the maintaining of Category 6/6A and higher bend radius requirements.
- Where walls are not suitable or have insufficient depth, stand electrical size outlet boxes shall be used.
- Each manager’s office shall have two (2) work area outlets on separate walls.
- One (1) 4-port, work-area outlet shall be associated with as many ports necessary (in groups of 4 or 2) on the snap-in faceplate installed in the patch panel of the TE or TR as is provided.
- Within each office outlet, only two of the ports shall be terminated at the work area faceplate and patch panel unless otherwise specified.
- Space shall be left in each conduit and faceplate for a third and fourth cable to be added at a later time.
- In the majority of cases one (1) 4-port, work-area outlet shall be installed within each systems furniture cubical work area partition.
- In some special situations where the systems furniture is configured fully the work-area outlet shall be installed directly on the wall in the office areas.
- Within systems furniture, only two of the four positions shall be terminated with work area jacks and on the patch panels unless otherwise specified.
- Space shall be left in conduits and faceplates for the inclusion of a third and fourth cable at a later time.
- In boardrooms and large general office areas, one single gang work area outlet shall be provided every 3.0 metres and within 1.0 metres of an electrical outlet if provided.
- Only two of the four positions shall be terminated with work area jacks and on the patch panels unless otherwise specified.

FACEPLATES

- Faceplates shall be modular Belden white format opening to allow the possibility of changing connector types in the future without replacing the entire unit.
- Faceplates shall be equipped with small form factor terminating connectors to fit the individual outlet's requirements
- Faceplates shall be equipped with a minimum of four (4) openings for modules. Contractors are to equip the faceplate with the required number of blank inserts as required.

WORKSTATION FACEPLATES AND ADAPTERS - CUBICLES

- Workstation outlets shall be supplied and installed for all terminations at the workstation end and as further specified below to suit the application.
- Each workstation shall be equipped with minimum two (2) RJ45 Cat6/6A green color jacks.
- The Communications Consultant shall confirm the color of outlets prior to placing order.
- Modular Furniture Faceplates
 - Modular furniture faceplates shall be installed in all furniture outlets that have a modular furniture knockout shall consist of 4 ports.
 - Each outlet shall be installed with the specified termination modules or a blank insert. No openings shall remain exposed.
 - Communications Consultant shall verify furniture modular faceplate requirement.
 - Belden MDVO modular furniture adapter, 4 port, white
 - Belden MDVO modular furniture adapter, 4 port, black
- Surface Mount Boxes
 - 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 back box.
 - The surface mounted box shall consist of a minimum of two (2) ports.
 - Each outlet shall be installed with the specified termination modules or a blank insert. No openings are to remain exposed.

- Belden MDVO side entry box, white
- Belden MDVO side entry box, black

RJ45 CAT6/6A JACKS

- Belden Eight-position modular jack (RJ45), type Category 6/6A to TIA-568 shall be green color and 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 milli-ohms minimum
 - Contact resistance 1 milli-ohms per contact
- The contact material of the jack in a modular jack connector shall be phosphor bronze with 50 micro-inches of gold over nickel.
- UTP termination modules shall be of the same category as the UTP cabling to ensure that manufacturer end to end warranties can be attained.
- UTP cables used for IP voice shall be terminated with the same specified jacks.
- All UTP termination modules shall be Belden MDVO type.
- Belden CAT6/6A modular jack, MDVO style, green color.
- Belden ID data tab, MDVO style, green color.

COPPER PATCH PANEL (CPP)

- All horizontal CAT6/6A U/UTP cabling shall be terminated on 1U, 24 ports, Belden CAT6/6A modular patch panel.
- All copper patch panels shall be black.
- All modular patch panels shall be populated with CAT6/6A UTP modules/jacks as required.
- The modular copper patch panel shall mount to standard TIA 482.6 mm (19") rack.

- Contractor to refer to installation instructions provided with the patch panel for proper installation.

COPPER CAT6/6A HORIZONTAL CABLE (U/UTP)

- Belden, four-pair, 100 ohm balanced unshielded-twisted-pair (U/UTP) cable, appropriate flame test classification, Category 6/6A (CAT 6/6A) shall be in compliance to TIA-568 standard.
- All cables fully contained within conduit or areas that are not plenum rated shall use CMR/FT4 rated cable.
- Any cable, regardless of length passing through a return air plenum ceiling and not in conduit shall be rated CMP/FT6.
- All UTP cables shall meet requirements identified below:
 - Color: Blue
 - Rating: CMR/FT4 (riser rated or in conduit) or CMP/FT6 (plenum areas or in J-hooks)
 - Category: 6/6A
 - 23 AWG, spool-in-a-box
- All CAT6/6A horizontal cables shall be eligible for the Belden 25 years Certification Warranty.
- Cabling shall be installed and terminated as per the BICSI Installation Methods Manual, Belden Certification training and the manufacturers' installation instructions.

COPPER CAT6/6A PATCH CORD (U/UTP)

- Patch cord shall be manufactured of stranded conductor cable with 8-position, 4-pair terminations at both ends.
- All patch cords shall be manufactured by Belden and performance rated to CAT 6/6A.
- All patch cords shall be of the same or higher performance category and manufacturer of the U/UTP horizontal cabling system that shall be warranted as part of the end-to-end solution.
- All patch cords shall be standard compliant and minimum of FT4 or LSZH rated.
- All patch cords shall be manufactured and certified, 4-pair stranded conductors copper cables, field assembled patch cords are not allowed.

- All patch cords shall be gray in color.
- The Contractor shall supply patch cords in the following length:
 - At patch panel location, provide 0.5 metres long patch cords for all terminated horizontal cables unless otherwise advised by Consultant or CoT-IT.
 - At workstation or work area outlet location, provide patch cords of suitable length and not longer than 5 metres (typically 2.1 metres but Project Consultant to finalize) for every terminated horizontal cable unless otherwise advised by Consultant or CoT-IT.
- Patch cords shall be installed and terminated into the final device by the Contractor as per the BICSI Installation Methods Manual, Belden Certification training and the manufacturer's installation instructions.

BACKBONE CABLE FOR VOICE CENTREX ONLY - ISP (CAT3/5E)

- Category 3/5e rated wire and cable placed in the inside environment shall be solid, 24 AWG, twisted pair and multi-conductor.
- All cables fully contained within conduit or areas that are not plenum rated shall use CMR rated cable.
- Any cable, regardless of length passing through a return air plenum ceiling and not in conduit shall be rated CMP.
 - Belden: CMR: min 25 pairs | CMP: min 25 pairs

TELEPHONE PATCH PANEL FOR VOICE (TPP)

- Minimum 1U 24 RJ45 UTP ports.
- Accommodates 180, 110, or 90 degree patch cord connectors on back of patch panel.
- Does or doesn't require the use of a punch-down tool and mounts to standard EIA 19" rack.
- Belden for voice unloaded patch panel - black
- Belden jacks for voice unloaded patch panel, white – CAT3/5e
- Belden ID voice tab for unloaded patch panel, white

VOICE CROSS CONNECT AT ENTRANCE FACILITY (EF)

- Voice cross-connect is a system that consists of various sizes of BIX blocks, cable distribution accessories (such as moulded rings and strips) and a BIX tool to terminate wires at the BIX block. The voice cross-connect system is primarily composed of two parts: the mount and the connectors.
- Cross-connect mount is a wall-mounted frame, generally built from 16-gauge steel. The frame features a rectangular plastic backplate and two plastic brackets that extend from either side of the backplate to fit between two and ten connectors. The connectors shall be oriented horizontally on the mount.
- The connectors are rectangular punch-down blocks used to terminate up to 25 pairs. The connectors shall have a slip-in fitting which automatically strips the wire as it is punched down, eliminating the need for pre-stripping. The connectors shall also have a pair-splitter to facilitate fast arranging of wires on the punch-down block.
- Backbone cables shall be terminated on the backboard (as shown on drawings) unless otherwise specified in this document.
- All cables shall be terminated on IDC connectors complete with associated hardware such as mounts, cable / cross-connect wire managers, etc.
- The IDC connectors shall accept 24 to 26 AWG solid copper conductors.
- The IDC mounts shall accept cables from behind the connector.
- Cross-connect shall be a 5-pair block and include appropriate mounting and number of designation strips and labels.
- 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.
- Instruction sheets for products are available from Belden.
- Belden 50 pair BIX mount
- Belden BIX distribution connector – 5 pair marking
- Belden accessories such as jumper wires, labels etc. to complete the system.

FIBROPTIC CABLES

INDOOR BACKBONE MULTIMODE OM4 FIBROPTIC CABLE

- The cable is performance rated to OM4 and shall be used only if the backbone link length is less than or equal to 150 meters.
- Primary and redundant, 12 strands in each cable shall run between the equipment room and the telecom room. Total of 2 x 12 strands shall run with diverse pathways between the equipment and telecom rooms.
- All cables shall be fully contained within conduit or areas that are not plenum rated shall use OFNR/FT4 rated cable.
- Any cable, regardless of length passing through a return air plenum ceiling and not in conduit or using cable tray / J-hook shall be rated OFNP/FT6.
- Fiber cables shall be protected when entering the patch panel with a black color flexible conduit.
- Core-locked, tight-buffered, black, indoor/outdoor fiber-express distribution cables.
- 50/125-micron core/cladding, laser optimized.
- 4700 MHz-km bandwidth at 850nm wavelength (EMB).
- 3500 MHz-km bandwidth at 1300nm wavelength.
- Only cables from Belden shall be accepted.
- All fibreoptics cables shall be installed and terminated into fibre optic adapters contained in fibre optic patch panels by the Contractor as per the BICSI Installation Methods Manual, Belden certification training and installation instructions.
- Belden:
 - OFNR/FT4
 - OFNP/FT6

FIBROPTICS PATCH PANEL (FPP)

- Fibreoptics cabling shall be terminated in patch panels intended for fibre optic cable management.

- Belden Fibreoptics Rack Mount Enclosure for Telecommunication Enclosures shall be:
 - 3U - 19" Rack Mount Enclosure
 - Durable black powder coat finish
 - Be equipped with cable strain relief and slack storage
- Belden Blank Fibre Adapter Panel shall be:
 - Blank Fibre Adapter Panel to fit Fibre Adapter Patch Panel
 - Durable black powder coat finish
- Belden Fibreoptics LC Fibre Adapter Strip shall be:
 - Loaded with TIA-604 FOCIS-10 compatible adapters, TIA-568.3 standard compliant
 - Split sleeve: Zirconia Ceramic
 - Adapter housing colors follow TIA-568.3 suggested color identification scheme.
 - Belden part number for 6 LC duplex adapter strip
- Belden 1U fibre cover, smoked plexiglas
- Belden Splice Case / Modules / Trays for OM4 Cable Terminations shall be:
 - Belden splice tray for 3U rack mount fibre enclosure

FIBREOPTICS LC CONNECTOR FOR FIELD TERMINATION OF OM4 CABLE

- Optical fibre terminations for OM4 cable shall be made for field termination with a pre-polished connector and shall be of the same manufacturer and LC style to suit the cabling installed.
- Fibre connectors shall match the performance of the fibreoptics cable (OM4).
- Fibre terminations shall be made with a ceramic ferrule and cable boot.
- Optical fibre cables shall be terminated with pre-polished connectors having the characteristics as below:
 - Return loss: >20dB (multimode)
 - Termination Style: Pre-Polished

- Connector Type: LC
- Ferrule Type Zirconia Ceramic
- The connector shall include connector body / ferrule assemblies, crimp sleeves, dust caps, clip, and appropriate boot.
- All Fiberoptics connector terminations and adapters shall be contained in fibre optic patch panels from Belden by the Contractor as per the BICSI Installation Methods Manual, Belden certification training and installation instructions

FIBEROPTICS LC PIGTAIL FOR FIELD TERMINATION OF OM4 CABLE

- Optical fibre OM4 cable shall be fusion spliced to pig-tails for field termination and shall be of the same manufacturer and LC style to suit the cabling installed.
- Pigtail shall be OFNR (FT4) or LSZH rated and stamped/printed accordingly.
- The pigtail shall be 100% factory terminated and inspected end face geometry in compliance with Telcordia GR-326-CORE, issue 3.
- Typical insertion loss per pigtail connection: 0.25dB.
- Field assembled pigtails are not allowed.
- The Contractor shall supply and fusion splices every strand of the fibre backbone cable with a pigtail. The pigtail length shall be 1m.
- Belden OM4 pigtail
- Belden fusion splice heat shrink protector sleeves

FIBEROPTICS MULTIMODE LC-LC DUPLEX PATCH CORDS – OM4

- All patch cords shall be CSA/TIA/UL approved, CMR (FT4) or LSZH rated and printed accordingly.
- All optical fibre patch cords shall be OM4.
- All optical fibre patch cords shall be manufactured and certified, 1-pair (duplex, 2 strands). Field assembled patch cord is not allowed.
- The Contractor shall supply a minimum two (2) patch cords for every OM4 backbone cable:

- At patch panel in the telecom room (TE), provide one (1) 2-meter-long patch cord unless otherwise specified by CoT IT.
- At patch panel location in the equipment room (ER), entrance facility (EF), or any other space provide one (1) 2-meter-long patch cord unless otherwise specified by CoT IT.
- All optical fibre patch cords shall be LC to LC duplex.

PATHWAY SYSTEM – CONDUIT AND CABLE TRAY

- Cable tray shall be used above ceilings in commercial facilities and below raised floor systems as may be found in equipment rooms or data centers.
- All pathway (conduit and cable tray) systems shall be designed in accordance with the latest version of the ANSI/TIA-569-E Standard which exceeds the minimum requirements of Canadian Electrical Code. Pathway systems that are designed only to the Canadian Electrical Code and do not include all requirements of the ANSI/TIA-569-E standard will be considered substandard and removed until such time as they are in compliance.
- Consultant to confirm with both the facility and CoT-IT regarding the areas that are suitable for Electrical Metallic Tubing (EMT).

ELECTRICAL METALLIC TUBING CONDUIT - EMT

- To be used within the office areas only (if applicable).
- Electrical Metallic Tubing shall be electro-galvanized steel.

FITTINGS

- Fittings for electrical metallic tubing shall be single screw indenter fittings for conduits up to 2" and double screw indenter fittings for conduits 2" and larger.
- Die-cast or pressure cast fittings are not permitted.
- Connectors shall have insulated throat up to and including 1" size. For sizes 1-1/4" and larger, provide plastic insulating bushing.
- Provide conduit body types, shapes and sizes as required to suit application and NEC requirements. Provide matching gasket covers secured with corrosion-resistant screws.

EXPANSION FITTINGS

- Provide expansion fittings with external grounding straps at building expansion joints.
- Minimum 4" movement in either direction.
- At expansion joints in concrete pours, provide deflection/expansion fittings capable of movement of $\frac{3}{4}$ " in all directions from the normal.

WATER PROOFING SEALS

- Provide watertight expanding link-type seals for installation between the conduit and the sleeve or core drilled hole.

WIRE BASKET TRAY

- The wire basket tray shall be 12 – 13 gauge, straight sections shall be powder coated black with an average paint thickness of 1.2 mils (30 microns) to 3.0 mils (75 microns).
- Tray shall be designed in such a way as to be secured to the following, but not limited to: wall, ceiling every 1.2 metres.
- Splicing trays shall be accomplished by using a single manufacturer supplied UL classified connector bolt or splice plate.
- Depth: Tray depth shall be (unless otherwise shown on the drawings) 100mm (4 inches).
- Width: Tray width shall be (unless otherwise shown on the drawings) 300mm (12 inches).
- Turning Fences shall maintain approved bend radius and be constructed from sheet steel and plated in accordance with applicable standards.
- Intersections shall be made from high strength steel, welded and plated in accordance with applicable standards.
- Proper manufactured accessories and fittings such as elbows, reduces, crossovers, tees and riser shall be used for any change in direction, height or size of the cable basket tray.
- Support cable tray to suit loading and recommended support requirements in the Canadian Electrical Code Part II.
- Materials bolted or riveted to the cable tray shall be free of burrs and or sharp edges.

VENTILATED CABLE TRAYS

- All cable tray systems shall be designed in accordance with the latest version of the ANSI/TIA-569-E Standard and BICSI TDMM which exceed the minimum requirements of Canadian Electrical Code. Cable tray systems that are designed only to the Canadian Electrical Code and do not include all requirements of the ANSI/TIA-569-E Standard and BICSI TDMM shall be considered substandard and removed until such time as they are in compliance.
- Consultant to confirm with both the facility and CoT-IT regarding the areas that are suitable for cable tray, if suitable, what material type given the impact of certain airborne chemicals (aka Chlorine) that corrode metals.
- The ventilated cable tray is preferred to be used for horizontal cable distribution.
- The ventilated cable tray shall include but not be limited to the following characteristics:
 - A prefabricated structure consisting of a ventilated bottom with integral longitudinal side rails with no openings exceeding 50mm or 2" in a longitudinal direction.
 - Shall be prefabricated from a pre-punched sheet to produce a one-piece ventilated tray.
 - Shall be available in Aluminum, pre-galvanized Steel, hot dip Galvanized Steel and Stainless Steel 316.
 - Shall be a minimum of 103mm or 4" in depth or as appropriately designed and approved by Project Consultant and CoT-IT.
 - Proper manufactured accessories and fittings such as elbows, reduces, crossovers, tees and riser shall be used for any change in direction, height or size of the cable tray.
 - Spine type cable tray is not acceptable.
 - Support cable tray to suit loading and recommended support requirements in the Canadian Electrical Code Part II.
 - The support shall be placed within a maximum of 610mm on either side of any connection to a fitting.
 - Materials bolted or riveted to the cable tray shall be free of burrs and or sharp edges.

JUNCTION BOX

- All junction box applications shall be designed in accordance with the latest version of the ANSI/TIA-569-E Standard and BICSI TDMM which exceed the minimum requirements of Canadian Electrical Code. Application of junction boxes that are only designed to the Canadian Electrical Code and do not include all requirements of the ANSI/TIA-569-E Standard and BICSI TDMM shall be considered substandard and removed until such time as they are in compliance.
- Consultant to confirm with both the facility and CoT-IT regarding the areas that are suitable for junction box construction type given the impact of certain airborne chemicals (aka Chlorine) that corrode metals.
- For standard non chemically hazardous environments junction boxes shall be constructed of not less than 14-gauge galvanized steel with trim for flush or surface mounting in accordance with the location to be installed.
- Provide screw-on type cover boxes installed in damp or wet locations shall be of rain-tight construction with gasketed cover and threaded conduit hubs.
- Boxes shall be NEMA approved for the environmental condition of the location where they will be installed.

POKE THROUGH FLOOR BOX

- Where office facilities exist but access for cable distribution from above is not possible it may be practical to serve the floor from the ceiling space below with a Poke Through.
- Aluminum modular fire rated poke-through floor boxes coverings.
- Installs in 4" (101.6mm) diameter core drilled hole through concrete.
- UL listed for use in 1-4 hour rated floors.
- Poke-through fitting and universal cover combination exceed UL514A scrub water exclusion requirements.
- Stationary fire barrier expands during fire conditions to provide upper fire seal with adjustable fire barrier that would accommodate concrete floor thickness from 2-1/4" to 7".
- Dual 1" E.M.T. conduit tubes feed from communications feed and one for the electrical (when needed).
- Furniture feed for both power and communication services to modular furniture systems.

- Poke-through to have dual panels, one to hold four (4) RJ45 CAT6/6A Data/Voice ports. The other panel will have a blank plate.
- One-piece dual style line Poke-Through aluminum finish.
- Aluminum modular fire rated poke-through floor boxes coverings.
- Installs in 4" (101.6mm) diameter core drilled hole through concrete.
- UL listed for use in 1-4 hour rated floors.
- Poke-through fitting and universal cover combination exceed UL514A scrub water exclusion requirements.
- Stationary fire barrier expands during fire conditions to provide upper fire seal with adjustable fire barrier that would accommodate concrete floor thickness from 2-1/4" to 7".

GROUNDING AND BONDING

- All bonding to ground systems shall be designed and installed in accordance with the latest version of the ANSI/TIA-607-D Standard and BICSI TDMM which exceed the minimum requirements of the Canadian Electrical Code. Grounding and Bonding for Communications that are designed only to the Canadian Electrical Code and do not include all requirements of the ANSI/TIA-607-D Standard and BICSI TDMM shall be considered substandard and removed until such time as they are in compliance.
- Consultant to confirm with both the facility and CoT-IT regarding the areas that are suitable bonding and grounding points given the impact of certain airborne chemicals (aka Chlorine) that corrode metals.

PRIMARY BONDING BUSBAR (PBB) / TELECOMMUNICATIONS MAIN GROUNDING BUSBAR (TMGB)

- An insulated predrilled copper busbar listed by NRTL, electro-tin plated with holes 8mm diameter for use with standard-sized lugs.
- Dimensions 6mm thick, 100mm wide, variable length as applicable.
- Shall be insulated from its support by a minimum of 50mm.

SECONDARY BONDING BUSBAR (SBB) / TELECOMMUNICATIONS GROUNDING BUSBAR (TGB)

- Predrilled copper busbar listed by NRTL, electro tin plated with holes 8mm diameter for use with standard-sized lugs.
- Dimensions 6mm thick, 50mm wide, variable length as applicable.
- Shall be insulated from its support by a minimum of 50mm.

TELECOMMUNICATIONS BONDING BACKBONE (TBB)

- Cable assemblies shall be UL Listed and CSA Certified and be a minimum of 6 AWG copper conductor, green insulated.
- Telecommunications Grounding and Bonding Conductor Label Kits shall be supplied and installed by the Electrical Contractor at every rack and cabinet as well as one for every Telecommunications Grounding Busbar.
- The bonding conductor size shall be as follows:

TBB Length in Linear metres Metres (feet)	TBB Size (AWG)
Less than 4 (13)	6
4-6 (14 – 20)	4
6-8 (21 – 26)	3
8 – 10 (34 – 41)	2
13 – 16 (42 – 52)	1/0
16 – 20 (53 – 66)	2/0
Greater than 20 (66)	3/0

TELECOMMUNICATIONS BONDING CONDUCTOR (TBC)

- Cable assemblies shall be UL Listed and CSA Certified and be a minimum, the same size as the largest TBB copper conductor.
- Shall be green insulated and marked in accordance with ANSI/TIA-607-D.

WARNING LABELS

- Non-metallic warning labels in English: TIA-607-D.
- Identify labels with wording "If this connector is loose, please call the building telecommunications manager or site / area supervisor".

FIRE-STOPPING

- A fire-stop system is comprised of the item or items penetrating the fire rated structure, the opening in the structure and the materials and assembly of the materials used to seal the penetrated structure. Firestop systems comprise an effective block for fire, smoke, heat, vapor and pressurized water stream.
- All penetrations through fire-rated building structures (walls and floors) shall be sealed with an appropriate fire-stop system (EZ-PATH). This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating item i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly fire-stopped with EZ-PATH.
- Firestop systems shall be UL Classified to ASTM E814 (UL 1479) and shall be approved by a qualified Professional Engineer (PE), licensed (actual or reciprocal) in the state where the work is to be performed. A drawing showing the proposed fire-stop system, stamped/embossed by the Professional Engineer of Ontario (P.Eng.), shall be provided to the Owner's Technical Representative prior to installing the fire-stop system(s).
- EZ-PATH Part Numbers:
 - EZ-PATH Series 22, 33 and 44 (size based on cable quantities).

END OF SECTION

SECTION – 3: EXECUTION

It is Consultant / Designer responsibility to check the latest version of this document from CoT-IT.

GENERAL

- RCDD certified engineer shall perform the design and consulting work.
- Contractors / Technicians shall be certified with Belden and Fluke Networks to perform installations and testing / commissioning.
- Contractors must have an RCDD installation Team Lead / Project Manager.
- Technicians who have not completed the appropriate certification or training shall not pull, terminate or otherwise be involved in the installation of the telecommunications physical infrastructure with the exception of bonding to ground.
- Installers performing the testing (SAT, Acceptance, Commissioning, etc.) shall be Certified Cabling Test Technician on Fluke DSX / Versiv and Optifibre OTDR equipment.
- Following are the procedures to follow for successful project handing over:
 - Cable Acceptance Testing (CAT) – See Appendix for correct Sample Test Results and Compliance Sheet
 - Site Acceptance Testing (SAT) - See Appendix for Sample SAT Documents
 - As-built Drawings and Documents (ADD)
 - Consultant Review and Comments (CRC)
 - CoT-IT Approval of Satisfaction (AoS) – Signing off

HORIZONTAL CABLE INSTALLATION

- All cables and components shall be installed as per the Belden’s instruction sheets, ANSI/TIA standards and the BICSI Installation Methods Manual to complete the project.
- All testing of the Category 6/6A cabling system shall be with Fluke DSX-5000 / 8000 Versiv Cable Analyzers.

FIBREOPTIC CABLE INSTALLATION

- All cables and components shall be installed as per Belden’s instruction sheets, ANSI/TIA standards and the BICSI Installation Methods Manual to complete the project.
- All testing of the fibre optic installation shall be with test equipment from Fluke DSX-5000 / 8000 Versiv and if required (upon CoT-IT request) Optifibre OTDR.

CABLE ACCEPTANCE TESTING

- This section specifies the acceptance testing requirements for backbone fibre optic as well as horizontal UTP cabling.
- Supply all of the test equipment required to conduct acceptance tests.
- Submit acceptance documentation as defined in this section.
- All of the installed cabling must be tested and successfully pass all test criteria.
- Standards referenced in this section include:
 - ANSI/TIA-568: Telecommunications Cabling Standard. All standards referenced within the TIA-568, where applicable, constitute standard provisions of this specification.
 - ANSI/TIA-526-14: Optical Power Loss Measurement, Multimode
 - ANSI/TIA-526-7: Optical Power Loss Measurement, Single-mode
 - ANSI/TIA-1152: Requirements for field test instruments and measurements for balanced twisted-pair cabling
- Visually inspect all cables, cable reels and shipping cartons to detect possible cable damage incurred during shipping and transport. Visibly damaged goods shall be returned to the supplier and replaced at no additional cost to the City.
- All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA-568 standard. All pairs of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed without cost to the City.

COPPER PERMANENT LINK TESTING – HORIZONTAL CABLING

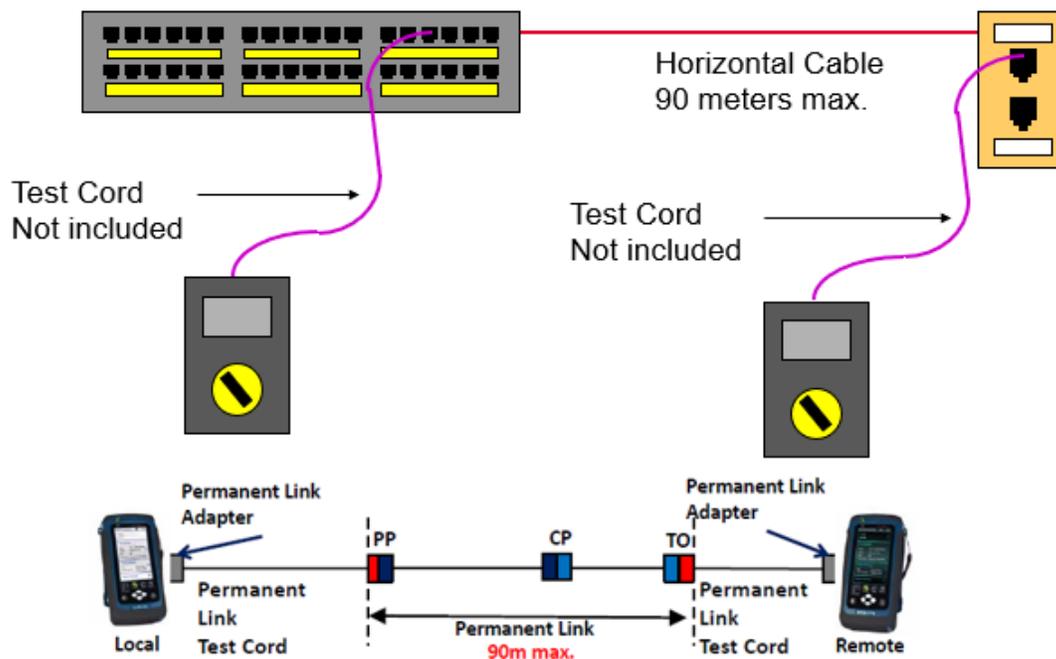
- All unshielded twisted-pair copper cable links shall be tested for continuity, pair reversals, shorts, opens and performance to Category 6/6A. Horizontal cabling shall be tested using a minimum level IIIe test unit for Category 6/6A performance compliance.
- Continuity - Each pair of installed cable shall be tested using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs. The test shall be recorded as pass/fail as indicated by the test unit and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.
- Length - Each installed cable link shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the ANSI/TIA-568.2 standard. Cable length shall be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cable, the shortest pair length shall be recorded as the length for the cable.
- Horizontal twisted pair cable shall meet or exceed the permanent link, performance requirements specified in ANSI/TIA-568.2 for Category 6/6A, Unshielded Twisted Pair (U/UTP).
- All tests shall be conducted using permanent link configuration on the testing equipment.

COPPER TEST EQUIPMENT

- Category 6/6A Test Equipment - Category 6/6A test equipment shall meet the following minimum criteria:
 - All test equipment of a given type shall be from the same manufacturer and have compatible electronic results output. Acceptable test equipment manufacturer is Fluke Networks. Unless the manufacturer specifies a more frequent calibration cycle, calibration date shall be not more than a year from cable test date. Recommended test equipment is a Fluke Networks DSX 5000 / 8000 Versiv Cable Analyzer.
 - Test adapters must be approved by the manufacturer of the test equipment. Adapters from other sources are not acceptable. For horizontal cabling, permanent link adapters shall be used.
 - Baseline accuracy of the test equipment must meet or exceed TIA Level IIIe, as indicated by independent laboratory testing.

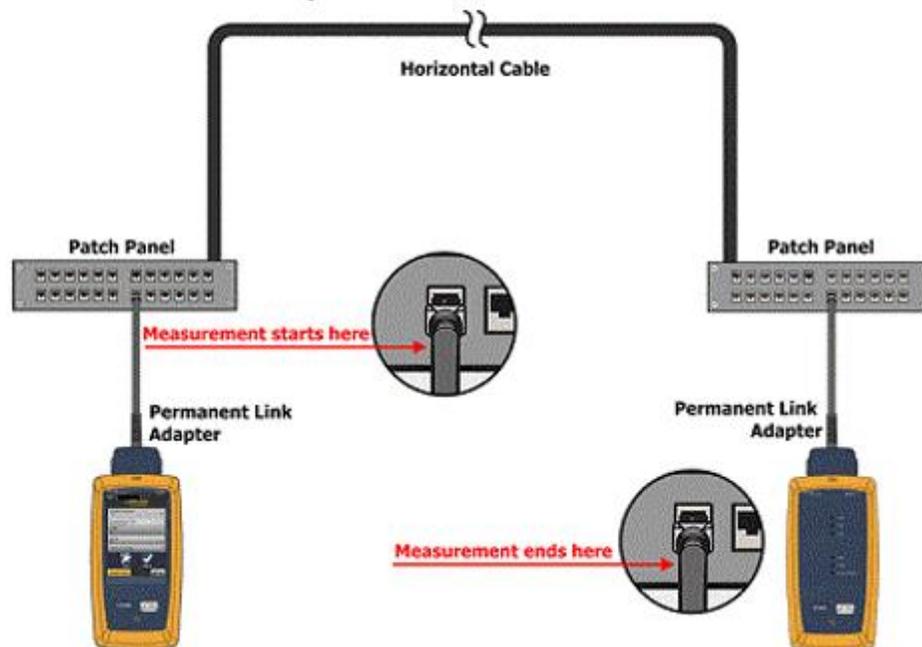
- Test equipment must be capable of certifying Category 6/6A to TIA-568.2 standard.
- Test equipment must have a dynamic range of at least 100 dB to minimize measurement uncertainty.
- Test equipment must be capable of storing full frequency sweep data for all tests.
- Test equipment must include S-Band time domain diagnostics for NEXT and return loss (TDNXT and TDRL) for accurate and efficient troubleshooting.
- Test equipment must be capable of running individual NEXT, return loss, etc., measurements in addition to auto tests. Individual tests increase productivity when diagnosing faults.
- Test equipment must make swept frequency measurements in compliance with ANSI/TIA-568.2 standard.
- The measurement reference plane of the test equipment shall start immediately at the output of the test equipment interface connector. There shall not be a time domain dead zone of any distance that excludes any part of the link from the measurement.
- The calibration of equipment shall be valid within one (1) year of the test date.

■ Permanent Link in LAN



■ Permanent Link Test in DC

Data center two connector permanent link definition:



HORIZONTAL CABLE TESTING DOCUMENTATION - COPPER

- Category 6/6A (UTP) Documentation - As a minimum, test reports shall include the following information for each U/UTP CAT6/6A cabling element tested:
 - Wiremap results that indicate the cabling has no shorts, opens, split, reversed, or crossed pairs and end-to-end connectivity is achieved.
 - Attenuation, NEXT, PSNEXT, Return Loss, ELFEXT and PSELFEXT data that indicate the worst-case result, the frequency at which it occurs, the limit at that point and the margin. These tests shall be performed in a swept frequency manner from 1 MHz to highest relevant frequency, using a swept frequency interval that is consistent with TIA and ISO requirements. Information shall be provided for all pairs or pair combinations and in both directions when required by the appropriate standards.
 - Length (in meters), propagation delay and delay skew relative to the limit.
 - Any individual test that fails the relevant performance specification shall be marked as a FAIL.

- Cable manufacturer, cable model number/type and NVP.
- Tester, manufacturer, model, serial number, hardware version and software version.
- Circuit ID number (Cable Tag Id) and Facility name.
- Test criteria used.
- Overall pass/fail indication.
- Date and time of test.

BACKBONE FIBREOPTIC TESTING

- Backbone fibre optic cable shall meet or exceed the permanent link, performance requirements specified in ANSI/TIA-568.3 for multimode and singlemode fibre.
- Test link attenuation with an OLTS:
 - For multimode fibre, make reference measurements in accordance with TIA-526-14, Annex A – One cord reference method. Measure optical loss on each fibre at 850nm and 1300nm. It is required to measure loss on each fibre from each direction (bi-directional).
 - For singlemode fibre, make reference measurements in accordance with TIA-526-7, one cord reference method. Measure optical loss on each fibre at 1310nm and 1550nm. It is required to measure loss on each fibre from each direction (bi-directional).
- Measure link length optically or calculate using cable sheath length markings.
- Multimode backbone fibre optic cabling shall meet the following loss and length criteria:
 - Attenuation @ 850nm shall be less than or equal to: fibre length (km) x 3.0 dB/km + number connector pairs x 0.5 dB + number of splices x 0.3 dB.
 - Attenuation @ 1300nm shall be less than or equal to: fibre length (km) x 1.5 dB/km + number connector pairs x 0.5 dB + number of splices x 0.3 dB.
 - Length shall be less than or equal to 150 meters.
- VCSEL driver is preferred to be used for testing as the SFP active modules on the switch runs with VCSEL drivers up to 10Gbps.
- Singlemode backbone fibre optic cabling shall meet the following loss and length criteria:

- Attenuation @ 1310nm shall be less than or equal to: fibre length (km) x 0.4 dB/km + number connector pairs x 0.75 dB + number of splices x 0.3 dB.
- Attenuation @ 1550nm shall be less than or equal to: fibre length (km) x 0.4 dB/km + number connector pairs x 0.75 dB + number of splices x 0.3 dB.
- Length more than 150 metres and shall be less than or equal to 10000 meters.

BACKBONE FIBREOPTICS TESTING DOCUMENTATION

- Fibreoptics Documentation: As a minimum, test reports shall include the following information for each fibreoptics cabling element (fibre) tested:
 - Actual measured attenuation, maximum allowable attenuation (loss) and the attenuation margin at the specified wavelengths. An individual test that fails the link criteria shall be marked as FAIL.
 - Reference method.
 - Number of mated connectors.
 - Actual length and maximum allowable length. Any individual test that fails the link length criteria shall be marked as FAIL.
 - Group refractive index (GRI) for the type of fibre tested, if length was optically measured.
 - Tester manufacturer, model, serial number and software version.
 - Circuit ID number (Cable Tag ID) and facility name.
 - Link criteria used.
 - Overall pass/fail indication.
 - Date and time of test.

FIBREOPTIC TEST EQUIPMENT

- All test equipment of a given type shall be from the same manufacturer and have compatible electronic results output. Acceptable test equipment manufacturer is Fluke Networks. Unless the manufacturer specifies a more frequent calibration cycle, calibration date shall not be more than a year from cable test date. Recommended test equipment is a Fluke Networks DSX-5000 /

8000 Versiv Cable Analyzers using VCSEL fibre modules (preferred) for multimode testing and/or OptiFiber OTDR (if advised by CoT-IT).

- The calibration of equipment shall be valid within one (1) year of the test date.
- Fiberoptics test equipment shall meet the following minimum criteria:
 - Test equipment shall be capable of measuring relative or absolute optical power in accordance with TIA-526-14, "Optical Power Loss Measurement of Installed Multimode Fiber Cable Plant."
 - Test equipment shall be capable of measuring relative or absolute optical power in accordance with TIA-526-7, "Optical Power Loss Measurement of Installed Single-mode Fibre Cable Plant."
 - Test equipment shall not include the loss or length of the test jumpers in the cable plant measurements.
 - Multimode test equipment shall incorporate both 850nm and 1300nm VCSEL/LED sources.
 - Single-mode test equipment shall incorporate both 1310nm and 1550nm laser sources.
 - Sources and meters shall automatically synchronize wavelengths to prevent calibration-related errors.
 - Test equipment shall employ a communications port to facilitate uploading of saved information from tester to PC.
 - Test equipment capable of measuring a Tx/Rx fibre pair simultaneously is recommended to enhance productivity. It is recommended that test equipment utilizing dual function main and remote units be used for bi-directional testing, eliminating the need to swap optical source and power meter.

CABLE TEST RESULTS MANUAL

- Consulting Engineer shall first review and comment on the test report. CoT-IT shall only receive the report after the review and approved comments of the Consulting Engineer. CoT-IT will finally provide their final review comment.
- Submit test reports in both a hardcopy and electronic format (native file). Hand-written test reports are not acceptable. If test results cannot be converted to a PDF format then provide any necessary proprietary/native software to view the results at no cost to the City.

- Fibre optic backbone cable test results shall be incorporated in the City of Toronto, Network - Cable Test Results manual. Submit two (2) copies of the Cable Test Results manual for each facility. The manual consists of hardcopy test result reports placed into lockable ‘D’ ring binders with a cover and spine that clearly indicates the title of the manual. Put a CD with the electronic copies of test reports in a pocket in the Cable Test Results manual.
- The Contractor (RCDD) PM must sign hardcopy reports before submitting it to the Consultant.

TEST COMPLIANCE SHEET

- A compliance sheet shall be prepared for every project of City of Toronto - IT. The criteria is summarized as below:

1	Test equipment with latest software version	8	Test results limits - TIA
2	Test equipment with latest test limit version	9	Test results based on VCSEL/LED Encircled Flux for OM4
3	Calibration of test equipment	10	Test results based on Laser for OS2
4	Test results submitted in native format and PDF format	11	MM testing at 850nm and 1300nm wavelength
5	Test result cable ID in compliance	12	SM testing at 1310nm and 1550nm wavelength
6	Permanent Link testing performed on copper (CAT6/6A)	13	Bi-directional testing
7	Test result cable type (copper and fibre) in compliance	14	Accurate quantity of adapters and splices

SITE ACCEPTANCE TEST (SAT)

- A Site Acceptance Test (SAT) will NOT test functionality of the system or its components. Site Acceptance Tests will evaluate the workmanship and verify installation against the *Installation* and *Layout* drawings.
- The SAT plan shall be submitted to CoT-IT, two (2) weeks in advance of commencement.

- The SAT plan shall have a checklist and identify tests with a schedule for CoT-IT to review and coordinate staff. Submit to the Contract Administrator/Project Manager and Consultant, three weeks prior to the commencement of the test, for review. The Contractor shall conduct the test when directed by the Contract Administrator. As a minimum, the Contract Administrator/Project Manager, Consultant and CoT-IT shall witness the test.
- The plan shall be sealed by the Installation Project Manager RCDD, followed by the RCDD Consultant.
- Prior to SAT, the Consultant shall review and approve all copper and fibre cabling testing, bonding and grounding inspections and any other criteria as may be described in the project tender.
- The SAT shall evaluate workmanship and verify construction and components against the Layout Drawings and associated Component Schedules submitted to and reviewed by the Consultant.
- The SAT shall be completed only when all items in the checklist have been witnessed and installed by the Contract Administrator/Project Manager, Consultant and CoT-IT as being in conformance with the design as specified.
- SAT of Equipment Room / Telecom Room
 - Each facility shall have one or more equipment room / telecom room, which house the server and network core closets. Each equipment / telecom room shall undergo a witnessed SAT.
 - The Consultant is responsible for the equipment / telecom room UPS, lighting panel and any ER/TR modifications noted in the tender drawings and specifications. The extent of ER/TR modifications varies for each facility.
 - In addition to the above, the ER/TR SAT shall include the evaluation of the server and core closet installation, power supplies to each closet and external cable management (e.g. cable tray). For the purpose of the ER/TR SAT the server and core closets shall be empty except for the installation of duplex receptacles to receive the UPS.
- SAT of Telecom Enclosure
 - As a minimum, the complete Telecom Enclosure for the SAT shall include the installation of copper patch panels, fibre patch panel, power supplies, horizontal cable terminations, cable management and patch cords.
 - At each facility, the Contractor shall provide one complete telecom enclosure, associated accessories and horizontal cable for the SAT. Following acceptance, the Contractor will be directed to proceed with the installation of the remaining TEs and horizontal cabling. The Contractor is to note that the fibre optic backbone cable installation will be included in the core closet SAT.

- The City reserves the right to do a random inspection of the telecom enclosure and those that do not comply with the above shall be made compliant at no expense to the City.

FIELD SUPPORT

- Provide 160 hours of on-site support for each facility beginning immediately after successful site acceptance test at that facility for a period of 24 months following Substantial Performance.
- Respond within 24 hours to a request for on-site support.
- The minimum site time per support call will be four (4) hours.
- The cost for the on-site field support shall be paid based on the rates quoted in the Schedule of Prices.

MAINTENANCE

- For a period of twelve (12) months following Final Acceptance, the Contractor shall provide a qualified technician/electrician to assist in the resolution of network related problems. The Contractor shall be given twenty-four (24) hours notice as to their requirement on-site.
- The Contractor will be compensated at the per diem rate quoted by the Contractor in the Form of Tender. However, if the source of the problem is discovered to be a result of work or components supplied by the Contractor, the Contractor shall not be compensated.

WARRANTY

- Testing and certification of the Building Network Distribution Cabling System shall be by the installer and shall include the provision of a Belden Warranty covering performance, products and installation.
- The Warranty shall cover the full repair and/or replacement of any component failing or failure to meet the design requirements within one (1) year.
- Warranty shall be delivered by the Contractor in coordination with Belden to the Client's Project Manager with the Testing and Certification documents. The project site shall receive manufacturer's plaque. All coordination regarding warranty and handing over of the manufacturer's plaque is the responsibility of the Contractor.

- The manufacturer shall warrant the project for twenty-five (25) years against application assurance and extended product manufacturing defects.
- The Contractor shall warrant installation against all product installation defects and that all approved cabling components meet or exceed the specified requirements for a period of twenty-five (25) years following acceptance.
- The Contractor shall warrant that all permanent fibre optic links meet or exceed the performance requirements of TIA-568.3 for multimode and singlemode fibre.
- The Contractor shall warrant that all permanent twisted pair links meet or exceed the performance requirement of TIA-568.2 for category 6/6A, unshielded twisted pair.
- Contractor must provide complete end to end mapping of all connectivity at the end in both hard and softcopy formats. This includes but not limited to horizontal data / voice cable number, copper and fibre backbone cable and active equipment ports.
- Within ten (10) days after testing, the cable installer shall provide the Project Manager with documentation, which shall include cable test results, a marked-up copy of the as-built cable network drawing and an electronic copy of the completed installation in Bentley Microstation Ver. 8 and AutoCAD or as per City's CAD guidelines.
- Contractor shall provide a manufacturer written certificate, plaque and warranty that the structured cabling platform is installed and fully operating in accordance with this standard and manufacturers specification.
- The warranty must guarantee that the design or installation negligence on the part of the Cabling Contractor shall not negate or void any portion of the certified system. The manufacturer must guarantee that all material, components and labour are covered in this circumstance for the full certification period of twenty-five (25) years. It must also guarantee that in the event a Cabling Contractor is no longer able to service the warranty, the full certification remains valid and is responsibility of the manufacturer.
- If a warranty issue arises for the cabling, the Warrantor must make arrangements to undertake the repair or replacement of warranty issues within 24 hours of notification. This may require the repair/replace of cabling components outside regular working hours at no additional cost.
- The warranty for the cabling must be such that the cable meets or exceeds the requirements of TIA-568 'Transmission Performance Specifications for 100 Ohm 4-pair Category 6/6A Cabling' including all Standards stated in this Contract.
- The Cabling Contractor shall forward the Structured Cabling Platform certification request form(s) to the proper authority and ensure that a Plaque and Certificate is issued to the Customer / Project Site along with the Structured Cabling Platform user manual. The successful bidder shall provide a certification number within two weeks of award of this project. Please

note that the Plaque/Certificate must have the Customer name/Project name on the Plaque/Certificate.

- The Cabling Contractor shall provide letter(s) of Certification within two weeks of substantial completion of the project to the Customer. This document will include the following: verification of the performance of the installed system, identification of the installation by location and project number and a copy of the warranty.
- Upon request and at no additional cost to the Customer the Cabling Contractor must provide a manufacturer's technical representative to conduct an on-site visit to ensure complete technical compliance.
- The Cabling Contractor must supply a copy of an unexecuted warranty statement (at the time of bidding) including all related terms and conditions. This copy shall be the Standard to which the warranty will be held. No changes shall be accepted unless it is deemed to benefit the Customer. Any proposed changes to the warranty must be submitted in writing to the Customer/their representative for review. The changes will then be accepted or declined by the Customer at their discretion. This is to remain valid for the entire warranty period.
- All cable Cabling Contractor technicians on site must be trained by the manufacturer of the Structured Cabling Platform being installed.
- Any defective or improperly installed products shall be replaced, or correctly reinstalled at no cost to the Customer.

QUALIFICATIONS AND TRAINING

- An on-site training may be required for the Client to understand the system and installation.
- Contractors shall be certified with Belden and Fluke Networks to perform installations and testing.
- Contractors must have an RCDD installation Project Manager.
- Technicians who have not completed any certification program shall not pull, terminate or otherwise be involved in the installation of the telecommunications physical infrastructure with the exception of bonding to ground.
- Installers performing the testing (SAT, Acceptance, Commissioning, etc.) shall be certified CCTT on Fluke DSX and/or Optifibre OTDR.
- All Fluke credentials shall be submitted to the City during project award process for validation.
- The testing equipment shall be valid and calibrated within one (1) year as per manufacturer specifications.

- The cable installer shall have full working knowledge of cabling low voltage applications such as, but not limited to, Non-Secure Data/Voice communications cabling systems.
- Provide references of the type of installation provided for in this specification.
- Have knowledge of all applicable Telecommunication Standards such as but not limited to: CSA, TIA, IEEE and ANSI.
- Have experience in the installation of pathways and support for horizontal and backbone cabling.
- Be experienced in the installation and testing of telecommunication network cabling system, including the use of a light meter and OTDR.
- Provide proof of being a manufacturer certified installer for all cable network components being installed such as but not limited to cables, connectors and end termination equipment. The use of a non-manufacturer certified installer is not permitted.

AS-BUILT DRAWINGS

- The drawings shall include cable routes and outlet locations.
- Outlet locations shall be identified by their sequential number as defined elsewhere in this document.
- Numbering, icons and drawing conventions used shall be consistent throughout all documentation provided.
- For new infrastructure project, the Consultant shall provide the design drawings / tender drawings / floor plans in paper and electronic (Microstation) formats on which as-built construction information can be added.
- For an existing infrastructure upgrade, the Owner may provide floor plans in paper and electronic (Microstation) formats on which as-built construction information can be added.
- These documents shall be modified accordingly by the Telecommunications Contractor to denote as-built information as defined above and returned to the Owner.
- The Contractors shall annotate the base drawings and return a hard copy (same plot size as originals) and electronic (Microstation) form.

FINAL ACCEPTANCE

- Once all work has been completed including all documentation submissions, the City will notify the satisfaction to the Consultant in writing of formal acceptance of the system.
- Consultant must warrant in writing that 100% of the installation meets the design requirements as specified.
- Contractor must warrant in writing that 100% of the installation meets the requirements specified in the tender documents.
- The CoT-IT reserves the right to conduct, using Contractor equipment and labour, a random re-test of up to five (5) percent of the cable plant to confirm documented results. Any failing cabling shall be re-tested and restored to a passing condition. In the event more than two (2) percent of the cable plant fails during re-test, the entire cable plant shall be re-tested and restored to a passing condition at no additional cost to the Owner.
- Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating and receipt of full documentation as specified.
- The City may agree to allow certain cable runs to exceed acceptable standardized performance criteria. If required these cable runs will be exempt from meeting the specified standards. However, the Contractor will still be required to test these cable runs to validate component and installation performance.
- Documentation: The Contractor shall submit the following documentation for final acceptance:
 - City of Toronto - IT Network — Cable Test Results Manual.
 - Cable Acceptance Test (CAT) – Compliance Sheet
 - Site Acceptance Test (SAT)
 - As-built Drawings and Documents (ADD)
 - Consultant Review and Comments (CRC)
 - CoT-IT Approval of Satisfaction (AoS) – Signing off

APPENDIX-A: SAMPLE OF CABLE ACCEPTANCE TEST (CAT)



CITY OF TORONTO - CABLE TEST RESULTS COMPLIANCE SHEET

Project Name		Contract/Project Number	
Facility Name		Facility Address	
Location		Closet/Rack Number	
Consultant		Contractor	
Original Submission Date	Second Submission Date	Third Submission Date	Fourth Submission Date
City Reviewer	Date Issued	Status <input type="checkbox"/> Approved <input type="checkbox"/> Disapproved	

General

No.	GENERAL	Comply	Does Not Comply	Not Applicable
1	Cable test equipment DSX-5000 / 8000 with latest software version			
2	Cable test equipment DSX-5000 / 8000 with latest limit version			
3	Calibration certificate of the cable test equipment provided to the City			
4	Cable test results supplied to the City in PDF and Native format			
5	Test result specify the project name and / or contract number			
6	Test result specify site name or facility code			

Copper Test Results

No.	COPPER	Comply	Does Not Comply	Not Applicable
1	Permanent link testing performed			
2	Patch cord testing performed			
3	Test result cable identification in compliance with CoT-IT Standard			
4	Test result cable type in compliance with CoT-IT Standard – TIA-568 Horizontal			

Fiberoptics Test Results

No.	FIBRE	Comply	Does Not Comply	Not Applicable
1	Test results based on LED/VCSEL for OM4 50/125 um MM fibre cabling			
2	Test results based on FP Laser for OS2 9/125 um SM fibre cabling			
3	MM testing at 850nm and 1300nm modal bandwidth			
4	SM testing at 1310nm and 1550nm modal bandwidth			
5	Test result cable identification in compliance with City of Toronto-IT Standard			
6	Test result cable type in compliance with City of Toronto-IT Standard and TIA-568 Backbone MM/SM			
7	Test link attenuation in accordance with TIA-526-14 or TIA-526-7 makes reference measurements in accordance with METHOD-B (one jumper cable measurement for MM) or METHOD-A.1 (one jumper cable measurement for SM). Measure optical loss on each fibre at 850nm and 1300nm (for MM) or 1310nm and 1550nm (for SM).			
8	Measure loss on each fibre from each direction (bi-directionally) as per CoT-IT Standard			
9	Accurate quantity of adapter and splices			
10	Smart Remote mode used for testing dual-fibre strands			





Cable ID: CCTV-MZ/02/01/020

Test Summary: PASS

Test Limit: TIA Cat 6A Perm. Link

Main: Versiv
S/N: 2790064

Remote: Versiv
S/N: 2797298

Limits Version: V7.6

Software Version: V6.6 Build 2

Software Version: V6.6 Build 2

Date / Time: 06/06/2022 04:38:25 PM

Calibration Date: 01/31/2022

Calibration Date: 01/31/2022

Operator:

Adapter: DSX-5000 (DSX-PLA004)

Adapter: DSX-5000R (DSX-PLA004)

Headroom 3.3 dB (NEXT 3,6-7,8)

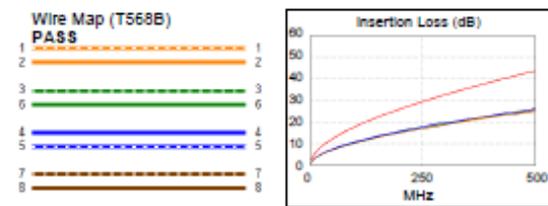
S/N: 4710039

S/N: 4710040

Cable Type: Cat 6A U/UTP

NVP: 68.2%

Length (ft), Limit 295	[Pair 7,8]	189
Prop. Delay (ns), Limit 498	[Pair 4,5]	295
Delay Skew (ns), Limit 44	[Pair 4,5]	13
Resistance (ohms)	[Pair 4,5]	9.09
Insertion Loss Margin (dB)	[Pair 3,6]	17.4
Frequency (MHz)	[Pair 3,6]	497.0
Limit (dB)	[Pair 3,6]	43.6



Worst Case Margin Worst Case Value

PASS	MAIN	SR	MAIN	SR
Worst Pair	3,6-7,8	3,6-7,8	3,6-7,8	3,6-4,5
NEXT (dB)	3.3	6.1	3.3	6.4
Freq. (MHz)	410.0	406.0	410.0	497.0
Limit (dB)	29.5	29.6	29.5	26.7
Worst Pair	3,6	3,6	3,6	3,6
PS NEXT (dB)	4.6	5.5	6.4	7.0
Freq. (MHz)	410.0	424.0	500.0	497.0
Limit (dB)	26.7	26.2	23.8	23.8

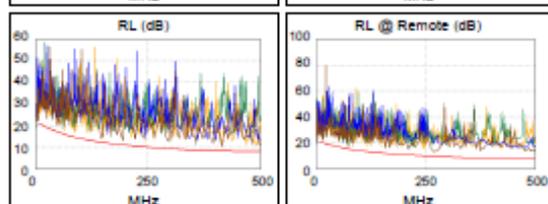
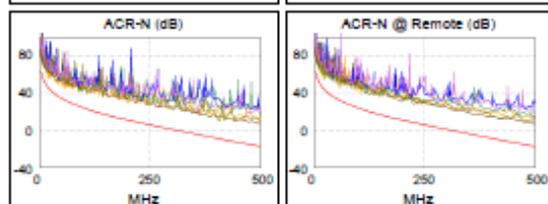
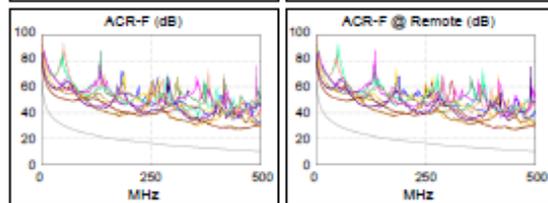
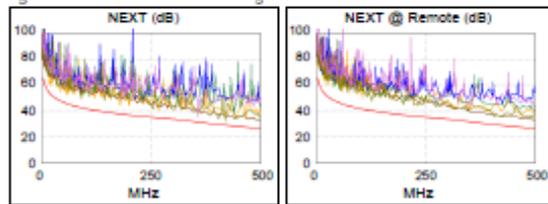
PASS	MAIN	SR	MAIN	SR
Worst Pair	4,5-3,6	3,6-4,5	4,5-3,6	3,6-4,5
ACR-F (dB)	15.7	15.9	15.7	15.9
Freq. (MHz)	441.0	450.0	441.0	450.0
Limit (dB)	11.3	11.1	11.3	11.1
Worst Pair	3,6	3,6	3,6	3,6
PS ACR-F (dB)	16.9	16.4	18.4	17.8
Freq. (MHz)	1.1	1.3	463.0	453.0
Limit (dB)	60.2	59.3	7.9	8.1

N/A	MAIN	SR	MAIN	SR
Worst Pair	1,2-3,6	1,2-3,6	3,6-4,5	3,6-4,5
ACR-N (dB)	10.6	12.2	24.0	23.8
Freq. (MHz)	17.4	17.4	500.0	497.0
Limit (dB)	46.8	46.8	-17.1	-16.9
Worst Pair	3,6	1,2	3,6	3,6
PS ACR-N (dB)	11.8	13.7	24.1	24.3
Freq. (MHz)	19.3	17.3	500.0	497.0
Limit (dB)	43.3	44.4	-20.0	-19.7

PASS	MAIN	SR	MAIN	SR
Worst Pair	7,8	7,8	7,8	7,8
RL (dB)	1.9	3.5	2.0	5.0
Freq. (MHz)	146.5	274.0	357.0	481.0
Limit (dB)	12.3	9.6	8.5	8.0

Compliant Network Standards:

10BASE-T	100BASE-TX	100BASE-T4
1000BASE-T	2.5GBASE-T	5GBASE-T
10GBASE-T	ATM-25	ATM-51
ATM-155	100VG-AnyLan	TR-4
TR-16 Active	TR-16 Passive	



LinkWare™ PC Version 10.5





Cable ID: 024 **Test Summary: PASS**
 Date / Time: 02/15/2022 09:45:58 AM n = 1.467000 (1310 nm) Backscatter Coefficient: -79.4dB (1310 nm)
 Cable Type: SMF G652D n = 1.468000 (1550 nm) Backscatter Coefficient: -81.7dB (1550 nm)

Loss (R->M)
PASS

Test Limit: ISO/IEC 14763-3
 Limits Version: 7.6
 Date / Time: 02/15/2022 09:45:58 AM
 Operator: JOHN
 Main: Versiv
 S/N: 21123084
 Software Version: V5.7 Build 1
 Module: CertiFiber Pro (CFP-QUAD)
 S/N: 21212667
 Calibration Start Date: 08/12/2021
 Remote: Versiv
 S/N: 21120065
 Software Version: V5.7 Build 1
 Module: CertiFiber Pro Remote (CFP-QUAD)
 S/N: 21212670
 Calibration Start Date: 08/12/2021

Propagation Delay (ns)	7887	
Length ft	5284	PASS
Limit 16404		
Result	1310 nm	1550 nm
Loss (dB)	PASS	PASS
Limit (dB)	0.78	0.52
Margin (dB)	3.21	3.21
Reference (dBm)	2.43	2.69
Reference (dBm)	-4.04	-4.00

Number of Adapters: 2
 Number of Splices: 2
 Connector Type: LC
 Patch Length1 (ft): 7
 Reference Date: 02/15/2022 08:55:51 AM
 1 Jumper

Loss (M->R)
PASS

Test Limit:
 Limits Version:
 Date / Time:

Result	1310 nm	1550 nm
Loss (dB)	PASS	PASS
Limit (dB)	0.46	0.32
Margin (dB)	3.21	3.21
Reference (dBm)	2.75	2.89
Reference (dBm)	-3.07	-3.05

Compliant Network Standards:

- | | | |
|----------------------------|----------------------------|---------------------------|
| 100GBASE-LX | 100GBASE-ER4 | 100GBASE-LR4 |
| 10GBASE-E | 10GBASE-L | 10GBASE-LX4 |
| 40GBASE-ER4 | 40GBASE-LR4 | Fibre Channel 100-SM-LC-L |
| Fibre Channel 1200-SM-LC-L | Fibre Channel 1600-SM-LC-L | Fibre Channel 200-SM-LC-L |
| Fibre Channel 400-SM-LC-L | Fibre Channel 400-SM-LC-M | Fibre Channel 800-SM-LC-L |

LinkWare™ PC Version 10.5



APPENDIX-B: SAMPLE OF SITE ACCEPTANCE TEST (SAT) DOCUMENTS

Checklist of Telecom Enclosure (TE) / Network / Core Closet Site Acceptance Test (SAT)

Facility:	Project Name:
Contract No.:	Telecom Enclosure / Network / Core Closet Tag:
Building:	Sub-Location:
Consultant:	Contractor:
Date:	CoT-IT Staff:

TELECOM ENCLOSURE (TE) / NETWORK / CORE CLOSET LAYOUT AND AS-BUILT DRAWINGS

Procedure:

- Verify that the as-built drawings are present.
- Verify the Telecom Enclosure components match the bill of materials.
- Verify equipment layout is as shown in the as-built drawings.
- Verify all components are tagged and wiring is labeled as per the drawings. (Enclosure, Patch Panels, Copper Patch Panel(s) Work Area Outlets, Cables, Power Distribution Components, etc.)
- Verify the horizontal and backbone fibre cable terminations and labeling.

If any comments are necessary, enter a note number in the test form column and record the comment in the comments form at the end of this document.

Acceptance Criteria:

Telecom Enclosure construction and labeling shall match the as-built drawings.

As Built Drawings Verification			
Item No.	Description	Pass/Fail	Notes
1	As built drawings present		
2	Bill of materials in compliance		
3	Layout / arrangement of components in compliance		
4	All components tagged as per as-built drawings. (Enclosure, Patch Panels, Copper Patch Panel(s) Work Area Outlets, Power Distribution Components, etc.)		
5	All wiring labeled as per as-built drawings		

Power and Fusing Verification

Procedure:

Verify that the indicated circuit breakers or fuses are installed and labeled with the indicated rating and source and destination distribution panel, breaker position ID. Refer to as built Telecom Enclosure wiring diagrams for the required circuit protection and rating. Record the installed protection device rating.

If the indicated installed circuit protection device matches the required rating enter PASS in the test form column.

If any comments are necessary, enter a note number in the test form column and record the comment in the comments form at the end of this document.

Acceptance Criteria:

Installed fuses and circuit breakers shall match the required specifications and labeled accordingly. The correct equipment is powered by the fuse and/or circuit breaker as shown on the as-built electrical drawings.

TE AC Power, Fusing and Tagging/Labeling Verification						
Circuit Breaker / Fuse ID	Description	Required Rating	Installed Rating	Pass / Fail	Source / Destination ID	Notes
120V AC UPS Power Supplementary Protectors						
SP02	UPS Receptacle and UPS Pilot Light (if applicable)	15A				
120V AC Hydro Power Supplementary Protectors						
SP01	Surge Suppressor and Utility Pilot Light (if applicable)	15A				
SP03	Panel Light	5A				
SP04	Utility Receptacle	15A				

Grounding & Bonding Verification

Procedure:

Verify that the indicated component is properly connected to the ground.

- Switch off system power.
- Verify the installation of the ground connection between the grounding bus or common ground terminal and the indicated component.
- Measure the DC resistance between the grounding bus or common ground terminal and the indicated component.
- Record the measured DC resistance between the ground connection and the component.

If the indicated grounding connection is installed and meets the maximum DC resistance specification enter a PASS in the test form column. If any comments are necessary, enter a note number in the test form column and record the comment in the comments form at the end of this document.

Acceptance Criteria:

The grounding or bonding conductor is installed and the DC resistance measurement must be less than or equal to 0.2 Ω between termination points.

Telecom Enclosure (TE) Grounding & Bonding Verification				
Grounding / Termination Point	Ground Conductor Visual Inspection	Resistance Ω Measured	Pass / Fail	Notes
Surge Suppressor		Ω		
UPS Receptacle / Isolated Ground		Ω		
Utility Receptacle		Ω		
Enclosure Door		Ω		
APC Power Bar		Ω		
Rack Mount Ground Bus		Ω		

Spare Parts, Loose Shipped Components, TE - Bill of Material Verification

Procedure:

Verify all spare parts and loose shipped components as required in the as-built drawings and bill of material are present. Typical items may be Fiber Optic Patch Cables, Copper Patch Cables, etc.

Enter PASS in the test form column if parts are present. If any comments are necessary, enter a note number in the test form column and record the comment in the comments form at the end of this document.

Acceptance Criteria:

Spare parts and loose shipped components are present as required.

Spare Parts and Loose Shipped Items			
Item No.	Description	Pass / Fail	Notes
1	Drawings		
2	Fiber Optic Patch Cords		
3	Copper Patch Cords		
4			
5			
6			
7			
8			
9			
10			

Approvals / Sign Off

Site Acceptance Test

City

Name : _____ Company: _____

Signature: _____ Date: _____

Consultant

Name : _____ Company: _____

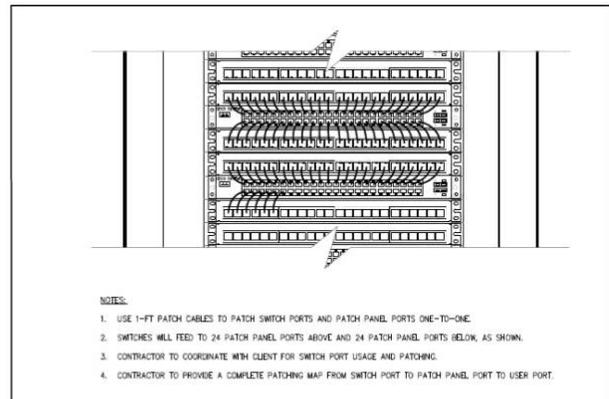
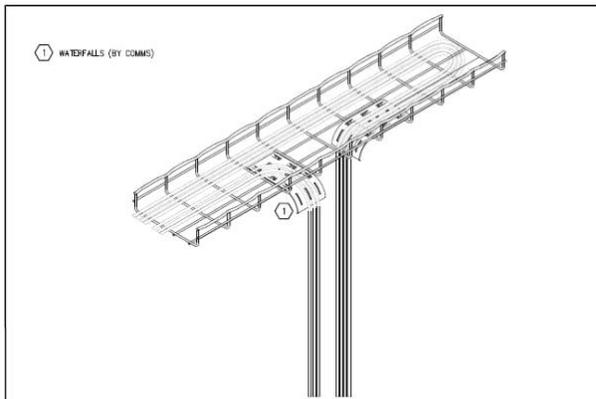
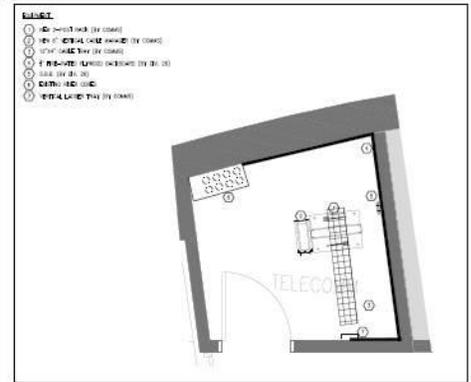
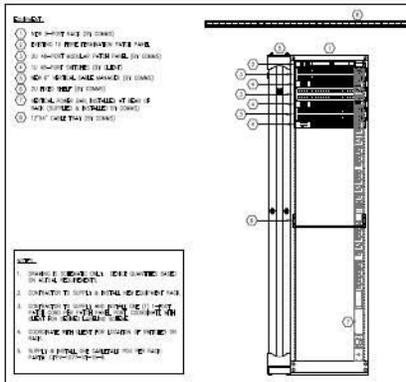
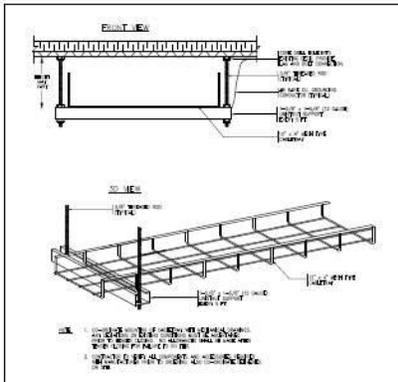
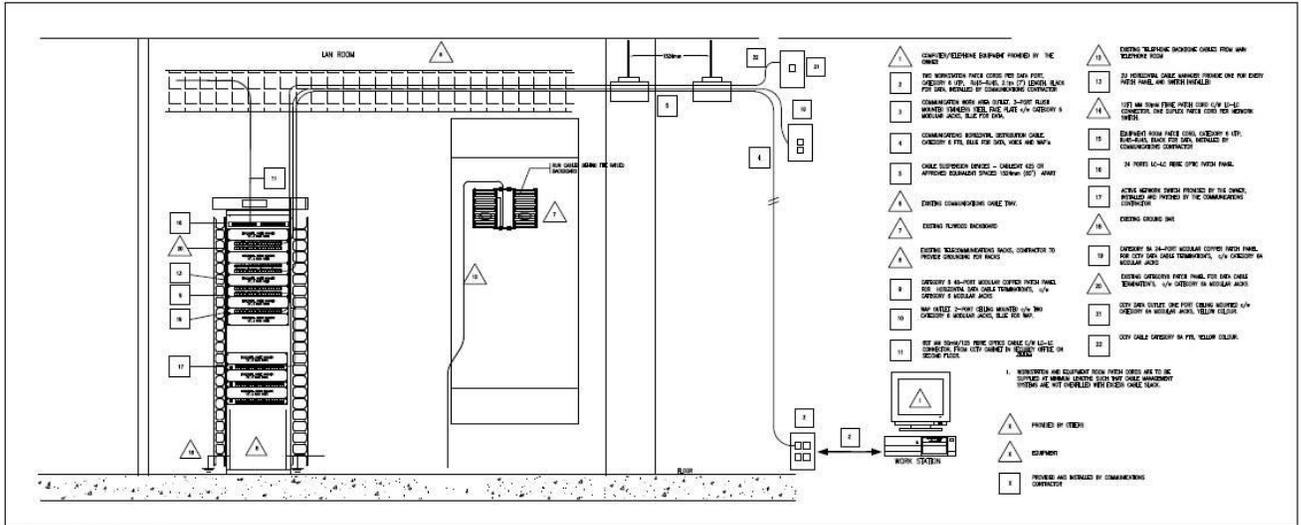
Signature: _____ Date: _____

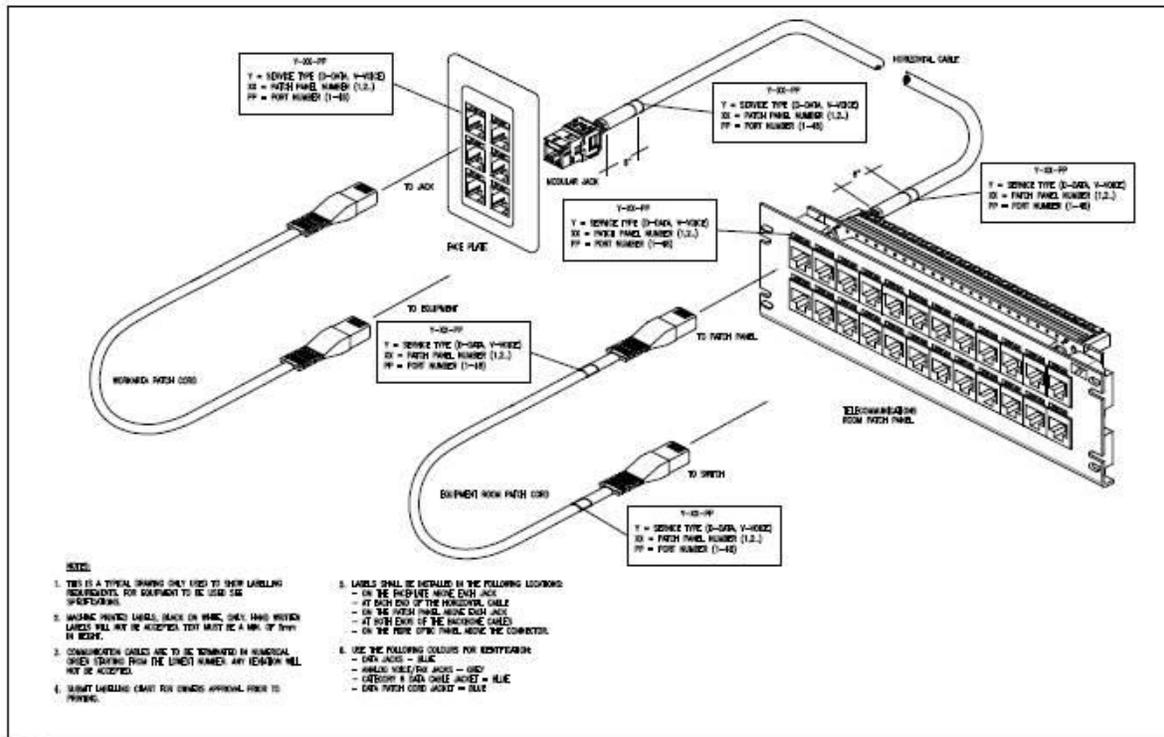
Contractor

Name : _____ Company: _____

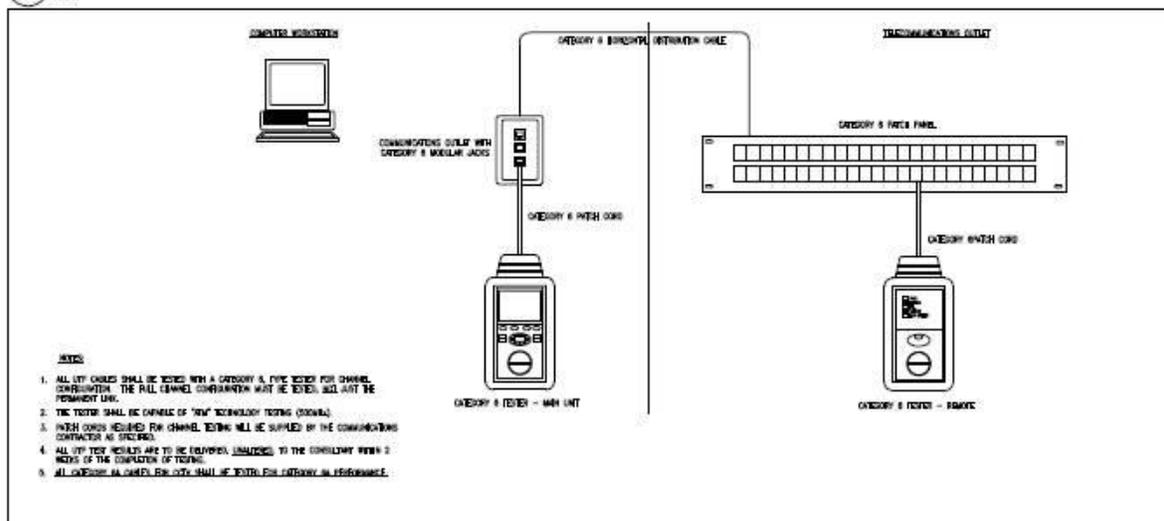
Signature: _____ Date: _____

APPENDIX-C: SAMPLE OF TELECOM WIRING DIAGRAMS | DRAWINGS | PHOTOGRAPHS

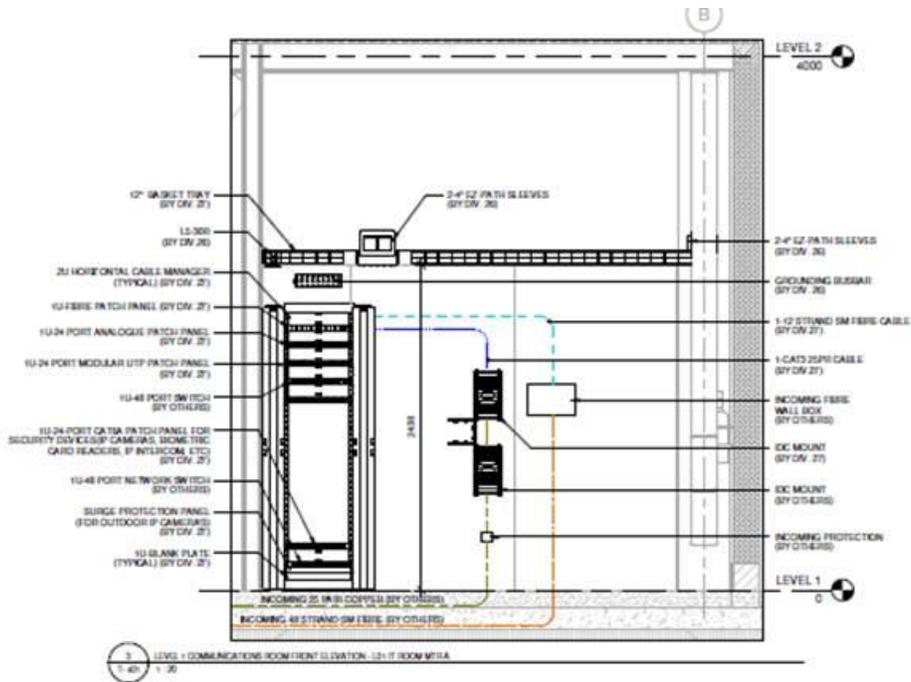
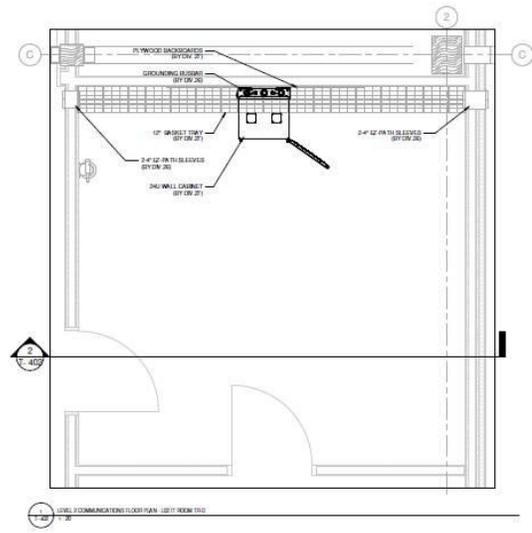
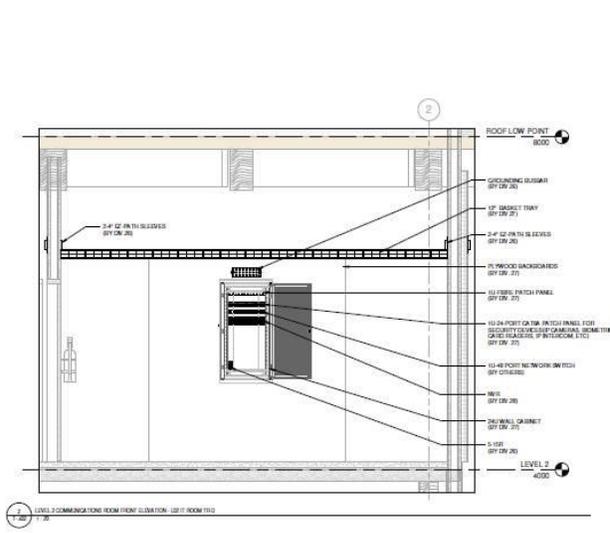


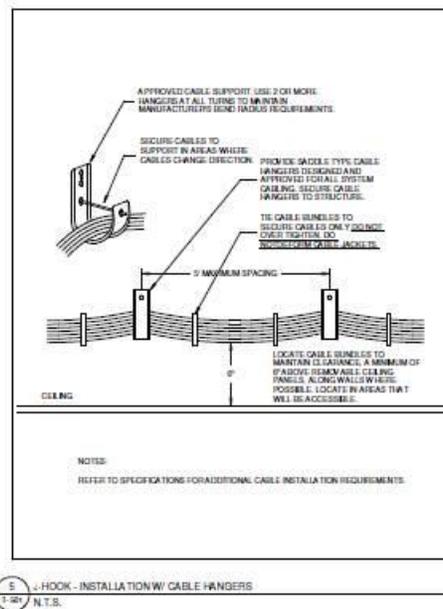
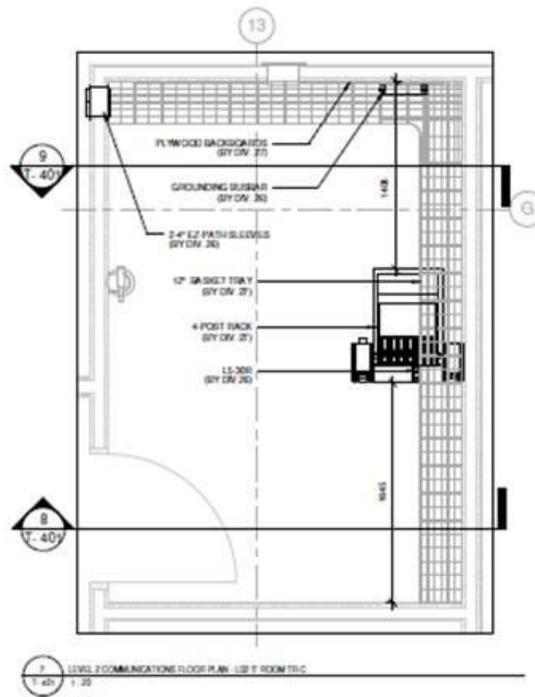


1 COMMUNICATIONS HORIZONTAL CABLE LABELLING
 N.T.S.



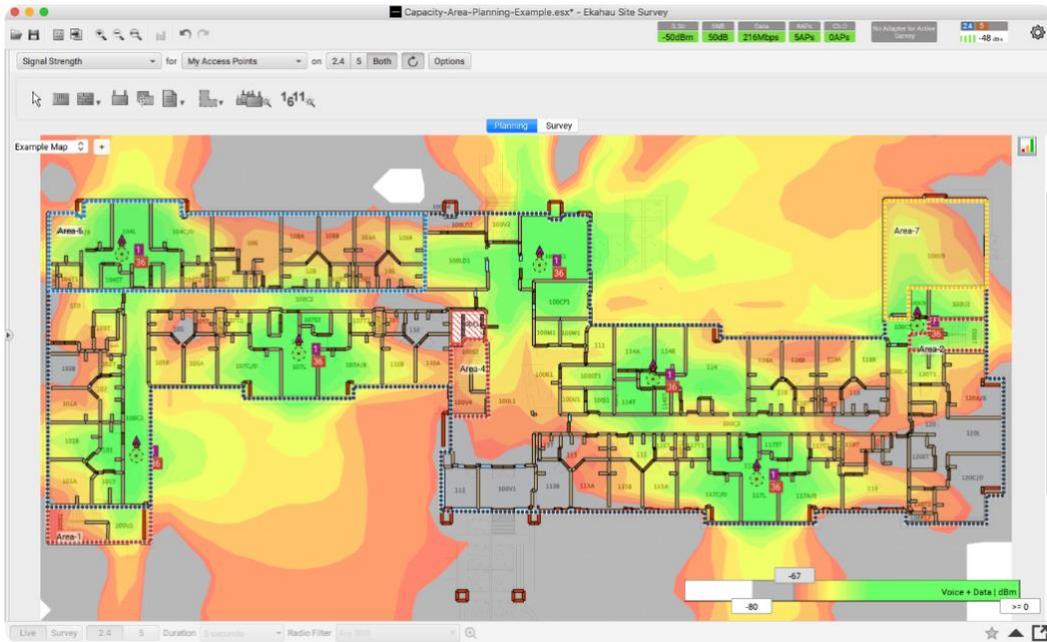
2 CATEGORY 6 UTP CABLE TESTING - TYPICAL
 N.T.S.











WI-FI COVERAGE HEATMAP – EXAMPLE (EKAHAU)

END OF DOCUMENT



DIVISION 27 00 00 – COMMUNICATIONS SYSTEMS

SPECIFICATIONS

FOR THE

CITY OF TORONTO

METRO HALL DAYCARE

55 JOHN STREET, TORONTO, ONTARIO

Prepared by:

The HIDI Group
155 Gordon Baker Road
Suite 200
Toronto, ON M2H 3N5

Telephone: 416-364-2100

Our Project No. 2021-0245

DISCIPLINES MECHANICAL
ELECTRICAL
PLUMBING
LIGHTING DESIGN
COMMUNICATIONS & AV
SECURITY & RISK
COMMISSIONING
ENERGY SERVICES

Issued for Tender

January 26, 2024

SECTION 27 05 00	COMMON WORK RESULTS FOR COMMUNICATIONS
SECTION 27 05 36	CABLE TRAYS FOR COMMUNICATIONS SYSTEMS
SECTION 27 05 53	IDENTIFICATION FOR COMMUNICATIONS SYSTEMS
SECTION 27 08 00	COMMUNICATIONS SYSTEM CX
SECTION 27 11 16	COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES
SECTION 27 11 19	COMMUNICATIONS TERMINATION BLOCKS & PATCH PANELS
SECTION 27 11 26	COMMUNICATIONS RACK-MOUNTED POWER PROTECTION & POWER STRIPS
SECTION 27 13 23	COMMUNICATIONS OPTICAL FIBRE BACKBONE CABLING
SECTION 27 15 13	COMMUNICATIONS COPPER HORIZONTAL CABLING
SECTION 27 15 33	COMMUNICATIONS COAXIAL HORIZONTAL CABLING
SECTION 27 15 43	COMMUNICATIONS FACEPLATES AND CONNECTORS
SECTION 27 16 19	COMMUNICATIONS PATCH CORDS, STATION CORDS, AND CROSS-CONNECT WIRE
APPENDIX A	CITY OF TORONTO – COMMERCIAL FACILITIES STRUCTURED CABLING SYSTEMS DESIGN GUIDE FOR CONSULTING ENGINEERS, ARCHITECTS, DESIGNERS & CONTRACTORS - REVISION 1.0, JANUARY 2023

PART 1: REQUIREMENTS

1.1 GENERAL CONTRACT DOCUMENTS

- .1 Comply with General Conditions of Contract, Supplementary Conditions and Division 01, 25, 26, 27, 28

1.2 SECTION INCLUDES

- .1 The purpose of this document is to provide a performance specification for a new Structured Cabling System for The City of Toronto.
- .2 This specification will outline the requirements for the scope areas, products, components, materials, and configuration of products.
- .3 This document details the system functional and performance requirements, and required submittals, testing/commissioning /certification procedures and installation procedures for all parts of the Structured Cabling System.
- .4 The Communications Cabling Contractor shall be a certified partner in good standings by the manufacturer of the Cabling solution being installed.
- .5 Refer to schedule for milestones and project completion date.

1.3 WORK INCLUDED

- .1 Work to be done under this section includes the furnishing of labour, materials, equipment, software, integration and services required for installation, testing and putting into proper operation complete systems as shown, as specified, as intended, and as otherwise required. Complete systems to be left configured to Owner's desired settings and ready for continuous and efficient satisfactory operation.
- .2 Coordinate with Owner, Consultant, Architect and other trades as necessary to ensure systems are provided with appropriate services, supports, finishes and integration.
- .3 Integrate, test and commission systems as specified.

1.4 DOCUMENT ORGANIZATION

- .1 The specification applies to the following:
 - .1 Division 27 – Communications and Audiovisual. See Separate 27 40 00 Specifications for Audiovisual.
 - .2 Division 28 - Electronic Safety and Security
- .2 Comply with the requirements of Division 26.
- .3 For clarity, any reference in the Contract Documents to Division 27 includes Division 28 unless otherwise indicated.
- .4 The Specifications for these Divisions are arranged in Sections for convenience. It is not intended to recognize, set or define limits to any subcontract or to restrict Contractor in letting subcontracts.
- .5 Contractor is responsible for completion of the Work whether or not portions are sublet.

1.5 DEFINITIONS

- .1 The words "indicated", "shown", "noted", "listed" or similar words or phrases used in these Specifications, mean that the material or item referred to is "indicated", "shown", "listed" or "noted" on the Drawings or in the Specifications.
- .2 The words "approved", "satisfactory", "as directed", "submit", "permitted", "inspected", or similar words or phrases used in these Specifications, mean that the material or item referred to, is to be "approved by", "satisfactory to", "as directed by", "submitted to", "permitted by", "inspected by" the Consultant.
- .3 Instructions using any form of the word "provide", requires the Contractor to furnish labour, materials and services as necessary to supply and install the referenced item.
- .4 The term "building code" means the current edition of the "Ontario Building Code".
- .5 The terms "electrical code" and "electrical safety code" mean the current edition of the "Ontario Electrical Safety Code".
- .6 The term "AHJ" means the "Authority Having Jurisdiction" and can include the local building inspector, the local fire department and the electrical safety inspector or their agents.
- .7 The definitions, acronyms, abbreviations and units of measure defined in TIA-568.1-D apply to these specifications.
- .8 The following acronyms are used:

Table 1 : Acronyms			
acronym	Definition	acronym	Definition
API	Application Program Interface	SDK	Software Development Kit
IP	Internet Protocol	RAID	Redundant Array of Independent Disks
GUI	Graphical User Interface	COTS	Commercial Off The Shelf
MTBF	Mean Time Between Failures	MTTR	Mean Time To Repair
MTBO	Mean Time Between Outages	RAM	Random Access Memory
TBC	Telecommunications Bonding Conductor	EMI	Electromagnetic Interference
BICSI	Building Industry Consulting Service International	EMT	Electrical Metallic Tubing or thin wall conduit
OEM	Original Equipment Manufacturer	STP	Shielded Twisted Pair
PA	Public Address System	PBB	Telecommunications Primary Bonding Busbar
PBX	Private Branch Exchange	UPS	Uninterruptible Power Supply
PoE	Power over Ethernet	UTP	Unshielded Twisted Pair
PSTN	Public Switched Telephone Network	LAN	Local Area Network
RF	Radio Frequency (refer to FR)	ISS	Integrated Security System
RU	Rack Unit (rack mounting unit)	AVIXA	Audiovideo and Integrated Experience Association (formerly Infocomm)

SME	Subject Matter Experts	SBB	Telecommunications Secondary Bonding Busbar
-----	------------------------	-----	---

- .9 For additional acronym definitions, refer to ANSI/TIA-569-D-2015: Telecommunications Pathways and Spaces Standards.
- .10 Conveniently Accessible: Capable of being reached without use of ladders, or without climbing or crawling under or over obstacles such as, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.
- .11 Head End (HE): Equipment, hardware and software, or a master facility at originating point in a communications system designed for centralized communications control, signal processing, and distribution that acts as a common point of connection between equipment and devices connected to a system's network of interconnected equipment, possessing greatest authority for allowing information to be exchanged, with which other equipment is subordinate

1.6 EXAMINATION

- .1 Examine any existing buildings and services, local conditions, building site, Specifications, and Drawings and report any condition, defect or interference that would prevent execution of the Work.
- .2 Examine work of other Divisions before commencing the Work, and report any defect or interference.
- .3 No allowance will be made for any expense incurred through failure to make these examinations of the site and documents prior to Tender or on account of any conditions on site or any growth or item existing there which was visible or known to exist at time of Tender

1.7 QUALITY CONTROL

- .1 Manufacturer qualifications:
 - .1 Produce, as a principal product, the equipment and material specified for this project, and have manufactured item for at least three years.
 - .2 Three installations of equipment presently in operation of similar size and type as this project, and that have continuously operated for a minimum of three years;
 - .1 Owner reserves the right to require a list of installations where products have been in operation before approval.
 - .3 Regularly engaged in the manufacture and supply of the system type proposed for this project;
 - .1 Authorized representative of OEM must be responsible for design, satisfactory operation of installed system, and certification.
- .2 Division 27 Contractor qualifications:
 - .1 The City of Toronto's Vendor of Record (Bell Canada) shall be used for all voice and data cabling infrastructure outlined in these specifications:
Roger Vachon – Project Manager BCE
E: roger.vachon@bell.ca
- .3 System supplier qualifications:
 - .1 Authorized by OEM to warranty installed equipment.

- .4 Installer qualifications:
 - .1 Trained, and certified by OEM on installation and testing of system;
 - .1 Provide written evidence of current OEM certifications for installers.
- .5 Manufactured products:
 - .1 Of a single manufacturer when more than one unit of same class of equipment is required.
 - .2 Product shall be manufactured by an ISO 9001 Certified facility.
 - .3 Product shall be free from defects in material or workmanship.
 - .4 Critical manufacturing processes of the product shall have documented in-process inspections and production testing according to ISO 9001.
 - .5 Equipment assemblies and components:
 - .1 Warranty need not be products of same manufacturer.
 - .2 Provide manufacturer's latest version of equipment and upgrade software to latest versions prior to handing over to the Owner.
- .6 Provide manufacturer's warranty on materials, equipment, installation, programming, performance, or workmanship for a period of one year (unless otherwise specified) from date of final acceptance of system by Owner.
- .7 Warranty will be for a period of 20 years, minimum, and will be issued in the name of the Owner, by the OEM Manufacturer. A Contractor Warranty will not be acceptable.
- .8 Include maintenance releases for embedded firmware and operating system and application software during the warranty period.
- .9 Provide OEM contact information to Owner for the purpose of emergency maintenance and logistic assistance, remote diagnostic testing, and assistance in resolving technical problems at any time.
- .10 Repair or replace equipment and/or materials found to be defective during the warranty period.
- .11 Provide approved temporary replacement equipment and materials during repair or replacement such that the system remains fully functional as designed and commissioned.
- .12 Transfer warranties to the Owner upon completion.
- .13 Refer to individual specifications for additional warranty requirements.
- .14 For phased projects, provide additional warranty coverage for operational systems from first substantial use by Owner until completion of project.

PART 2: SUBMITTALS

2.1 PROJECT SCHEDULING

- .1 See overall (GC) project schedule and plan activities in coordination with overall schedule. In addition, coordinate with Prime Consultant, GC, and other Divisions.
- .2 Prepare and submit project schedules for review by Owner's representative.

- .3 Schedules required:
 - .1 Permits
 - .2 Scope of work, including: Project kickoff, weekly and monthly milestones, testing, commissioning, deficiency correction, acceptance, completion
 - .3 Required submittals and review periods
 - .4 Invoicing in accordance with milestones
- .4 Schedule:
 - .1 Dates
 - .2 Scope areas
 - .3 Dependencies
 - .4 Maintain schedules and present impacts and contingencies weekly at construction meetings. Report any changes to Owner's Representative in writing weekly.

2.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings, manufacturers' product data and samples in accordance with Section 01 33 05;
 - .1 Submit for each item of equipment.
 - .2 Submit shop drawings in the same unit of measure as used on the drawings. Both metric and imperial measures may be included.
 - .3 Submit shop drawings by email to Consultant for review
- .2 Include a shop drawing cover sheet form prepared for this project, for each shop drawing, or include the same information on the contractor's submittal cover sheet:
 - .1 Client/Architect name
 - .2 Project Name
 - .3 Project number
 - .4 Date
 - .5 Contractor name
 - .6 Contractor reference No.
 - .7 Manufacturer's name
 - .8 Product type
 - .9 Specifics of product application: area, schedule, function, purpose
 - .10 Specification section number
 - .11 Contractor trade: Electrical, Communications, Security, Audiovisual or general trades

- .12 If a re-submission, the reference number from the previous submission.
- .3 Submit shop drawings in PDF format;
- .4 Manufacturers' printed product data sheets for standard items are acceptable in place of shop drawings provided that physical characteristics are identified and are related to specification references.
- .5 Submit manufacturers' data sheets with typed schedules listing manufacturers' and suppliers' name and catalogue model numbers for such items as components, etc.
- .6 For sub-systems, submit bound sets of sub-system cut sheets with manufacturers' names and catalogue numbers for devices to be used on the project. Identify and arrange the system cut sheets and catalogue numbers in the same sequence as the Specification List.
- .7 Shop drawings and product data to show;
 - .1 CSA,CUL or equivalent approval,
 - .2 Dimensioned outlines of equipment,
 - .3 Dimensioned details showing service connection points.
- .8 Indicate details of construction, dimensions, capacities, weights and functional performance characteristics of equipment or material.
- .9 Where applicable, include;
 - .1 Copies of Contractor, Sub-contractor, vendor, manufacturer, integrator, and installers certifications and qualifications. Include date of issue, individual's legal name, contact information and OEM credentials and contact information in certification.
 - .2 Description of system operation, maintenance and test procedures
 - .3 Equipment catalog sheets with the pertinent specified parameters highlighted,
 - .4 Component assemblies,
 - .5 Fastening and mounting arrangements for devices,
- .10 Each shop drawing to be checked and stamped as being correct, by trade purchasing item, before drawing is submitted. If above requirements are not complied with, shop drawings will be rejected and returned forthwith.

2.3 DRAWINGS

- .1 Include wiring diagrams and installation details of hardware and cables indicating proposed locations, cable dress, conduit, sleeve assignments, layout and arrangements, and other items that must be shown to ensure a coordinated and compliant installation.
- .2 Revise to 'As-Built' at the completion of the project and submit.

2.4 CLOSEOUT

- .1 Submit prior to project closeout date;
 - .1 Manufacturer's warranty certificate.

- .2 Vendor system certifications
- .3 Test results
- .4 As Built drawings
 - .1 As built, and including changes. Submit CAD files. Keep a live set of cable, equipment, and device schedules on site throughout construction.

PART 3: APPLICABLE CODES AND STANDARDS

3.1 GENERAL

- .1 Conform to the requirements of codes and standards referenced herein.
- .2 Comply with the owner's City of Toronto Cabling Standard V4.4 issued with and appended to these specifications.
- .3 Workmanship and materials shall be in full conformance with applicable building, electrical, and other codes, as determined by the authority having jurisdiction (AHJ).
- .4 Unless documents include more stringent requirements, applicable construction industry standards have same force and effect as if bound or copied directly into the documents to extent referenced. Such standards are made a part of these documents by reference.
- .5 Legislation:
 - .1 CSA C22.1 Ontario Electrical Safety Code
- .6 Codes and standards:
 - .1 CSA C22.2 No. 214 Communications Cables
 - .2 CSA 22.2 No. 232 Fibre Optic Cables
 - .3 AC193 Mechanical Anchors in Concrete Elements
 - .4 NEMA VE2 Cable Tray Installation Guidelines
 - .5 NEMA 250 Enclosures for Electrical Equipment (1,000V Maximum)
 - .6 EIA/ECA 310 Cabinets, and Associated Equipment
 - .7 IEEE1100-2005 IEEE Recommended Practice for Powering and Grounding Electronic Equipment
 - .8 ISO/IEC 14763-1:1999 Implementation and Operation of Customer Premises Cabling – Part 1: Administration
 - .9 ANSI/TIA-606-D Administration Standard for Telecommunications Infrastructure.
 - .10 ANSI/TIA-607-D Generic Telecommunications Bonding And Grounding (Earthing) For Customer Premises
 - .11 EN 50310 Telecommunications Bonding Networks for Buildings and other Structures
 - .12 TIA/EIA TSB 67 Transmission Performance Specification for Field Testing of Unshielded Twisted-Pair Cabling Systems

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- .13 TIA/EIA TSB 75 Additional Horizontal Cabling Practices for Open Offices
 - .14 TIA-TSB-184-A Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling
 - .15 TIA-604-10-C FOCIS 10 Fiber Optic Connector Intermateability Standard- Type LC
 - .16 ANSI/TIA/EIA-862-A Building Automation Systems Cabling Standard for Commercial Buildings.
 - .17 ANSI/TIA-568.0-E Generic Telecommunications Cabling for Customer Premises
 - .18 ANSI/TIA-568.1-E Commercial Building Telecommunications Cabling Standard
 - .19 ANSI/TIA-568.2-D Balanced Twisted-Pair Cabling Components
 - .20 ANSI/BICSI N2-17 PoE Installation
 - .21 IEEE 802.3an 10GBASE-T (10 Gb/s Ethernet operations over balanced twisted-pair cabling)
 - .22 TIA-569-E Telecommunications Pathways and Spaces
 - .23 ANSI/TIA-942-A Telecommunications Infrastructure Standard for Data Centers
 - .24 ANSI/BICSI 008-2018 Wireless Local Area Network (WLAN)
 - .25 ANSI/BICSI 001-2017 Educational Facilities Design
 - .26 ANSI/BICSI 002-2014 Data Center Design
 - .27 ANSI/BICSI 003-2014 Building Information Modeling (BIM)
 - .28 ANSI/BICSI 005-2016 Electronic Safety and Security (ESS)
 - .29 ANSI/BICSI 006-2015 Distributed Antenna Systems (DAS)
 - .30 ANSI/BICSI 007-2017 Intelligent Buildings and Premises
 - .31 BICSI G1-17 Outside Plant (OSP) – General
 - .32 BICSI Outside Plant Design Reference Manual (OSPDRM) – Latest Edition
 - .33 ANSI/TIA-758-B Customer-owned Outside Plant Telecommunications Infrastructure Standard
 - .34 BICSI Information Transport Systems Installation Manual (ITSIM) – Latest Edition
 - .35 BICSI Telecommunications Distribution Methods Manual (TDMM) – Latest Edition
 - .36 BICSI Electronic Safety and Security Design Reference Manual
 - .37 ANSI Z136.2 American Standards For the Safe Operation of Fibre Optic Communications Systems Utilizing Laser Diode and LED Sources
 - .38 TIA/EIA TSB72 Centralized Optical Fibre Cabling
 - .39 ANSI/ICEA S-83-596 Fibre Optic Indoor Fibre Cable

- .40 ANSI/ICEA S-87-640 Fibre Optic Outside Plant Communications Cable
- .41 ANSI/ICEA S-104-696 Fibre Optic Indoor/Outdoor Communications Cable
- .42 TIA/EIA/ANSI 598 Colour Coding of Fibre Optic Cables
- .43 TIA 598-D Optical Fibre Cable Colour Coding
- .44 TIA/EIA/ANSI 604-3 Fibre Optic Connector Intermateability Standard (FOCIS 3)
- .45 TIA TSB-140 Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fibre Cabling Systems.
- .46 TIA-455-C General Requirements for Standard Test Procedures for Optical Fibres, Cables, Transducers, Sensors, Connecting and Terminating Devices, and other Fibre Optic Components
- .47 TIA-455-61-A Measurement of Fibre Cable Attenuation Using an OTDR
- .48 TIA-526-7-A Measurement of Optical Power Loss of Installed Single-Mode Fibre Cable Plant
- .49 TIA TSB-162-B Telecommunications Cabling Guidelines for Wireless Access Points
- .50 TIA-1152-A Requirements for field test instruments and measurements for balanced twisted-pair cabling
- .51 TIA-222-H Structural Standard for Antenna Supporting Structures and Antennas
- .52 ISO 11064, Part 1 - 7 Ergonomic Design of Control Centres
- .7 Where requirements of this specification exceed those of the above mentioned standards, this specification to govern.
- .8 In the event of a conflict between codes, regulations, or standards, or where work shown is in conflict with these documents, obtain interpretation before proceeding. Failure to clarify any ambiguity will result in an interpretation requiring the application of the most demanding requirements.

PART 4: EQUIPMENT

4.1 STORAGE

- .1 Store equipment according to manufacturer's instructions and protected from dust, water and other potential contaminants.
- .2 Do not install active equipment until final cleaning is complete.

4.2 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements:
 - .1 Obtain consultant's approval of submittals for equipment and material before delivery to job site.
 - .2 Deliver, receive, and store materials to job site in OEM's original unopened containers, clearly labeled with OEM's name and equipment catalog numbers, model and serial identification numbers.
- .2 Storage and Handling Requirements:

- .1 Protect equipment and materials during shipment and storage against physical damage, dirt, moisture, cold and precipitation:
- .2 Store and protect equipment in a manner that prevents damage or loss, including theft.
- .3 Protect painted surfaces with factory installed removable heavy kraft paper, sheet vinyl or equivalent.
- .4 Protect enclosures, equipment, controls, controllers, circuit protective devices, and other like items, against entry of foreign matter during installation; vacuum clean both inside and outside before testing and operating.

4.3 PRE-PURCHASED EQUIPMENT, DAMAGE AND OWNERSHIP

- .1 At time of receipt of pre-purchased or pre-tendered equipment at job site by the installing communications contractor, the manufacturer/distributor/supplier's technical representative to be present to inspect the equipment prior to unloading and report any damage to the Consultant. The technical representative to also witness the unloading and advise the Contractor on the appropriate method for handling the equipment in order to avoid damage during unloading, moving, storing and setting in place.
- .2 OTDR testing reports per reel for fibre optics cables to be available to the Contractor and Consultant.
- .3 In the event that the equipment or cabling is found to be damaged before unloading it is to be returned immediately to the factory for repairs and/or replacement by the manufacturer/supplier.
- .4 In the event of damage occurring at any time during unloading and until the equipment is accepted by the Owner, the Contractor is responsible for repairs and/or replacement to the satisfaction of the Owner.

4.4 OWNER-SUPPLIED EQUIPMENT

- .1 In cases where Owner has supplied equipment for installation, test that supplied equipment is in working order upon receipt and notify the owner within seven (7) days if any equipment is not functioning properly. Replacements following this period to be at Contractor's expense.

PART 5: OFFICE, STORAGE & TOOLS

5.1 OFFICE AND STORAGE

- .1 Provide temporary office and lunchroom facilities, workshop, tools and material storage space. Facilities may be site trailers or as otherwise approved by the General Contractor/Construction Manager.
- .2 Assume responsibility for these facilities.
- .3 Provide power, heat, light, telephone, and internet services.
- .4 Owner's cafeteria is off limits.

5.2 APPLIANCES AND TOOLS

- .1 Provide tools, equipment, scaffolding, extension cords, lamps and miscellaneous consumable materials, as required to carry out the Work.

PART 6: COORDINATION

6.1 GENERAL

- .1 Consultant's drawings are diagrammatic and illustrate the general location of equipment, and intended

routing of conduits, cable trays, cables, etc. and do not show every structural detail. In congested areas drawings at greater scale may be provided to improve interpretation of the Work. Where equipment or systems are shown as "double line", they are done so either to improve understanding of the Work, or simply as a result of the use of a CAD drawing tool, and in either case such drawings are not represented as fabrication or installation drawings.

- .2 Lay out and coordinate the Work to avoid conflict with work under other Divisions.
- .3 Make good damage to Owner's property or to other trade's work caused by inaccurate layout or careless performance of the Work.
- .4 Where equipment provided under other Divisions connects with material or equipment supplied under this Division, confirm capacity and ratings of equipment being provided.
- .5 Take information involving accurate measurements from dimensioned Architectural Drawings or at the building.
- .6 Install services and equipment which are to be concealed, close to the building structure so that furring is kept to minimum dimensions.
- .7 Location of conduit, raceways and equipment may be altered without extra cost provided instruction is given or approval is obtained, in advance of installation of items involved. Changes will be authorized by site instructions and are to be shown on Record Drawings.
- .8 Include incidental material and equipment not specifically noted on Drawings or mentioned in Specifications but which is needed to complete the Work as an operating installation.

PART 7: EXECUTION

7.1 PREPARATION

- .1 Verify condition of systems and related sub-systems previously installed under other Sections or Contracts are acceptable for installation and integration in accordance with these Contract Documents and in accordance with manufacturer's written instructions.
 - .1 Visually inspect spaces in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery
 - .3 Visually inspect components and related sub-systems in presence of Consultant.
 - .4 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .5 Assess System and intersystem coordination
 - .6 Make modifications to work plan as necessary
- .2 Verification of existing conditions
 - .1 Verify location, use and status of material and equipment specified, indicated, or determined necessary for removal.
 - .1 Verify materials, equipment, and utilities to be removed are inactive, and not required or intended for use after completion of project.
 - .2 Replace with equivalent any material, equipment and utility removed by contractor that was required to be left in place.

- .2 Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner unless permitted under the following conditions and then only after arranging to provide temporary utility services, according to requirements indicated:
 - .1 Notify Owner in writing at least 14 days in advance of proposed utility interruptions.
 - .2 Do not proceed with utility interruptions without Owner's written permission.
- .3 Provide pull strings where empty conduit is installed.
- .4 Ensure continuity of existing services while completing the specified installation.
- .5 Arrange for any outages or interruptions in service one (1) week prior in writing with the Owner and notify affected stakeholders. Coordinate with Owner for any additional resources required during interruption in service.
- .6 Should services be interrupted accidentally, provide material and labour to re-establish services immediately and continue without stoppage until services have been re-established.
- .7 Cutting and Patching
 - .1 Perform cutting and patching according to contract general requirements and as follows:
 - .1 Remove and replace defective work.
 - .2 Remove and replace non-conforming work
 - .2 Cut, remove, and legally dispose of selected equipment, components, and materials, including removal of material, equipment, devices, and other items indicated to be removed and items made obsolete by new work.
 - .3 Provide and maintain temporary partitions or dust barriers adequate to prevent spread of dust and dirt to adjacent areas.
 - .4 Protect adjacent installations during work activities
 - .5 Protect structure, furnishings, finishes, and adjacent materials not to be removed
 - .6 Restoration of components using new materials specified for original installation and qualified subcontractors

7.2 INSTALLATION

- .1 Protect facility, equipment, and wiring from damage.
- .2 Install and configure systems in accordance with the manufacturer's instructions
- .3 Install wiring and cabling between equipment and related devices.
 - .1 Do not connect cabling to Owner's Ethernet switches. Owner's IT personnel only may authorize connection to Ethernet switches
- .4 Coordinate systems, equipment, and materials installation with other building components.
- .5 Install systems, materials, and equipment to conform to approved submittal data, including coordination drawings.

- .6 Conform to Contract Document arrangements indicated, recognizing that work may be shown in diagrammatic form or have been impracticable to detail items because of variances in manufacturers' methods of achieving specified results.
- .7 Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, whether installed in exposed or un-exposed spaces.
- .8 Install cabling, wiring, and equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum interference of adjacent other installations.
- .9 Provide access panel or doors where units are concealed behind finished surfaces.
- .10 Coordinate for risers, slots, and openings in other building components during construction, to allow for wiring, cabling, and equipment installations.
- .11 Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment in accordance with Prime Consultant's interior design sections and elevations
- .12 Avoid interference with structure and with work of other trades, preserving adequate headroom and clearance from obstructions, doors, and passageways to satisfaction of Owner and code requirements.
- .13 Install equipment and cabling to distribute equipment loads on building structural members provided; install and support suspensions evenly at 3-meter intervals and without concentrating loads
- .14 Provide supplementary or miscellaneous items, appurtenances, devices and materials for a complete installation
- .15 Install equipment in conveniently accessible locations for operation and maintenance. Remove and reinstall inaccessible equipment as directed and without extra cost.
- .16 Replace ceiling tiles as required to restore ceiling to uniformity and original condition
- .17 Restore walls, T-bar, paint, concrete surfaces, junction box covers as necessary to recreate original conditions
- .18 Replace missing junction or outlet box covers, firestopping material, bushings, screws, fasteners as necessary to provide systems as specified.
- .19 Restore weatherproofing to match existing where conduit or sleeve passes through building envelope to exterior. Reinstate weatherproof seal.
- .20 Locate equipment as close as practical to locations shown on drawings.
- .21 Note locations of equipment on record drawings.
- .22 Verify site conditions and dimensions of equipment to ensure access for proper installation of equipment including equipment cabinets, without disassembly.

7.3 WIRING METHODS

- .1 Install cables in conduits or in cable tray as indicated; conceal cable and conduits.
- .2 Provide physical protection for installed cables.
- .3 J-hooks may be used under floor, or where cable tray is not provided

- .4 Horizontal cabling shall be supported by J-hooks every 4-feet once it leaves the cable tray.
- .5 Category cables for use in security systems such as CCTV shall be pulled through designated home-run conduit (by div. 26) from work area outlet to security cabinet in Hub room .
- .6 Install wiring to conform to the requirements of the Canadian Electrical Code, Part 1 and applicable Provincial Codes. Size wiring in accordance with Class 2 requirements; protect wiring against mechanical injury or other injurious conditions such as moisture, excessive heat or corrosive action in accordance with Class 1 requirements.
- .7 Use wire with copper conductors.
- .8 Copper termination hardware installation
 - .1 Cables shall be dressed and terminated in accordance with standards-based recommendations, the manufacturer's recommendations/installation guides, and industry best practices.
 - .2 Guide, position and secure twisted pairs at the connector termination point using a termination device that locks the pairs in place to prevent untwisting of pairs into the cable when terminating the conductors.
 - .3 The termination device holding the wires in place at the rear of the connector to withstand a tensile force of 15 lbs minimum applied to the cable without impacting the cable/connector continuity
 - .4 The connector termination method to involve no pair separation making bonded-pair cable quick and easy to terminate
 - .5 Install cables neatly bundled, dressed, and routed to their respective termination connectors. Each patch panel to terminate a cable bundle separated and dressed back to the point of cable entrance into the equipment cabinet or rack.
 - .6 Clearly label each cable on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support element(s). Labels obscured from view are not acceptable.

7.4 PROJECT MANAGEMENT

- .1 Obtain Safety, Environmental Report, Security, Parking, and credentialing information from Owner for conditions surrounding safety and access works on Owner's site.
- .2 Assign a project manager to serve as point of contact for Owner, contractor, and Consultant. This project manager is responsible for coordinating any work related to other divisions.
- .3 Be proactive in scheduling work.
 - .1 Use of premises is restricted to times directed by Owner.
 - .2 Movement of materials: Unload materials and equipment delivered to site. Pay costs for rigging, hoisting, lowering and moving equipment on and around site, in building or on roof.
 - .3 Coordinate installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
 - .4 Sequence, coordinate, and integrate installations of materials and equipment for efficient flow of Work. Plan for large equipment requiring positioning prior to closing in building.

- .5 Coordinate connection of materials, equipment, and systems with exterior underground and overhead utilities and services. Comply with requirements of Owner, Governance, carriers, service providers, and legislation; provide required connection for each service.
- .6 Initiate and maintain discussion regarding schedule for ceiling construction and install cables to meet that schedule.

.4 Communications Project Manager Responsibilities:

- .1 Assume responsibility for overall telecommunications system integration and coordination of work among trades, subcontractors, and authorized system installers.
- .2 Coordinate with related work indicated or specified.
- .3 Manage work related to telecommunications system installation in a manner approved by manufacturer.

7.5 WORK IN EXISTING FACILITIES

- .1 Minimize disruption in active renovation areas and comply with Owner requirements. Coordinate with the Owner to create an efficient phasing plan so as to not disrupt a single area for an extended period of time.
- .2 Owner will have the final option for allowing the work to continue at the beginning of the day's work, if expected use is deemed critical for any specific day, Owner's staff can ask the contractor to work in another area until the expected peak usage diminishes
- .3 Develop a work plan for any renovations to be done in existing areas, whether operational or not, and submit work plan to the Owner for approval at least four (4) weeks prior to commencement of work. Revise the work plan as requested by the Owner to receive approval. Do not start work until the work plan has been approved. Include the following as a minimum:
 - .1 Phasing of work, itemize systems to be worked on or added and expected completion dates and times
 - .2 Room layout before and after to ensure proper clearances are being met.
 - .3 Rack elevations showing existing, interim and final placement of equipment.
 - .4 Areas affected by the work.
 - .5 Contractors responsible for the work.
 - .6 Any Owner staff or resources required.
 - .7 Hazardous materials or Designated Substances Engineering Controls or other protective measures required; hoarding and signage requirements
 - .8 Shut downs or interruptions in service, including anticipated and worst case timeframes, rollback procedures and systems affected.

7.6 CLEANING

- .1 Perform final cleaning in accordance with Division 01 documentation
- .2 Remove debris, rubbish, waste material, tools, construction equipment, machinery and surplus materials from project site and clean work area prior to final inspection and acceptance of work.

- .3 Place or restore building and premises into neat, clean condition.
- .4 Clean equipment and devices installed as part of this project.
- .5 Perform final cleaning after construction activities that create dust have been completed and prior to project acceptance by Owner's Representative.
- .6 Remove paint splatters and other spots, dirt, and debris; touch up any scratches to match original finish.
- .7 Clean devices internally using methods and materials recommended by manufacturer.
- .8 Perform final cleaning of telecommunications spaces:
 - .1 Thoroughly vacuum and clean interiors of panels, cabinets, racks and other equipment of construction debris and dust prior to installation of active equipment, using a HEPA vacuum cleaner. Final clean using clean lint free cloths with a cleaning liquid as recommended by the manufacturer for the purpose.
 - .2 HEPA vacuum the top, bottom and inside of cabinets, racks, cable trays, PDUs, IDC blocks and conduits, fire suppression equipment and mechanical duct work in the room, followed by a thorough HEPA vacuuming of the floors. Thoroughly wash floors with wet mop and clean water. Control access to the room after cleaning. Provide temporary filter media on air supply ducts to these rooms to prevent re-contamination from other areas of construction.

7.7 MILESTONE REVIEWS

- .1 Specific milestone reviews may be conducted at key stages by the Consultant, including;
 - .1 before backfilling of buried services,
 - .2 before closing of shafts,
 - .3 before closing of walls,
 - .4 before closing of ceilings,
 - .5 equipment demonstration,
 - .6 Substantial Performance deficiency review,
 - .7 Total Performance deficiency review.
- .2 Coordinate with the Consultant the type and quantity of milestone reviews required and incorporate these requirements into the construction schedule.
- .3 Prior to Work being concealed, notify the Consultant in writing seven (7) calendar days in advance of the planned concealment to arrange a site review, where required by the Consultant. Correct noted deficiencies before concealing the Work. Failure to provide notification can result in the Work being exposed for review at the Contractor's cost.

PART 8: TESTING & COMMISSIONING - See Division 27 08 00 for details

***** END OF SECTION *****

Project Name: METRO HALL DAYCARE
Project No.: 2021-0245
Section Name: **Table of Contents**
Section No.: **Division 27**
Date: January 26, 2024

Section 27 05 28 Pathways for Communications Systems

Project Name: METRO HALL DAYCARE
Project No.: 2021-0245
Section Name: **Pathways for Communications Systems**
Section No.: **27 05 28**
Date: January 26, 2024

1 **GENERAL**

1.1 SYSTEM DESCRIPTION

- 1.1.1 Refer to the Base Building Vendors List for Metro Hall in Part 3 of the City of Toronto's General Specifications.
- 1.1.2 Provide a complete telephone and data raceway system consisting of outlet boxes, cover plates, cabling, cabinets, conduits, cabletroughs, pull boxes, sleeves and caps, backboards, fish wires, service poles, and service fittings, required to make a complete and operative system.
- 1.1.3 The system shall be provided to the requirements of the local telephone company, interconnect company and all other authorities having jurisdiction.
- 1.1.4 Install the empty raceway system, including pullstrings, terminal cabinets, outlet boxes, pull boxes, conduit, sleeves and caps, cabletroughs, miscellaneous and positioning material to constitute a complete system. Coordinate with other services.
- 1.1.5 Supply all labour, materials, tools and equipment required to complete the installation in accordance with the full intent of the drawings and specifications.
- 1.1.6 Provide all work in accordance with codes and manufacturers recommendations
- 1.1.7 All pathways including conduits, innerduct and cable tray should be installed parallel or perpendicular to building lines.

2 **PRODUCTS**

2.1 MATERIAL

- 2.1.1 Conduits: In accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- 2.1.2 Junction boxes and cabinets: In accordance with Section 26 05 33.16 – Boxes for Electrical Systems..
- 2.1.3 Outlet boxes, conduit boxes and fittings: In accordance with Section 26 05 32 – Outlet Boxes, Conduit Boxes & Fittings.
- 2.1.4 Cover Plates: In accordance with Section 26 27 26 – Wiring

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Devices

2.1.5 Fish wire: polypropylene type, minimum 3/8" (9 mm) dia.

3 **EXECUTION**

3.1 INSTALLATION

3.1.1 Install empty raceway system, including overhead 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.

END OF SECTION

PART 1: GENERAL

1.1 SUMMARY

.1 Section Includes:

- .1 Commercial building cable trays for Communications.

1.2 REFERENCES:

- .1 ANSI/NFPA 70 – National Electrical Code (NEC)
- .2 Canadian Electrical Code (CEC)
- .3 ANSI/TIA-569C - Telecommunications Pathways & Spaces
- .4 ASTM A 510 - Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
- .5 ASTM A 380 – Specification for Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
- .6 ASTM B 633 – Specification for Electrodeposited Coatings of Zinc on Iron and Steel
- .7 ASTM A 123 – Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- .8 ASTM A 653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality
- .9 IEC 61537 (2001) – Cable Tray Systems and Cable Ladder Systems for Cable Management
- .10 NEMA VE 1-2002/CSA C22.2 No. 126.1-02 – Metal Cable Tray Systems

1.3 RELATED SECTIONS:

- .1 Section 01 00 00 – General Requirements
- .2 Section 27 05 26 – Grounding and Bonding for Communications Systems
- .3 Section 27 05 39 – Surface Raceway for Communications Systems
- .4 Section 27 05 53 – Identification for Communication Systems
- .5 Section 27 06 28 – Pathways for Communication Systems
- .6 Section 27 08 00 – Commissioning for Communications Systems
- .7 Section 27 11 16 – Communications Cabinets, Racks, Frames and Enclosures
- .8 Section 27 11 19 – Communications Termination Blocks and Patch Panels
- .9 Section 27 11 26 – Communications Rack Mounted Power Protections and Power Strips
- .10 Section 27 13 23 – Communications Fiber Backbone Cabling
- .11 Section 27 15 13 – Communications Copper Horizontal Cabling

.12 Section 27 15 43 – Communications Faceplates and Connectors

1.4 DEFINITIONS

- .1 Cable Raceway – Solid bottom rigid steel or aluminum raceway, with available solid lid. Comes in various sizes. Sometimes called “trunking”. This specification covers ONLY Wire-Mesh cable tray for Communications and does not cover solid bottom raceway.
- .2 Cable Tray – wire mesh basket tray, made of steel wire, welded and electro-tin coated and/or hot dip painted
- .3 Cable trays are defined to include straight sections, supports and accessories

1.5 OWNER FURNISHED

- .1 None. All equipment and installation noted in this specification is new.

1.6 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00, Submittal Procedures.
- .2 Action Submittals:
- .3 Shop Drawings for communications equipment room or floor area cable trays. Include plans, elevations, sections, details, and attachments to other work.
- .4 Submit shop drawings indicating materials, finish, dimensions, accessories, layout, supports, splices, and installation details..
- .5 Design Calculations: Verify loading capacities for supports.
- .6 Field verification of all dimensions, routing, etc., is directed.
- .7 Factory-certified test reports of specified products, complying with IEC 61537, NEC, and NEMA VE 1/CSA C22.2 No. 126.1.
- .8 Submit manufacturer’s certification indicating ISO 9001 quality certified.
- .9 Submit training procedure for certifying cable tray installers

1.7 QUALITY ASSURANCE

- .1 Source Limitations: Obtain cable tray components through one source from a single manufacturer.
- .2 Approval and Labeling: Provide cable trays and accessories specified in this Section that are approved and labeled.
- .3 The Terms “Classified” pertaining to cable trays (rather than “Listed”) and “Labeled”:
- .4 “Nationally Recognized Testing Laboratory” such as UL, CUL and ETL.
- .5 Comply with NEMA VE 1/CSA C22.2 No. 126.1, Metal Cable Tray Systems, for materials, sizes, and configurations; provide cCSAus Certificate and labels.

1.8 COORDINATION

- .1 Coordinate layout and installation of cable tray with other trades.

- .2 Revise locations and elevations from those indicated as required to suit field conditions and as approved by the Architect.
- .3 Storage and Handling: Avoid breakage, denting and scoring finishes. Damaged products will not be installed. Store cable trays and accessories in original cartons and in clean dry space; protect from weather and construction traffic. Wet materials will be unpacked and dried before storage

1.9 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, wood, corrugated cardboard packaging material in appropriate on site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal, wiring and plastic materials from landfill to metal/plastics recycling facility as approved by Departmental Representative.
- .5 Fold up metal banding, flatten and place in designated area for recycling.
- .6 Dispose of unused paint material of at official hazardous material collections site approved by Departmental Representative.
- .7 Do not dispose of unused paint material into the sewer system, into streams, lakes, onto ground or in any other location where it will pose health or environmental hazard.

PART 2: PRODUCTS

2.1 MANUFACTURED COMPONENTS

- .1 Approved Manufacturers
- .2 Legrand Cablofil
- .3 Copper B-Line Flextray
- .4 nVent WBT
- .5 Chatsworth Products Inc. (Pemsa Rejiband)

2.2 MATERIALS AND FINISHES:

- .1 Cable Tray Materials:
- .2 Carbon steel wire, ASTM A 510, Grade 1008. Wire welded, bent, and surface treated after manufacture.
- .3 Cable Tray Finishes:
- .4 Finish for Carbon Steel Wire after welding and bending of mesh;
- .5 Electrodeposited Zinc Plating: ASTM B 633, Type III, SC-1.
- .6 Cable tray will consist of continuous, rigid, welded steel wire mesh cable management system, to allow continuous ventilation of cables and maximum dissipation of heat, with UL Classified splices where tray (including UL Classified painted tray) acts as Equipment Grounding Conductor (EGC).

- .7 Provide splices, supports, and other fittings necessary for a complete, continuously grounded system.
- .8 Mesh: 4 x 12 inches (100 x 300 mm)
- .9 Straight Section Lengths: 118 inches (3,000 mm).
- .10 Wire Diameter: minimum 5mm.
- .11 Fittings: Wire mesh cable tray fittings are field-fabricated from straight tray sections, in accordance with manufacturer's instructions.
- .12 Cable Tray Supports & Accessories
- .13 Fittings/Supports: Wire mesh cable tray fittings are field-fabricated from straight tray sections, in accordance with manufacturer's instructions. Place supports so that support span does not exceed 5 ft.
- .14 System support methods to mount from ceiling and wall structures with 1/4", 3/8" or 1/2" threaded rod, if applicable
- .15 Splices, including those approved for electrical continuity (bonding), as recommended by cable tray manufacturer.
- .16 Grounding and bonding – Follow ANSI/TIA 607D, ensuring bonding continuity of wire mesh tray sections to earthing system. Bond to PBB/SBB with a minimum #6 AWG Grounding Bonding conductor.

PART 3: EXECUTION

3.1 EXAMINATION

- .1 Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of cable trays. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION.

- .1 Install cable tray level and plumb according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.
- .2 Cutting: Field-fabricate changes in direction & elevation by cutting & bending cable tray.
- .3 Cut cable tray wires in accordance with manufacturer's instructions.
- .4 Cable tray wires must be cut with side-action bolt cutters with offset head to ensure integrity of protective galvanic layer.
- .5 Remove burrs and sharp edges from cable trays.

3.3 IDENTIFICATION AND ADMINISTRATION

- .1 Provide labeling according to the requirements of:
- .2 ANSI/TIA/EIA-606D.

END OF SECTION

PART 1: GENERAL

1.1 SUMMARY

- .1 Identification for Communications Systems
- .2 The Contractor shall supply a labelling standard based on the City of Toronto – Commercial Facilities Structured Cabling Systems Design Guide for Consulting Engineers, Architects, Designers & Contractors - Revision 1.0, January 2023 which have been referenced below. The contractor shall confirm final labelling requirements with City of Toronto IT prior to deployment. All labelling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labelling scheme.

1.2 SUBMITTALS

.1 Product Data

- .1 Labelling software shall be easily useable and run on Microsoft Windows® operating systems. Labelling software shall be compliant with TIA/EIA-606-D and shall be able to produce complex unique identifiers of up to 12 independent segments. Labelling software shall be capable of inserting symbols as well as use any standard True Type Font as well as capable of saving individual build information and of fine tuning print adjustments.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, wood, corrugated cardboard packaging material in appropriate on site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal, wiring and plastic materials from landfill to metal/plastics recycling facility as approved by Departmental Representative.
- .5 Fold up metal banding, flatten and place in designated area for recycling.
- .6 Dispose of unused paint material at official hazardous material collections site approved by Departmental Representative.
- .7 Do not dispose of unused paint material into the sewer system, into streams, lakes, onto ground or in any other location where it will pose health or environmental hazard.

PART 2: PRODUCTS

2.1 OWNER FURNISHED

- .1 The labelling standard below is taken directly from Appendix A - City of Toronto – Commercial Facilities Structured Cabling Systems Design Guide for Consulting Engineers, Architects, Designers & Contractors - Revision 1.0, January 2023
- .2 Design Guide of Tagging Convention (Identification and Labeling)
 - .1 The requirements of this section shall take precedence over other sections
 - .2 The labeling of the City of Toronto network components, structured cabling and cable routing/containment shall comply with the ANSI/TIA-606 standard.
 - .3 The codification of network components, cables and cable routing shall follow the identification standards detailed in this standard.
 - For example:

- Building Location: YDE – 30 Dee Ave
- Floor and Room Location: ER – Equipment Room / Server Room / Main Communications Room
 - TRA – Telecom Room - A
 - TRB – Telecom Room – B
 - EF - Entrance Facility
- Service Provider / Network Cabinet Label in ER: COT-IT-YDE-0100 Network Closet
- Network Cabinet Label in ER: COT-IT-YDE-0200 Network Closet
- Server Cabinet Label in ER: COT-IT-YDE-0300 Server Closet
- Patch Panel:
 - A – Data Patch Panel A (A,B,C, etc ...)
 - FP01 – Fibre Optic Patch Panel
 - TP01 – Telephone/Voice Patch Panel
- Patch Panel Port:
 - 01 – Patch Panel Port (01, 02, 03, ..., 24)
- Work Area Number:
 - 125 – Work Area number associated in the admin/office areas of the facility
- Work Area Outlet:
 - WA01 – Work area outlet (01, 02, 03, etc...),
 - 1 – Port number (1, 2, 3, 4)

.3 Equipment / Network / Server Room Cabinets Identification and Labeling

- Equipment Room/Server Room network enclosure contains active network components, including: Network Core Closet, Server Closet and Telecommunications Enclosure. All Network Closets/Cabinets related to the Equipment Room (ER) shall be tagged as follows.
- COT-IT-XYZ-XX00, where:
 - XYZ = Site three-character code name
 - XX00 = First two numbers (XX) identify the closet
- For all closets/enclosures/cabinets in the Equipment Room, the last two numbers are always zero (00).
- For Closets/Cabinets in the Equipment Room, they are numbered from (0100) to (1000).
- Network Core Closet and Server Closet nameplate shall conform as follows:
 - Provide nameplate for each enclosure on the bottom-center of the door, front and back.
 - Use engraved gravoply laminate nameplates using black letters on a white background.
 - The laminate nameplates shall have a dimension of 210mm W x 50mm H.
 - Minimum character height shall be 12mm. Character lettering shall be centered on each line.
 - Mount nameplates with two stainless steel machine screws.
 - Include device identification (tag) number as well as a descriptive name.
 - For example: the tag name: COT-IT-XYZ-0100 followed by the description i.e. "NETWORK CLOSET"

.4 Copper Patch Panel (CP) & Work Area Outlet (WA) Identification and Labeling

- The copper data patch panels in a Telecommunications Enclosure/Closet shall employ one character A, B, C, ..., Z. The rack shall be populated with patch panel(s) as necessary and
- labeled in sequential order from top to bottom.
- For example, the first copper data patch panel from the top of the rack shall be labeled A, the second shall be B, and so on.
- Each 24-port patch panel shall have six (6) snap-in faceplates that group four terminations. For
- office areas, the minimum number of ports associated with a work area outlet shall be a group
- of two (2) ports.
- Labels shall be applied to patch panels in such a manner as to be readily visible and not
- obscured by structured cabling or patch cords.
- Labels for each 4-port or 2-port, snap-in faceplate shall be laser printed, self-laminating, adhesive, polyester or polyolefin. Hand-written labels shall not be accepted.

- Lettering shall be black on a white background. Characters are a minimum of 4mm high. Apply a label on the top of each group of 4-ports or 2-ports on the snap-in faceplate to indicate the destination of the cables terminated on the data ports (RJ).
 - For office areas, the label 125-WA01 would be applied on the patch panel for a group of 2 ports with destination cables to work area outlet 125-WA01. Whereas, 125 represents the room number of the facility and WA01 represents the work area 01.
 - Apply a two-digit label immediately above each data port (RJ) indicating its destination port number on the work area outlet. For example, a group of four consecutive ports on a 24-port patch panel whose destination is port numbers 1 to 4 on a WAO would have the ports labeled 1, 2, 3, 4. Provide color-coded, snap-in icons for each data port (RJ).
- .5 Fibreoptics Patch Panel (FPP) Identification and Labeling
- Lettering shall be black on a white background. Characters are a minimum of 4mm high.
 - Terminate all 12 fibres of each fibre optic cable in Fibre Enclosures (Telecommunications Enclosure or Network Core Closet).
 - The fibre cable for all even-numbered Telecommunications Enclosures shall terminate at Network Core Closet 02 (XYZ-0200) while odd-numbered shall terminate at Network Core Closet 01 (XYZ-0100).
 - For cases where Network Core Closet 01 and Network Core Closet 02 are located in different Equipment Rooms, Telecommunications Rooms / Telecommunications Enclosures shall have fibre terminating in both Network Core Closets.
 - The ordering and color of individual fibres shall be the same for each fibre cable and compliant with the latest ANSI/TIA-568.3 and ANSI/TIA-598 standards.
 - Labels for patch panels shall be laser printed, self-laminating, adhesive, polyester or polyolefin. Hand-written labels shall not be accepted.
 - Labels shall be applied to patch panels in such a manner as to be readily visible and not obscured by structured cabling or patch cords.
 - A label shall be applied to the top of the LC duplex adapter modules associated with a single fibre cable indicating the destination of the cable.
 - For example, the adapter modules that terminate the fibre cable whose destination is Telecommunications Enclosure 1400 would be labeled as XYZ-1400.
 - The fibre patch panel label shall be labeled as follows FPXX where XX is the fibre patch panel sequence i.e. 01, 02, 03...etc. The rack shall be populated with patch panels as necessary and labeled in sequential order from top to bottom.
 - For example, the first patch panel from the top of the rack would be labeled as FP01, the second is FP02 and so on.
- .6 Work Area Outlet (WAO) Identification and Labeling
- Labels for each 4-port, work area outlet shall be laser printed, self-laminating, adhesive, polyester or polyolefin. Hand-written labels shall not be accepted.
 - Lettering shall be black on a white background. Characters shall be a minimum of 4mm high.
 - A label shall be applied to the top of each 4-port, work-area outlet indicating the source of the Horizontal cables.
 - For example, WAO port 1 connected to patch panel A port 1 would be labelled as A01. WAO port 2 to patch panel A port 2 is labelled A02 and so on.
- .7 Cable Identification and Labeling
- Use durable non-fading sleeve type wire markers to identify all network cables. Labels for cabling shall be laser printed, self-laminating, adhesive, polyester (indoor/outdoor). Hand-written labels will not be accepted.
 - Lettering shall be black on a white background. Characters shall be a minimum of 4mm in height.
- .8 Fibreoptics Backbone Cable Identification and Labeling
- As a minimum, all fibre optic backbone cables shall be labeled at both ends of the cable, within every pull box and every 15 metres.
 - In addition, the fibre backbone cables shall be labeled at each transition. A transition is defined as: a change in ducting (e.g. cable tray to conduit), a change in direction of more than 45 degrees, or an entrance and exit of ducting through a wall or floor.
 - If the fibre cable is run in conduit then the transition labels shall be applied to the conduit.
 - The tagging convention for identification of fibre optic backbone cables shall indicate the

source and destination of the cable separated by a colon.

- For example, a fibre optic backbone cable whose source is Network Core Closet 2 (XYZ-0200), Fibre Patch Panel 01, adapter panel A and terminates in Telecommunications Enclosure 1400 (XYZ-1400) on the fibre patch panel 01 adapter panel A would have the following tag: 0200-FP01-A.01: 1400-FP01-A.01. The last "01" digits represent fibre strands.
- The Telecommunications Enclosure fibre optic patch panel must be labeled.
 - For example: Telecommunication Enclosure 1400 with two fibre optic patch panels would be labeled "FP01" and "FP02", where "FP01" is the first patch panel from the top.

.9 Horizontal Copper Cable Identification and Labeling

- As a minimum, all horizontal CAT6/CAT6A cables shall be labeled at both ends of the cable, within every pull box and every 15 metres.
- In addition, the cables shall be labeled at each transition. A transition is defined as: a change in ducting (e.g. cable tray to conduit), a change in direction of more than 45 degrees, or an entrance and exit of ducting through a wall or floor.
- If the cable is run in conduit then the transition labels shall be applied to the conduit.
- The tagging convention for identification of Horizontal cables shall indicate the source and destination of the cable separated by a colon.
 - Example 1: a horizontal cable whose source is Telecommunications Enclosure TRB-4, Patch Panel A, port 01 and whose destination is port 1, Work-Area Outlet 01, in room number 125 would have the following tag: YDE-TRB-4-A01:125-WA01-1.

.10 Voice Backbone Copper Cable Identification and Labeling

- As a minimum, all voice backbone cables shall be labeled at both ends of the cable, within every pull box and every 15 metres.
- In addition, the voice backbone cables shall be labeled at each transition. A transition is defined as - a change in ducting (e.g. cable tray to conduit), a change in direction of more than 45 degrees, or an entrance and exit of ducting through a wall or floor. If the voice cable is run in conduit then the transition labels shall be applied to the conduit.
- The tagging convention for identification of voice cables between the voice block and the Telecom Closet/Enclosure patch panel in the building shall be VFFA-CC : XYZ-A-TP01 (indicate the source and destination of the cable separated by a colon), where V indicates voice, FF indicates the floor number, EF indicates telecommunications entrance facility ID, CC indicates 2-digit voice cable number, and XYZ-A is telecommunications closet/enclosure ID.
 - For example, voice cable 01 whose source is entrance room EF and terminates in Telecommunications Room B (YDE-TRB) on patch panel TP01 would have the following tag: V01EF-01 : YDE-TRB-TP01.

.11 Patch Cord Identification and Labeling

- As a minimum, all Contractor installed CAT6/CAT6A or fibre optic patch cords shall be labeled at both ends of the cable.
- The tagging convention for identification of patch cords shall indicate the source and destination of the cable separated by a colon. The source is the switch port and the destination is the patch panel, termination point.

.12 Cable Pathways Identification and Labeling

- All ducting (cable tray or conduit) carrying fibre optic and multi-pair voice backbone cables shall be tagged as "LAN BACKBONE".
- All ducting (cable tray or conduit) carrying Horizontal cables shall be tagged as "LAN HORIZONTAL" with the source and destination network panels.
- All ducting shall be labeled at each transition. A transition is defined as - a change in ducting (e.g. cable tray to conduit), a change in direction of more than 45 degrees, or an entrance and exit of ducting through a wall or floor.
- Use engraved Gravoply laminate nameplates using black letters on white background.
- The laminate nameplates shall have a dimension of 210mm W x 50mm H.
- Minimum character height shall be 12mm. Character lettering shall be centered on each line.

2.2 MANUFACTURED COMPONENTS

- .1 Faceplate labels for faceplates at each work station shall be white perforated card stock compatible with inkjet and laser printers or pre-cut self-adhesive polyester compatible with inkjet or laser printers. Labels shall be 1.98" x 0.373" in size and be divided 72 labels per sheet with each sheet being 8.5" x 11". Labels may also be printed on polyester roll stock for a suitable TIA-606D Standards compliant handheld labeler. Printed labels are a minimum of 10 pt, sans-serif font.
- .2 Patch Panel labels shall be white pre-cut self-adhesive polyester. Labels shall be [3.10" x 0.50" (for patch panels without icons) or 3.30" x 0.25" (for patch panels with icons)] in size and be divided [36 or 72] labels per sheet with each sheet being 8.5" x 11". Labels may also be printed on polyester roll stock for a suitable TIA-606D Standards compliant handheld labeler. Printed labels are a minimum of 10 pt, sans-serif font.
- .3 Cross-connect labels shall be perforated card stock compatible with inkjet and laser printers or pre-cut self-adhesive polyester compatible with laser printers and be colour coded per the labelling scheme for card stock. Labels shall be 7.90" x 0.48" in size and be divided 18 labels per sheet with each sheet being 8.5" x 11". Printed labels are a minimum of 10 pt, sans-serif font.
- .4 Cable labels shall be self-adhesive, self-laminating, pre-cut and laser-printer compatible. Labels shall be used with 4-pair horizontal unshielded/shielded twisted pair cable and for fiber optic cable, and/or 25-Pair backbone cables, be 0.984" x 1.496" (4-Pair) and/or 0.984" x 2.480" (25-Pair) in size and be divided 48 (4-Pair) and/or 24 (25-Pair) labels per sheet with each sheet being 8.5" x 11". Printed labels are a minimum of 10 pt, sans-serif font.

PART 3: EXECUTION

3.1 PREPARATION

- .1 The labelling shall be machine-generated and affixed to the cable, faceplate, patch panel, rack or other hardware.
- .2 Labelling must match the cable run-sheets and cable certification tester conformance documentation, for both copper and optical fibre components.

3.2 INSTALLATION

- .1 Install all systems in accordance with manufacturer's printed instructions, as well as ANSI/EIA/TIA 606-D – "Administration Standard for Commercial Telecommunications Infrastructure".
- .2 Labels shall be affixed in a level and square position.
- .3 Install labels in such a way as to be physically and visually accessible.
- .4 Remove any temporary labels and ensure no permanent labels are damaged during construction.
- .5 Replace all damaged or missing permanent labels prior to substantial completion.
- .6 Cable Labelling
 - .1 All cabling runs shall be labelled in four (4) locations including at each end of the cable, on the corresponding faceplate and patch panel or IDC mount.
- .7 Patch Cord Labelling
 - .1 Each patch cord shall be labelled with one label at each end.

- .8 Rack and Cabinet Labelling
 - .1 Each rack and cabinet shall be labelled with one label on the front (top) and one label on the back (top).
- .9 Active Equipment Labelling
 - .1 Each piece of active equipment, such as switches, routers, local ups, etc. shall be labelled with one label on the front and one label on the back.

3.3 PATHWAYS

- .1 Conduit
 - .1 Label exterior of conduit as COMMUNICATIONS (unless otherwise noted on the drawings) with text readable from a standing position on the finished floor.
 - .2 For wall stub-up locations, label overhead only.
 - .3 For strictly overhead conduits, label both ends.
 - .4 For long runs of conduits that stub directly up or into Communications Room, label the end of the conduit in the Communications Room with the destination room number or location..
 - .5 Sleeves which pass through a single wall or floor need not be labeled.
- .2 Junction boxes and pull boxes
 - .1 Label exterior of junction boxes and pull boxes as COMMUNICATIONS with text readable from a standing position on the finished floor.
- .3 Firestop locations
 - .1 All communications firestop locations are to be labeled on both sides of wall or floor. Refer to firestopping specification section for additional information.
- .4 Grounding
 - .1 Label PBB as FLOOR# - ROOM# - PBB.
 - .2 Label SBB's as FLOOR# - ROOM# - SBB.
 - .3 Label grounding conductors within 12" of both ends with Warning Marker and Identification Label.
 - .1 Identification label is to include the source and destination of the grounding conductor.

***** END OF SECTION *****

PART 1: GENERAL

1.1 INCLUDED SYSTEMS AND EQUIPMENT

- .1 The following is a list of the equipment and system test requirements that will need to be included in this section.

1.2 DESCRIPTION

- .1 The purpose of this section is to specify Division 27 responsibilities in the commissioning process which are being directed by the Commissioning Authority (CA).
- .2 Commissioning requires the participation of Division 27 to ensure that all systems are operating in a manner consistent with the Contract Documents.

1.3 RESPONSIBILITIES

- .1 Communication Contractor. The commissioning responsibilities applicable to the Communication Contractor are as follows (all references apply to commissioned equipment only):
 - .1 Documentation of all procedures performed shall be provided and forwarded to the Communications Designer. Written documentation must contain recorded test values of all electrical tests performed per the individual product specification.
 - .2 The start-up service company shall be present during energization of the Communication equipment. Jobsite and equipment access must be provided by the General Contractor during regular business hours
 - .3 The contractor shall supply a power source, specified by the start-up service company, for on-site test equipment.
 - .4 Perform tests using qualified personnel. Provide necessary instruments and equipment.
 - .5 Include the cost of commissioning in the contract price, if not yet let.
 - .6 Provide a copy of the O&M manuals submittals of commissioned equipment, through normal channels, to the CA for review.
 - .7 Contractors shall assist (along with the design engineers) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
 - .8 Perform and clearly document all completed system operational checkout procedures, providing a copy to the CA.
 - .9 Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
 - .10 Perform functional performance testing under the direction of the CA for specified equipment in Section 27. Assist the CA in interpreting the monitoring data, as necessary.
 - .11 Correct deficiencies (differences between specified and observed performance) as interpreted by the CA, PM/GC and Communications Engineer and retest the equipment.
 - .12 During construction, maintain as-built red-line drawings for all drawings and final CAD as-builts for contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing). Prepare red-line as-built drawings for all drawings and final as-builts

for contractor-generated coordination drawings.

- .13 Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
- .14 Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

PART 2: EXECUTION

2.1 SUBMITTALS

- .1 Division 27 shall provide submittal documentation relative to commissioning to the CA as requested by the CA. Refer to Section 01 91 00 for additional Division 27 requirements.

2.2 TESTING OF CABLES

- .1 All cables to be tested after complete installation from termination end to termination end under worst-case environmental conditions and in accordance with this and the manufacturer's specification.
- .2 Testing of all copper media will include verification of labelling integrity, d.c., continuity of each conductor, correct pair polarity termination, shorts between conductors, shorts between conductors and shield, length and the proper operation of shorting bars where provided.
- .3 Testing of 75 Ohm copper coaxial cables shall be as per TIA/EIA 568.4-D-2017, *Broadband Coaxial Cabling and Components Standard*.
- .4 Testing of 50 Ohm RF coaxial cables shall be done with the coaxial cable adapter on the certification tester. If the cables are terminated in BNC or NC connectors, use a BNC/NC to F adapter for the cable test. Record continuity, DC resistance, Velocity of propagation, impedance, capacitance and attenuation values at multiple frequencies, including the maximum frequency in use on that particular link. Compare the values with the manufacturer's documentation and record in test results.
- .5 The Contractor shall also test all four (4) pair Communications data and voice UTP cabling runs to full compliance of TIA/EIA 568.2-D-2018 performance parameters including but not limited to the following parameters: wire map, insertion loss (attenuation), noise, DC loop resistance, DC resistance Unbalance within a pair, DC Unbalance resistance between pairs, PSNEXT, ELFEXT, PS ELFEXT, ACR, PS ACR, Delay Skew, Propagation Delay and Signal Loss measurements for Category 6A (data and voice) compliance in accordance to TIA/EIA 568.2.-D-2018. Full bandwidth, graphical results of all tests must be provided for all cables. Category 6A testing to include Alien Crosstalk (ANEXT and AFEXT) to 500 MHz.
- .6 Alien Cross talk testing to satisfy Category 6A shall be tested according to the Sampling Plan outlined in ISO/IEC 14763-2. There shall be an equal selection of short, medium and long length links in the sample plan.
- .7 All installed cables and terminations must meet or exceed the minimum specifications of the manufacturer. All four (4) pair UTP cables must fully pass minimum of TIA/EIA Category 6A **Permanent Link** performance specifications. Marginal or conditional passes are NOT acceptable and must be corrected prior to test result submission. Any cables or terminations failing to meet these specifications to be promptly replaced or repaired by the Contractor at no additional cost. The Owner and/or Engineer reserve the right to determine whether such product should be replaced or repaired. Such products to be replaced when requested by the Owner and/or Engineer.
- .8 The tester and procedures for the testing of copper twisted cables shall be as defined in ANSI/TIA-1152A. A minimum Level IV calibrated tester will be used for the tests.
 - .1 Acceptable Testers are:

- .1 Fluke Versiv DSX-5000 series, with copper, optical fibre and coaxial cable adapters
- .2 Ideal Networks Lantek IV series, with copper, optical fibre and coaxial cable adapters
- .3 WireExpert 4500, by Softing, with copper, optical fibre and coaxial cable adapters
- .9 Tabulation and Documentation of all test results and cable characteristics.
 - .1 All testing and repairing must be completed and approved at least (30) thirty days prior to the handover of the project.
 - .2 Provide adequate personnel for immediate on-site problem determination, these staff must be available onsite for support five (5) days post-handover.
 - .3 All defects and deficiencies which originate or become evident during the warranty period to be repaired or replaced without additional expense to the Owner within 24 hours (1 day). All such work must be performed at a time which is acceptable to the Owner which may be outside regular working hours.
 - .4 Provide in soft copy format on media stick, tabulated results for every communication cable (copper/fiber/coaxial).The soft copy to be supplied with the test equipment manufacturer's software required to view the test results including viewing of all full bandwidth graphical data.
 - .5 Additionally, the contractor shall provide a cable test summary report indicating when the cable was tested, the result (pass or fail), the length of the cable, and the minimum headroom over TIA/EIA Category 6A standards. This test summary to be signed by an authorized cabling contractor personnel/manager.
 - .6 All test equipment used must have been calibrated at the manufacturer within twelve (12) months of test performed. Proof of calibration to be provided either by manufacturer certificate or a picture of the test equipment calibration field.
 - .7 All cable test results/reports must be submitted to The Hidi Group for review two (2) weeks prior to handover of project.
 - .8 Submit complete test results and formal written certification that the Communications Cabling System is installed and operating in accordance with this and the manufacturers' specifications.
 - .9 Contractor to provide manufacturer's preliminary certification number within 10 days of contract award.

2.3 WRITTEN WORK PRODUCTS

- .1 Contractor to provide a letter of certification within 2 weeks of substantial completion. This letter shall include: notification of 10Gig or Augmented Category 6 installation, verification of performance of the installed system, manufacturers certification number, identification of installation by location and project number and a copy of the warranty certification request form. The system must meet or exceed a minimum 20 Year warranty offered by the main structured wiring manufacturer. The contractor must follow the process from start to finish and document all steps to meet the warranty as outlined by the manufacturer. The acceptable manufacturer warranties are listed on page 1 of 4 in section 27 15 13. (MANUFACTURED COMPONENTS)

***** END OF SECTION *****

PART 1: GENERAL

1.1 SUMMARY

.1 Communications Cabinets, Racks, Frames, Enclosures

- .1 The Telecommunication Rooms (TR) shall house racks, cabinets, voice termination fields, and required cable routing hardware. Racks and cabinets shall be placed in a manner that will allow a minimum of 3 feet of clearance from the front and rear mounting surfaces and on one side. If one mounting rail of the rack is placed against a wall, the mounting rail shall be no closer than 6" to the wall to allow room for vertical management. Where there is more than one rack or cabinet, the racks or cabinets shall be ganged with vertical management hardware to provide inter-bay management. Ganged rack/cabinet frames will be placed in a manner that will allow a minimum of 3 feet of clearance from the front and rear mounting surfaces and on one side of the ganged assembly. In all telecommunication rooms the racks/cabinets shall be on the opposite side of the room from the voice termination fields.

1.2 SUBMITTALS

.1 Product Data

- .1 All equipment racks and cabinets shall be augmented with horizontal and vertical cable management hardware, both front and rear, to properly dress horizontal cables and patch cords. See drawings for cabinet and rack elevation positions of equipment.
- .2 The HIDI Group makes reference to product names as follows:
- .1 "Racks" – open frame 2 post or 4 post support structures for telecommunications and power distribution devices. Racks usually have few configuration options beyond size and vertical cable managers. Refer to the drawings and part numbers for the accessories and configurations required.
- .2 "Cabinets" – enclosed 4 post frames equipped with side walls, front and rear doors and top/bottom panels and heat management devices. Cabinets often have multiple configuration options. Refer to the drawings and part numbers for the accessories and configurations required.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, wood, corrugated cardboard packaging material in appropriate on site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal, wiring and plastic materials from landfill to metal/plastics recycling facility as approved by Departmental Representative.
- .5 Fold up metal banding, flatten and place in designated area for recycling.
- .6 Dispose of unused paint material of at official hazardous material collections site approved by Departmental Representative.

- .7 Do not dispose of unused paint material into the sewer system, into streams, lakes, onto ground or in any other location where it will pose health or environmental hazard.

PART 2: PRODUCTS

2.1 OWNER FURNISHED

- .1 Contractor to provide all equipment as per drawings.

2.2 MANUFACTURED COMPONENTS

.1 Communications Racks/Cabinets

- .1 See drawings for rack design intent.
- .2 Ensure that power distribution components such as UPS units, PDUs and surge suppressors fit properly into the racks/cabinets so that all doors can close with power supply cables and communications patch cables installed, without pinching. Ensure that PDUs selected match the height or depth of the rack/cabinet.
 - .1 Locate racks/cabinets as shown on the drawings; anchor racks/wall cabinets securely to the floor/wall. Floor mount racks and cabinets will be anchored with four (4) bolts each. Bolts/anchors used to mount must be made flush and any sharp edges must be removed. Mount equipment in racks/cabinets as shown on detail sketches.
 - .2 Ensure lighting is available to provide 300 Lux illumination to the front and rear of all racks and cabinets, in open and closed positions. Coordination with the Electrical Engineers is required.
 - .3 Casters should be used for placement of equipment; if casters cannot be concealed when raised they must be removed in order to provide a flush mounting surface for the cabinets.
 - .4 Ground racks, patch panels, cabinets, voice cables, metal raceways and data equipment to building ground busbars using minimum #6 AWG insulated ground wire. Main grounding system including room serving ground busbars will be designed and installed under the electrical scope of work.
 - .5 All racks must be connected to the telecommunications grounding bus bar as defined in the grounding section.
 - .6 Ground cable shall be insulated green jacket, braided copper wire installed in each communication room that connects to the building ground system. Minimum wire size shall be #6 AWG for Telecommunications closets and #1/0 for main building communications room.
 - .7 Grounding system for main building communications room shall be designed such that the individual grounding runs to each piece of equipment does not exceed 5' from the main loop.
 - .8 Grounding to tie into a single ground point only.
 - .9 Daisy chain of # 6 gauge wire between cabinets will not be accepted.
 - .10 In all cases racks and components are to be black in colour.

- .3 Rack requirements:
 - .1 Refer to drawings for locations and quantities.
 - .2 Full Size 2-Post Racks must be 7-foot, 45U and have threaded holes for 10/32 screws. No cage nuts.
- .4 Vertical cable managers
 - .1 Contractor shall supply and install cable managers as per the drawings.
 - .2 The vertical cable managers shall have the following characteristics:
 - .3 Suitable for use with any EIA Compliant 45U rack.
 - .4 Vertical cable managers shall be metal with a hinged cover.
- .5 Finishes:
 - .1 Racks/Cabinets, Horizontal and Vertical management shall be black in color, electro-powder coat.

PART 3: EXECUTION

3.1 INSTALLATION

- .1 Install all systems in accordance with manufacturer's printed instructions and manufacturer suggested best practices.
- .2 All cabinets must be connected to the Telecommunications Primary Busbar (PBB) or Telecommunication Secondary Busbar (SBB) as defined in the grounding section.
- .3 Locate cabinets as shown on contract drawing, anchor cabinets securely to the floor. Bolts/anchors used to mount must be made flush and any sharp edges must be removed. Mount equipment in cabinets as shown on detail sketches.
- .4 Ensure cabinet is mounted in a way in which all doors are free from impediment and to ensure that ease of execution of work is considered.

***** END OF SECTION *****

PART 1: GENERAL

1.1 SUMMARY

- .1 Communications Termination Blocks and Patch Panels
- .2 Termination block fields shall be mounted on 4' x 8' x .75" fire retardant plywood, unless otherwise noted in drawings. Patch panels for fiber and copper terminations will be housed in racks, cabinets, wall cabinets and other types of communication enclosures. The Contractor shall provide innerduct for all backbone fiber runs within telecommunication rooms. Industry approved J-Hook style cable supports must be used for added support where required by the standards as outlined by the TIA/EIA and other local CEC/ESA requirements.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, wood, corrugated cardboard packaging material in appropriate on site bins for recycling in accordance with the Waste Management Plan.
- .4 Divert unused metal, wiring and plastic materials from landfill to metal/plastics recycling facility as approved by Departmental Representative.
- .5 Fold up metal banding, flatten and place in designated area for recycling.
- .6 Dispose of unused paint material of at official hazardous material collections site approved by Departmental Representative.
 - .1 Do not dispose of unused paint material into the sewer system, into streams, lakes, onto ground or in any other location where it will pose health or environmental hazard.

PART 2: PRODUCTS

2.1 OWNER FURNISHED

- .1 All products are new and supplied by contractor.

2.2 MANUFACTURED COMPONENTS

- .1 Acceptable Manufacturer: Belden.
- .2 The contractor will provide submittals and cut sheets for all products that they are proposing.
- .3 The contractor must issue at time of project completion a manufacturers certified solution certificate from one of the following manufacturers:
 - .1 Termination Hardware - Copper Backbone
 - .1 The copper backbone cable will be terminated on BIX termination blocks and run back to a dedicated patch panel within the IT rack within all Telecommunications Rooms (TR) as noted on the drawings. Include D-rings between each field.
 - .2 The contractor will provide all necessary x-connects between fields where required.

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- .3 Designation Strips labels must be used to identify cable pair counts, colour coded and label standards as per the TIA/EIA 606 standards. Samples of all labeling schemes and label types must be provided to owner before implementation.
 - .4 Refer to drawings for a typical Voice Backboard layout and/or detail.
 - .4 Horizontal Copper Cabling termination modules, Voice and Data Cat 6, and Security Cat6A
 - .1 All UTP modules shall be Category 6 and Category 6A Modules and shall follow performance parameters as outlined in ANSI/TIA 568.2-D.
 - .2 Cover plates
 - .1 Division 26 (Electrical) shall supply and install all communication outlet boxes. Faceplates will be supplied by ELV contractor. These are to match electrical specifications for cover plate style and colour. Communication contractor is responsible for the module mounting strap, colors to be determined by Owner.
 - .2 Hub Room terminations - Horizontal Voice and Data Cables
 - .1 Some voice cables will terminate using BIX termination products. See drawings for details.
 - .2 All data cables and voice cables shall terminate on 24 or 48 port modular patch panels, 1 RU high for 24 port and 2RU high for 48 port, rack mount (No 1RU 48 port high density Cat 6 or 6A panels will be accepted). See drawings for details. They shall have the following minimum parameters:
 - .3 Physical Characteristics:

1U Panel:	45 x 483 x 13 mm (1.75" x 19" x 0.5")
2U Panel:	90 x 483 x 13 mm (3.5" x 19" x 0.5")
 - .4 Materials:

Panel:	Steel, 16 gauge, powder paint finish, black
Modular Holder:	Fire retardant plastic, UL94V-0
 - .5 These shall be placed on the front of the cabinets/racks. Refer to drawings for quantities of panels and modules.
 - .6 All patching and cross connects will be done by the Communications Contractor
 - .5 Termination Hardware – 75 Ohm Coaxial Cables for Cable TV, horizontal station cables
 - .1 Copper coaxial cables shall be terminated on 75 Ohm rack or bulkhead products using F precision 75 ohm connectors. All connectors in bulkheads or faceplates are female. 75 Ohm patch cords are male to male.
 - .2 F connectors must be sized for the size and type of cable. An RG-6U sized connector must be used on an RG-6U cable, for example. Plenum cables often have different diameters than non-plenum cables. Use the Connector size that matches the cable type.
 - .3 Connectors must be mechanically compressed onto the cable using the appropriate die for the

size of the cable, as per the manufacturer instructions. Soldered connectors are not acceptable.

- .4 Return loss performance of installed 75 Ohm connectors shall be equal to or better than -20dB at 4.5GHz.
- .5 All runs of coaxial cable are to be terminated at the work area outlet location indicated on the drawings, with a minimum of 25-feet of slack neatly coiled and secured at the plywood backboard closest to racks within the Hub room.

PART 3: EXECUTION

3.1 INSTALLATION

- .1 Install all systems in accordance with manufacturer's printed instructions and manufacturer suggested best practices.
 - .1 The horizontal data cables will be contained in cabinets, racks and other types of enclosures. All equipment racks shall be augmented with horizontal and vertical cable management hardware, both front and rear, to properly dress horizontal cables and patch cords.
 - .2 All voice terminations will be done on plywood backboards and brought to a 24-port patch panel in the rack via six (6) category 6 cables. See drawings.

***** END OF SECTION *****

PART 1: GENERAL

1.1 SUMMARY

- .1 The power cord must be a minimum 8 feet in length to reach up to the cable-tray or down to the floor where it will plug into a receptacle (supplied by Division 26).
- .2 The power bar(s) shall be UL/ULC listed and shall meet UL/ULC 1363 and 1449 requirements.

PART 2: PRODUCTS

2.1 OWNER FURNISHED

- .1 All products are new by Contractor.

2.2 MANUFACTURED COMPONENTS

- .1 Vertical Power Bars.
 - .1 Each equipment rack located in the Hub Room shall come complete with one (1) vertical power bar.
 - .2 The power bars shall be UL/ULC listed and shall meet UL/ULC 1363 and 1449 requirements.
 - .3 Specified Product for 2-post IT racks: Cabletalk CTPBV-1277-ST-B – contractor shall confirm PDU specifications with City of Toronto IT prior to ordering.
- .2 Uninterruptible Power Supplies
 - .1 There are no UPS products in scope for this project.

PART 3: EXECUTION

3.1 INSTALLATION

- .1 Install all systems in accordance with manufacturer's printed instructions and manufacturer best practices.

***** END OF SECTION *****

PART 1: GENERAL

1.1 SUMMARY

- .1 Communications Optical Fiber Backbone Cabling CMP/FT6
- .2 Multi-mode backbone data cable shall be all-dielectric and shall consist of 900µm tight-buffered 850nm laser-optimized 50/125µm OM4 OFCP multi-mode fibers surrounded by aramid strength members and a PTFE outer jacket.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section
- .2 01 74 19 - Construction/Demolition Waste Management and Disposal.
- .3 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .4 Collect and separate for disposal paper, plastic, polystyrene, wood, corrugated cardboard packaging material in appropriate on site bins for recycling in accordance with the Waste Management Plan.
- .5 Divert unused metal, wiring and plastic materials from landfill to metal/plastics recycling facility as approved by Departmental Representative.
- .6 Fold up metal banding, flatten and place in designated area for recycling.
- .7 Dispose of unused paint material of at official hazardous material collections site approved by Departmental Representative.
- .8 Do not dispose of unused paint material into the sewer system, into streams, lakes, onto ground or in any other location where it will pose health or environmental hazard.

PART 2: PRODUCTS

2.1 OWNER FURNISHED

- .1 All fibre cables will be new as per the drawings.

2.2 MANUFACTURED COMPONENTS

- .1 Manufacturer List for multi-mode cables. The following manufacturers or Equivalent will be considered along with manufacturer technical cut sheets for approval. Contractor to verify that fibre backbone cable meets the requirements for a single manufacturer warranty:
 - .1 Belden
- .2 Product Options
 - .1 Multi-mode Fiber cables are illustrated on the communication drawings. The fiber cables will be multi-mode OM4 OFCP to match the flame-spread rating related to the area in which the cables will be installed.
 - .2 The cable must be able to support 10 Gbps Ethernet (802.3ae) at 850nm for a distance of 300m. Refer to drawings for locations of each fiber type.

PART 3: EXECUTION

3.1 INSTALLATION

- .1 Install all systems in accordance with manufacturer's printed instructions.
- .2 All backbone cables shall be installed in the following manner.
- .3 Backbone cables shall be installed separately from horizontal cables except in locations where only one tray or conduit system is provided.
- .4 Where cables are housed in conduits, the backbone and horizontal cables shall be installed in separate conduits or in separate inner duct(s) within conduits where provided.
- .5 Where cables are installed in an air return plenum, the cable shall be installed in conduit, or plenum cable shall be installed in a plenum inner duct to provide protection to the cable.
- .6 Where backbone cables and distribution cables are installed in a cable tray or wire-way, backbone cables shall be installed first and bundled separately from the horizontal distribution cables.
- .7 Inside plant cables above four fibers shall support a minimum bend radius of ten (10) times the cable diameter under no tensile load, and 15 times the cable diameter under tensile loading, or to the cable's rated limit.
- .8 All fiber within the Telecommunications rooms must be installed in inner duct; cable in other areas must be clearly marked as fiber optic with manufacturer produced warning labels.
- .9 Lubrication: if cable pulling lubricant is used for fiber optic cable installation the contractor must provide in writing the manufacturer and product specific specification sheet. The contractor must also specify if the product is suitable based on temperature of installation and whether it is for indoor or outdoor application.
- .10 The contractor must leave service loops of a minimum 20ft for all telecommunication rooms; cables must be secured in tray system or with suitably sized J-Hook basket style cable hangers. All fiber from start of run through to end point must be supported based on standards as outlined by the TIA/EIA.
- .11 Optical fibre connectors shall be fusion spliced and be of the same manufacturer as the cable installed.
- .12 Optical fibre shall be terminated with LC connectors.
- .13 The connector polish shall be PC for MM fibre.
- .14 Optical fibre adapter strips shall be of the same manufacturer and style to suit the cabling installed.

3.2 FIELD QUALITY CONTROL

- .1 Testing
 - .1 All cables and termination hardware must be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA/EIA-568-D.3 All fibers of every installed cable should be verified prior to system acceptance. Any defect in the cabling system installation including, but not limited to, cable, patch panels, and connectors should be repaired or replaced in order to ensure 100% useable conductors in all cables installed.
- .2 Fiber channel testing
 - .1 All fiber testing must be performed on all fibers in the completed end to end system. There should

be no splices unless clearly defined in an RFP. Testing should consist of an end to end power meter test performed per TIA/EIA-455-53A. The system loss measurements should be provided at 850 and/or 1300 nanometers for multi-mode fibers and 1310nm, 1385nm and 1550 nanometers for single-mode fibers. These tests also include continuity checking of each fiber.

- .2 All fiber test equipment must be manufacturer calibrated within one year of fiber testing, all records must indicate such.
 - .3 Backbone multi-mode fiber cabling should be tested at both 850 nm and 1300 nm in at least one direction.
 - .4 Backbone single-mode fiber cabling should be tested at 1310 nm, 1385 nm and 1550 nm in at least one direction.
 - .5 Test set-up and performance should be conducted in accordance with ANSI/TIA/EIA-526-7 revision 2 and/or ANSI/TIA/EIA-526-14 revision A Standards, and to the manufacturer's application guides.
 - .6 Attenuation testing should be performed with a stable launch condition using two-meter jumpers to attach the test equipment to the cable plant. The light source should be left in place after calibration and the power meter moved to the far end to take measurements.
 - .7 An Optical Loss Test may only be declared a PASS when the attenuation meets the demands of the optical transceivers and the link length of the permanent link. The testing Contractor must collect the Optical Loss Budget from the end-users prior to issuing a PASS/FAIL test statement. For example, the Optical Loss Budget for a 400M OM4 channel using 802.3ae serial standard, with 10Gbase-SR transceivers, is 2.9dB. For this channel to receive a PASS, the Optical Power test must record a loss, with all patch cords installed, of less than 2.9dB.
- .3 The contractor must adhere to all related standards below:
- .1 ANSI//TIA-568-D.3 Optical Fiber Cabling Components Standard
 - .2 ANSI/EIA/TIA-569-C Commercial Building Standard for Telecommunications Pathways and Spaces
 - .3 ANSI/EIA/TIA-606(B) Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
 - .4 ANSI/EIA/TIA-607(C) Commercial Building Grounding and Bonding Requirements for Telecommunications
 - .5 ANSI/EIA/TIA-598 Color Coding of Fiber Optic Cables
 - .6 ANSI/EIA/TIA-455 Test Procedures For Fiber Optics, Cables and Transistors
 - .7 ANSI/EIA/TIA-604-3 FOCIS 3 Fiber Optic Connector Intermatability Standard
 - .8 ANSI/ICEA S-83-596 Fiber Optic Premises Distribution Cable
 - .9 ANSI/ICEA S-83-640 Fiber Optic Outside Plant Communications Cable
 - .10 ANSI/NECA/BICSI-568 Standard for Installing Commercial Building Telecommunications Cabling

END OF SECTION

PART 1: GENERAL

1.1 SUMMARY

.1 Communications Copper Horizontal Cabling

- .1 Horizontal cabling for voice and data circuits shall be 23 AWG; 4-pair Unshielded Twisted Pair CMP/FT6 rated and is independently verified for compliance. Cable shall meet or exceed all TIA/EIA Category 6A requirements.
- .2 All communication cabling from Hub Room to Work Area Outlets (voice, data, wireless access point, etc) shall be Category 6A.
- .3 All communication cabling from CCTV cabinet in Control Room [B135] to Security Camera/CCTV outlet locations shall be Category 6A.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, wood, corrugated cardboard packaging material in appropriate on site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal, wiring and plastic materials from landfill to metal/plastics recycling facility as approved by Departmental Representative.
- .5 Fold up metal banding, flatten and place in designated area for recycling.
- .6 Dispose of unused paint material of at official hazardous material collections site approved by Departmental Representative.
 - .1 Do not dispose of unused paint material into the sewer system, into streams, lakes, onto ground or in any other location where it will pose health or environmental hazard.

PART 2: PRODUCTS

2.1 OWNER FURNISHED

- .1 All products are new by contractor.

2.2 MANUFACTURED COMPONENTS

- .1 Acceptable Manufacturers:
 - .1 Belden
- .2 Product Options:
 - .1 Belden 10GXS13 Category 6A Copper UTP Cable - CMP-rated.
 - .2 Cable Colours:
 - .1 All Category 6A UTP cable designated for horizontal cables shall have a blue outer jacket for Voice, Data, and Wireless Access Points.

- .2 All Category 6A UTP cables designated for CCTV/Security cameras shall have a Yellow outer jacket.

PART 3: EXECUTION

3.1 INSTALLATION

- .1 Install all systems in accordance with manufacturer's printed instructions as well as manufacturer best practices.
- .2 All copper horizontal cables shall be installed in the following manner:
 - .1 Cable raceways must not be filled greater than the maximum fill for the particular raceway type.
 - .2 Cables must be installed in continuous lengths from origin to destination (no splices) unless specifically addressed in this document.
 - .3 Where cable splices are allowed, they shall be in accessible locations and housed in an enclosure intended and suitable for the purpose.
 - .4 The cable's minimum bend radius of four (4) times the cable diameter and maximum pulling tension of 25 lbs. shall not be exceeded.
 - .5 If a J-hook or trapeze system is used to support cable bundles all horizontal cables shall be supported at a maximum of four-foot intervals – at no point shall cable(s) rest on acoustic ceiling grids or panels.
 - .6 Horizontal distribution cables shall be bundled in groups of not greater than forty (40) cables. Attention to cable bundle size must be taken; excess of forty (40) cables may cause deformation of the bottom cables within the bundle.
 - .7 Cable shall be installed above fire-sprinkler and systems and shall not be attached to the system or any ancillary equipment or hardware.
 - .8 The cabling system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
 - .9 Cables shall not be attached to ceiling grid or lighting support wires.
 - .10 Where light support for drop cable legs is required, the Contractor shall install "J" Hooks to support the cabling.
 - .11 Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the Contractor prior to final acceptance at no cost to the Owner.
 - .12 Cables shall be identified by a self-adhesive label in accordance with the System Documentation Section of this specification.
 - .13 The cable label shall be applied to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate.
 - .14 Unshielded twisted pair cable shall be installed so that there are no bends less than four times the cables outside diameter (4 X cable O.D.) at any point in the run.
 - .15 Pulling tension on 4-pair UTP cables shall not exceed 25-pounds for a single cable or cable bundle.
 - .16 Cables shall be dressed and terminated in accordance with the recommendations made in the TIA/EIA-568.2-D document, manufacturer's recommendations, and/or best industry practices.

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- .17 Pair untwist at the termination shall not exceed 0.25 inch for connecting hardware.
 - .18 Cables shall be neatly bundled and dressed to their respective panels or blocks. The combing of cables can be done if the manufacturer supports this cable dressing technique.
 - .19 Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
 - .20 The cable jacket shall be maintained as close as possible to the termination point and must be keeping with manufacturer guidelines.
 - .21 Each cable shall be clearly labelled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support Velcro ties.
 - .22 Cable labels shall not be obscured from view.
 - .23 No plastic or metal cable ties are permitted. Only hook-and-loop cable ties are to be used.
 - .24 Pulling lubrication is not permitted unless the cable manufacturer approves the product prior to installation.

***** END OF SECTION *****

PART 1: GENERAL

1.1 COMMUNICATIONS COAXIAL HORIZONTAL CABLING

- .1 Horizontal cabling for CATV / TV shall be 75-ohm RG6, Coaxial cable CMP/FT6 rated and be independently verified for compliance. Cable shall meet or exceed all ANSI/SCTE 74.2003 requirements.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section
- .2 01 74 19 - Construction/Demolition Waste Management and Disposal.
- .3 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .4 Collect and separate for disposal paper, plastic, polystyrene, wood, corrugated cardboard packaging material in appropriate on site bins for recycling in accordance with Waste Management Plan.
- .5 Divert unused metal, wiring and plastic materials from landfill to metal/plastics recycling facility as approved by Departmental Representative.
- .6 Fold up metal banding, flatten and place in designated area for recycling.
- .7 Dispose of unused paint material of at official hazardous material collections site approved by Departmental Representative.
- .8 Do not dispose of unused paint material into the sewer system, into streams, lakes, onto ground or in any other location where it will pose health or environmental hazard.

PART 2: PRODUCTS

2.1 OWNER FURNISHED

- .1 All products are new by contractor.

2.2 MANUFACTURED COMPONENTS

.1 Manufacturer List:

- .1 Belden

.2 Product Options

.1 RG6 -75-ohm Braided Coaxial Cable –CMP/FT6

- .1 The coaxial cable shall be RG6 – 75-ohm, installed in conduit or fully enclosed cable tray above plenum ceilings. Riser/FT4 rated cable may only be used in EMT, enclosed Risers or in area of floor without plenum ratings.

.1 Physical Characteristics:

Quantity: As per drawings

Conductors: 18 AWG Solid-centre copper conductor

Insulation: Polyolefin

Cable Core: Insulated foamed copper conductor + aluminum polyester shield (100%)
+ copper braid (min 90% coverage)

Jacket: PVC for FT4, FEP for FT6

.2 Transmission Characteristics:

DC Resistance @ 20°C, max.: 10.2 Ω/100m

Impedance: 75 Ω

Attenuation @ 500 MHz <15 dB / 100m

Return Loss 5-1000Mhz <20dB

.3 Mechanical Characteristics:

Minimum recorded installation temp.: 5°C (40°F)

Temperature Rating: 60°C (140°F)

Nominal Outside Diameter: 5.9mm/0.235in

Minimum bend radius: 4X O.D. at 20° C ±1° C

.4 Qualifications

Meets or exceeds requirements of ANSI/SCTE 74.2003 standard

Cable Colours:

Black for Riser Rated, White for Plenum rated

PART 3: EXECUTION

3.1 INSTALLATION

- .1 Install all systems in accordance with manufacturer's printed instructions and manufacturer best practices.
- .2 Contractor shall bring all coaxial cables to a common location at the plywood backboard closest the racks. Cables shall be labelled and coiled neatly with at least 15-feet of slack.
- .3 All coaxial horizontal cables shall be installed in the following manner:
 - .1 Cable raceways shall not be filled greater than the maximum fill for the particular raceway type.
 - .2 Cables shall be installed in continuous lengths from origin to destination (no splices) unless specifically addressed in this document.
 - .3 The cable's minimum bend radius of 4 times the cable diameter and maximum pulling tension of 25 lbs. shall not be exceeded.
 - .4 If a J-hook or trapeze system is used to support cable bundles all horizontal coaxial cables shall be supported at a maximum of four-foot intervals – at no point shall cable(s) rest on acoustic ceiling grids or panels.
 - .5 Horizontal distribution cables shall be bundled in groups of not greater than 16 cables (cable bundle quantities in excess of 16 cables may cause deformation of the bottom cables within the bundle).

- .6 Cable shall be installed above fire-sprinkler and systems and shall not be attached to the system or any ancillary equipment or hardware.
- .7 The cabling system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
- .8 Cables shall not be attached to ceiling grid or lighting support wires.
- .9 Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the Contractor prior to final acceptance at no cost to the Owner.
- .10 Cables shall be identified by a self-adhesive label in accordance with the System Documentation Section of this specification.
- .11 The cable label shall be applied to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate.
- .12 Coaxial cable shall be installed so that there are no bends less than four times the cables outside diameter (4 X cable O.D.) at any point in the run.
- .13 Pulling tension on cables shall not exceed 25-pounds for a single cable or cable bundle.
- .14 Cables shall be neatly bundled and dressed to their respective panels or blocks.
- .15 Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
- .16 The cable jacket shall be maintained as close as possible to the termination point.
- .17 Each cable shall be clearly labelled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support Velcro ties.
- .18 Cable labels shall not be obscured from view.

***** END OF SECTION *****

PART 1: GENERAL

1.1 SUMMARY

.1 Communications Faceplates and Connectors

- .1 Modular furniture faceplates and Wall faceplates shall contain Category 6A jacks for Data, Voice and other technology components. The quantity of cables is represented on the drawings.
- .2 Ceiling or wall-mounted outlets designated as being for wireless access points or security cameras or labelled as 'CCTV' or 'WAP' respectively shall contain Category 6A jacks, matched with the cable type. The quantity of cables is represented on the drawings.
- .3 Refer to drawings for locations of floor mounted outlets, ceiling mounted outlets and wall/raceway mounted outlets.

PART 2: PRODUCTS

2.1 OWNER FURNISHED

- .1 All products are new by Contractor

2.2 MANUFACTURED COMPONENTS

.1 Acceptable Manufacturers:

- .1 Belden

.2 Product Options:

- .1 Horizontal Copper Cabling termination modules:
- .2 Category 6A modules shall all be green with exception to cables for CCTV which shall be yellow.
- .3 All UTP modules shall be Belden MDVO Category 6A modules and shall have the following minimum performance parameters:

.1 Physical Characteristics:

Quantity: Determined by floor plans.

Dimensions: 23.8 x 16.2 x 34.7 mm (0.94 x 0.64 x 1.34 in.)

Materials: Module snap-in: fire retardant plastic, UL94V-0, (*color)

Protective cap: fire retardant plastic, UL94V-0, clear

IDC housing: fire retardant plastic, UL94V-0, white

ID tab: polypropylene (*colour)

IDC Module: IDC clip material: copper alloy with nickel plating

Encapsulated clips, in fire retardant, UL94V-0, plastic support, black

Modular Jack: Contact Material: copper alloy with 50 micro-inches gold over nickel

.2 Technical Specifications:

IDC Module: Gas tight connection – insulation slicing of 22 and 24AWG (0.64, and 0.51 mm) plastic insulated solid copper conductors

Durability: 10 insertions of any combination of wire gauge

Modular Jack: 8-pin or 6-pin connector, FCC part 68, Subpart F compliant

8-pin connector is compatible with 6-pin plugs

Durability: 750 mating cycles

.3 Transmission Characteristics:

Designed to exceed the Category 6A standard

Minimum average values measured at 500 MHz with Category 6A plugs

<u>Parameter</u>	<u>Value</u>
NEXT	26.1dB
PSNEXT	23.2 dB
Attenuation	0.10 dB
Return Loss	6.0 dB

.1 Electrical Characteristics:

Current rating: 1.5 Amperes maximum

Insulation Resistance: 500 MOhm minimum

Contact Resistance: 20 mOhm per contact

Dielectric Strength: 1,000 V RMS at 60 Hz for 1 minute

.3 Coaxial Connectors

.1 Coaxial connectors shall be compression style f-type and have a screw type coupling for quick connect/disconnect of coaxial cable at both ends.

.2 F Connectors shall be MDVO style for faceplates and/or patch panels.

.4 Modular Furniture Outlets

.1 Appropriate modular furniture faceplates shall be used and determined by modular furniture brand. Use four (4) port modular furniture faceplates to match furniture selected. Supply blanks for unused ports.

.2 The faceplates shall be mounted in the appropriate knockouts in the furniture channel.

.5 Surface Raceway mounted Outlets

.1 Appropriate modular surface raceway (e.g. Wiremold) faceplates shall be used and determined by surface raceway brand. Use three (3) port modular surface raceway faceplates to match surface raceway selected.

.2 The faceplates shall be mounted in the appropriate knockouts in the surface raceway and shall be segregated from the electrical raceway section

.6 Wall Faceplates

- .1 Work area wall outlets shall be constructed utilizing single gang, MDVO 4-port faceplates with label windows. Specified Product: AX101437
- .2 Wall Phones will be supplied with a single outlet metal faceplate, with metal mounting studs for the phone.
- .3 Data/voice outlets shall be loaded with modular jacks. Faceplates shall contain labelling.

PART 3: EXECUTION

3.1 INSTALLATION

- .1 Install all systems in accordance with manufacturer's printed instructions and manufacturer best practices.

***** END OF SECTION *****

PART 1: GENERAL

1.1 SUMMARY

- .1 Communications Patch Cords, Station Cords, and Cross-Connect Wire.
 - .1 Data cable assemblies for the horizontal cross-connect and the workstation shall be Category 6A RJ-45 to RJ-45 4-pair assemblies.
 - .2 Data, voice and other technology cable assemblies shall be factory-assembled by the manufacturer of the cabling system.
 - .3 Contractors to supply and install two (2) Cat6A patch cables for each Cat6A cable installed.
 - .1 One (1) Patch cable at Equipment room shall be 6-inch to facilitate tidy, interleaved patch-panel and switch layout as shown on drawings.
 - .2 One (1) patch cable at workstation end shall be 10ft
 - .3 Alternate workstation patch cord for Wireless Access Points (WAP) shall be 15ft for WAPs in accessible ceiling areas to allow for easy relocation of WAPs for best coverage. For WAPs in open-ceiling areas with hanging conduit electrical rough-ins, use 6" or 1' patch cables.
 - .4 Patch cables for WAPs in plenum spaces shall be plenum-rated. Contractor shall ensure plenum-rated patch cables are included in shop drawing submittals.
 - .4 Patch cord colours for both Hub Room and Work-Area Outlets shall be grey.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section
- .2 01 74 19 - Construction/Demolition Waste Management and Disposal.
- .3 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .4 Collect and separate for disposal paper, plastic, polystyrene, wood, corrugated cardboard packaging material in appropriate on site bins for recycling in accordance with Waste Management Plan.
- .5 Divert unused metal, wiring and plastic materials from landfill to metal/plastics recycling facility as approved by Departmental Representative.
- .6 Fold up metal banding, flatten and place in designated area for recycling.
- .7 Dispose of unused paint material of at official hazardous material collections site approved by Departmental Representative.
- .8 Do not dispose of unused paint material into the sewer system, into streams, lakes, onto ground or in any other location where it will pose health or environmental hazard.

PART 2: PRODUCTS

2.1 OWNER FURNISHED

- .1 All products are new by contractor.

2.2 MANUFACTURED COMPONENTS

- .1 Manufacturer warranty required for all communication structured wiring components.
 - .1 Acceptable Manufacturer: Belden
 - .2 The Project Manager reserves the right to switch out at no additional cost any patch cords to a shorter length. If this does occur, the General Contractor or his representative will notify the Contractor in writing prior to the Cut-Over date.
 - .3 The lengths requested must be common available lengths. If uncommon lengths are requested, the Contractor shall have two (2) weeks to substitute them. If common lengths are requested 48 hours shall be sufficient time to exchange to the desired length.
 - .4 Horizontal Category 6A Patch Cords.
 - .1 The Patch Cords at the Hub Room are to be small outside diameter, 28AWG stranded with exception to cables for CCTV which shall be standard 23 AWG (if Channel Performance Warranty requires solid conductors these must be used to maintain the Warranty) copper conductors (straight through mapping) consisting of 4 pairs that are twisted to form a cable core.
 - .2 The Patch Cords at the work area outlet locations are to be 23 AWG stranded (if Channel Performance Warranty requires solid conductors these must be used to maintain the Warranty) copper conductors (straight through mapping) consisting of 4 pairs that are twisted to form a cable core.
 - .3 The Patch Cords are to be CMR rated and stamped accordingly. The 8-pin modular/8-pin modular Patch Cords are to be consistent with the grade and manufacturer of the Data Cable that is being warrantied.
 - .4 All patch cables within plenum spaces shall be CMP/FT6 rated.
 - .5 The Contractor is required to supply and install all Patch Cords for complete connectivity of Horizontal Cables.
 - .6 Each Patch Cord is to be labelled as per the standards.

PART 3: EXECUTION

3.1 INSTALLATION

- .1 Install all systems in accordance with manufacturer's printed instructions as manufacturer best practices.

***** END OF SECTION *****



DIVISION 28 00 00 – SECURITY SYSTEMS
SPECIFICATIONS
FOR THE
CITY OF TORONTO
METRO HALL DAYCARE
55 JOHN STREET, TORONTO, ONTARIO

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Our Project No. 2021-0245

DISCIPLINES MECHANICAL
ELECTRICAL
PLUMBING
LIGHTING DESIGN
COMMUNICATIONS & AV
SECURITY & RISK
COMMISSIONING
ENERGY SERVICES

January 26, 2024
Issued for Tender

PART 1: GENERAL

1.1 COPYRIGHT

- .1 Copyright to these Division 28 Specifications is retained by Hidi Group Consulting Engineers Inc. The use of these Specifications is granted to the City of Toronto solely for their use on the (TESS) Toronto Employment & Social Services located on 900 Dufferin Street, Toronto, ON.

1.2 BUILDING SECURITY SYSTEM (BSS) DOCUMENTS

- .1 The requirements of the Project Manual are related to and shall be read in conjunction with this section.
- .2 The contract documents for the Building Security System (BSS) include the following Division 28 documents:
 - .1 Section 28 00 00 – BSS General
 - .2 Section 28 05 00 – BSS Installations – General
 - .3 Section 28 05 13 – BSS Installations – Electrical
 - .4 Section 28 08 00 – Testing and Inspections
 - .5 Section 28 08 01 – Documentation
 - .6 Section 28 13 13 – Access Control and Alarm Monitoring System
 - .7 Section 28 13 26 – ACAMS Field Devices
 - .8 Section 28 23 00 – Video Surveillance System
 - .9 Section 28 26 00 – Security Intercom System

1.3 DEFINITIONS

- .1 "OWNER" shall mean City of Toronto or their appointed representative.
- .2 "ARCHITECT" shall mean the Project Architect, Diamond Schmitt Architects.
- .3 "ELECTRICAL ENGINEER" shall mean the Project Electrical Engineer, The Hidi Group Consulting Engineers Inc.
- .4 "CONSULTANT" shall mean the Project Security Consultant, HIDI Security Consulting, an operating name of The Hidi Group Consulting Engineers.
- .5 "CONTRACTOR" shall mean the BSS Contractor who shall provide the Building Security System.
- .6 "GENERAL CONTRACTOR" shall mean the project general contractor.
- .7 "ELECTRICAL CONTRACTOR" shall mean the project electrical contractor or Subcontractor.
- .8 "BSS" shall mean the complete Building Security System.
- .9 "FURNISH" shall mean purchase and deliver to the appropriate installing Contractor/Subcontractor or equipment manufacturer, complete with every appurtenance, document, commission and Warrant.

- .10 "PROVIDE" shall mean furnish, install, commission, test and warranty.
- .11 "COMPONENT" shall mean any individual item of equipment, software or material, which is an element of the BSS.
 - .1 The above definitions shall apply to the words when they are in the upper case, when they are in lower case and when they are capitalized.
 - .1 Words used in the singular shall not be construed as limiting to one item where other requirements of the contract documents or the scope of work require multiple items and associated accessories in order to provide a fully functional BSS meeting all of the requirements detailed in the contract documents.
 - .2 When a specific reference to a manufacturer of a product is made, and the terms "or approved equal" are used, substitutions of a product by another manufacturer or model will be allowed, but the substituted product must conform to all specified requirements. A submission including a compliance statement and technical information must be made to the Consultant for consideration. The Consultant determination on the acceptability of substitutes shall be final. Approved substitution equipment shall conform to available space, functional, and power requirements. Substituted equipment that does not conform to the requirements shall be replaced or required modifications made at no additional cost to the Owner.
- .12 When a specific reference to a manufacturer of a product is made, and the terms "or alternate with credit" are used, substitutions of a product by another manufacturer or model with a cost credit will be allowed. A submission including a compliance statement, technical information, and cost implication must be made to the Consultant for consideration. Areas where the product is not in compliance with the Specifications shall be clearly noted. The Consultant determination on the acceptability of substitutes shall be final. Approved substitution equipment shall conform to available space, functional, and power requirements. Substituted equipment that does not conform to the requirements shall be replaced or required modifications made at no additional cost to the Owner.

1.4 ABBREVIATIONS

- .1 The following abbreviations shall apply to this and all subsequent sections of the Specifications:

ACAMS	-	Access Control and Alarm Monitoring System
BSS	-	Building Security System
CCTV	-	Closed Circuit Television
CIS	-	Computer Interface Station
CO	-	Control Output
CPU	-	Central Processing Unit
DRS	-	Digital Recording System
DVR	-	Digital Video Recorder
FAS	-	Fire Alarm System
HEACS	-	Hotel Electronic Access Control System
ICP	-	Intelligent Control Panel
ID	-	Identification
IDS	-	Intrusion Detection System
MI	-	Monitored Input
NAS	-	Network Attached Storage
NDR	-	Network Digital Recorder
NDS	-	Network Data Server
NSW	-	Network Switch
OIW	-	Operator Interface Workstation
PCS	-	Parking Control System
RAM	-	Random Access Memory
REX	-	Request to Exit
RFI	-	Request for Information

RFP	-	Remote Field Panel
RM	-	Remote Module
SAN	-	Storage Area Network
SER	-	Security Equipment Room
SIS	-	Security Intercom System
SMD	-	Security Monitoring Desk
VBS	-	Video Badging System
VDW	-	Video Display Wall
VMD	-	Video Motion Detection
WDS	-	Web Data Server
WDU	-	Wall Display Unit
WFP	-	Workstation Flat Panel

1.5 SCOPE OF WORK

- .1 Provide a complete BSS turnkey installation as detailed in this and other sections of these specifications. The BSS shall comprise of the following systems:
 - .1 An IP-based Access Control and Alarm Monitoring System (ACAMS) throughout the facility as detailed on the BSS drawings and in compliance with section 28 13 13 and 28 13 26 of these specifications. ACAMS shall be connected to and utilize the property’s security network for communication. ACAMS head end is existing.
 - .2 Access cards shall be supplied by the client.
 - .3 An IP-based Video Surveillance System (VSS) throughout the facility as detailed on the BSS drawings and in compliance with section 28 23 00 of these specifications. VSS shall be connected to and utilize the property’s security network for communication. VSS NVR is existing.
 - .4 An IP-based Security Intercom System (SIS) capable of two-way real-time communication between the substation and master station locations. Substations will be purpose-built for the function and installed location. Provide throughout the facility as detailed on the BSS drawings and section 28 26 00 of these specifications. SIS shall be connected to and utilize the property’s converged network for communication.
 - .5 An IP-based Intrusion Detection System (IDS) throughout the facility as detailed on the BSS drawings and in compliance with section 28 16 00 of these specifications.
 - .6 Provide integration from the BSS to other systems as follows:
 - .1 Connect BSS components to barrier-free equipment and coordinate with door hardware provider to ensure all functionality and sequencing is in compliance with Building Codes and does not cause electrical or mechanical conflict on each respective system. Provide all necessary components and coordination.
 - .7 Testing, scheduling and inspections as specified in section 28 08 00 of these specifications.
 - .8 Training as specified in section 28 08 02 of these specifications.
 - .9 The following City of Toronto Security documents will be shared post-tender with the selected Security sub-contractor:
 - .1 CITY OF TORONTO CORPORATE SECURITY – ACCESS CONTROL SYSTEM INSTALLATION STANDARD.
 - .2 CITY OF TORONTO CORPORATE SECURITY ACCESS CONTROL SYSTEM INSTALLATION AND SYSTEM REQUIREMENTS.

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- .3 CCURE 9000 PROGRAMMING STANDARDS.
 - .4 TORONTO CORPORATE SECURITY – STANDARD FOR IP VIDEO SURVEILLANCE SYSTEM.
- .2 Provide the following support for the BSS components:
- .1 Installations in compliance with industry best practices, and in compliance with sections 28 05 00 and 28 05 13 of these specifications.
 - .2 Submittals, samples and record documentation as specified in section 28 08 01 of these specifications.
 - .3 Coordination with other site subcontractors.
 - .4 Reporting to the Owner, the Architect and Consultant for the coordinated and timely execution of the Work.
 - .5 2 year warranty on all components furnished, beginning from date of substantial performance/completion.
 - .6 Maintenance services during the warranty period.
 - .7 All power supplies and conditioners, interlocking and control relays, equipment enclosures, conduit and cable trays, junction and mounting boxes, cabling, access doors, sleeves, fire stopping and other components, software, materials and services required for a completed and fully operational turnkey BSS installation meeting these specifications.
- 1.6 BSS GENERAL CRITERIA
- .1 The BSS shall meet the following general criteria:
 - .1 All BSS control equipment, including but not limited to: system control panels, networked devices, workstations, interface devices shall be fully IP networked, microprocessor based, and feature real time distributed processing. All networked devices shall reside on a common security network, provided as detailed in the BSS drawings and these specifications.
 - .2 The BSS shall be configured to ensure reliability of systems operation and control of critical functions/systems. The following describes, in very general terms, a relationship between the various components of the BSS that would be acceptable. Other BSS topologies shall be acceptable if they meet the intent and performance requirements defined in these specifications.
 - .1 All ACAMS, CCTV, and SIS Network Data Servers are existing and are located off site.
 - .2 Where requested in the BSS drawings and specifications, provide a BSS Local Area Network (LAN) to serve the BSS system(s). The Security LAN shall be a high speed Ethernet TCP/IP based network compliant to telecommunications standards, with either a copper or fiber backbone sufficient to support 10Gbs of network activity.
 - .3 Any Intelligent Control Panels (ICP's) shall be network based, communicate natively via TCP/IP, and connect to the BSS LAN for communication to the ACAMS server. The network connection shall be via a direct on-board RJ-45 connection on the ICP. The use of code or protocol converters (cobox) is not permitted.
 - .4 Any Remote Modules (RM's) (specific system required control or monitoring panels if required) that are subcomponents of ICP's shall be directly connected to their corresponding ICP via dedicated cabling referred to as panel cabling. If physically

possible, the RM's shall be located within the same room as the ICP, otherwise in approved locations as agreed upon by the owner and consultant.

- .5 Field devices connected to RM's or ICP's shall be directly connected via dedicated cabling. This cabling shall be compliant to the device's functional requirements, manufacturer's recommendations, and these specifications.

1.7 WARRANTY AND SERVICES DURING THE WARRANTY PERIOD

- .1 The Warranty Period for all components of the new BSS and their installation shall be a minimum of one (1) year from the date of Substantial Performance. The date of Substantial Performance shall be the date when all components have been certified by the Consultant and accepted by the Owner to be complete in accordance with the definition of Substantial Performance.
- .2 All components and their installations shall be free from defects. Any defective material or workmanship and any resulting damage to work of other trades shall be replaced or repaired as directed during the Warranty Period. Comply with General Conditions, agreeing to repair or replace any components of the BSS that have failed within the warranty period.
- .3 Schedule repair work with the Owner's representative to prevent interference with normal building activities.
- .4 The Base Tender price shall include the cost of all replacement parts during the warranty period and all of the associated installation costs and all of the costs associated with the repair of components during the warranty period but shall not include the cost of labour for routine maintenance during the warranty period. The cost of labour for routine maintenance during the warranty period shall be provided separately as an Alternate Price as detailed below.
- .5 Replace or repair all supplied defective installations. Respond and be on site within four hours of the Owner placing a system trouble call for items of a critical, urgent or immediate nature (e.g. failed head end component, non-functioning controller, etc.). Response to Warranty call out by the Owner shall be within 24 hours for items not requiring immediate attention. Work to trouble shoot and identify the cause of the BSS or component failure shall begin immediately and shall continue until repaired to the satisfaction of the Owner.
- .6 Any software modifications or upgrades that become standard product offerings from the BSS Contractor and/or BSS equipment vendors during the warranty period shall be brought to the attention of the Owner and, at the discretion of the Owner, may be requested and, if so, shall be provided at no additional cost to the Owner.
- .7 The BSS Contractor shall maintain an inventory of commonly replaced components in the local office for the replacement of failed components. Larger components shall be readily available within the North America for overnight courier shipping response.

1.8 CODES, PERMITS AND APPROVALS

- .1 Obtain all required permits, such as Magnetic Lock Installation Permits, and any other security –related inspection certificates. All permits and certificates shall be made available to the Owner.
- .2 The latest requirements of all national, provincial, county, municipal and other authorities having jurisdiction shall be met.
- .3 Work that is not clearly defined by local ordinance or amendment shall be governed by the Canadian Building Code, the Ontario Building code and the Canadian Electrical Code.
- .4 The requirements of The Occupational Health and Safety Act (OHSA), Environmental Protection Act (EPA), Americans with Disabilities Act (ADA), Accessibility For Ontarians With disabilities (AODA) and CSA Barrier Free Design Standards shall be followed for all job-site procedures and installation methods.

- .5 Work shall be performed in compliance with Owner's insurance underwriters' requirements which will be provided to the successful BSS proponent following project award.
- .6 All equipment and materials furnished under this subcontract shall be new, and shall meet all applicable UL/ULC standards and all requirements of these specifications.

1.9 SCHEDULE

- .1 Complete all requirements of the BSS subcontract prior to the scheduled Substantial Performance date for each portion of the work.
- .2 Provide to the General Contractor a schedule indicating the sequence of work, durations of individual tasks, delivery dates for all material, devices and equipment and detail any interface that must be coordinated with any other subcontractors.
- .3 Attend all project meetings as requested by the Owner and the General Contractor.
- .4 Provide written status reports at required intervals and in a format acceptable to the Owner. An updated schedule of work shall be included in each status report.
- .5 Comply with the Project Construction Schedule. Provide additional staff and work overtime as required to comply with the Project Schedule and so as not to interfere with other on-site subcontractors in their effort to comply with the Project Schedule.
- .6 Provide written Request for Information notices to the Owner when specific information or clarification of the specifications is required. Request for Information notices shall be provided at least two weeks prior to the need for the information.

1.10 CONTRACTOR QUALIFICATIONS

- .1 The Contractor shall:
 - .1 Be certified by the manufacturer to procure, install, program, maintain, and service the acceptable BSS components.
 - .2 The Contractor must have permanent full-time certified staff available in the Toronto area to perform all necessary project cycle installation functions, including service and maintenance work following system acceptance.
 - .3 Have staff and be able to supply information to support that their current installation and service technicians are competent factory trained and certified personnel capable of maintaining and servicing the proposed system.
 - .4 Have a proven record of experience with similar in the supply and installation of equivalent systems over a minimum period of five years. Document at least three and no more than six projects, of equal or greater size and complexity, on the acceptable BSS components. Indicate quantities of card readers, CCTV cameras, and SIS units included in the scope of the projects along with a description of the property secured.
 - .5 Have been a factory certified representative for the ACAMS, CCTV, and SIS products indicated, for a minimum of three years entailing design, installation, configuration, and maintenance.
 - .6 Have comprehensive local service and support facilities in the Toronto area for the total BSS as provided.
 - .7 Maintain local supplies, or have access to a factory authorized organization that shall carry a complete stock of essential and expendable parts.

1.11 SYSTEM COMPLIANCE AND PERFORMANCE CERTIFICATION

- .1 The BSS Contractor shall thoroughly review all aspects of the BSS Design Documents and certify that their bid submission and proposed BSS facilities are in compliance with the Contract Documents. The Contractor shall provide a compliance review (“Compliance Review”) of all Specifications and Addenda as part of the Contractor’s proposal. The Compliance Review will be an item-by-item list and review of the Specifications. The BSS Tender Respondents shall clearly identify any areas where the proposed BSS facilities are not in full compliance with the BSS design. An accompanying performance statement and technical supporting documentation must be supplied for consideration.

- .2 Unless an exception is specifically noted in the Compliance Review, it is assumed that the Contractor is in complete compliance with the Contract Documents. Exceptions taken in cover letters, subsidiary documents, by omission or by contradiction do not release the Contractor from being in complete compliance unless the exception has been specifically noted (explicitly, not by implication) in the Compliance Review.

***** END OF SECTION *****

PART 1: GENERAL

1.1 WORK OF THIS SECTION

- .1 This section of the specification details the components to be provided by the BSS Contractor relating to BSS Installations - General.

1.2 RELATED REQUIREMENTS

- .1 The requirements of the Project Manual are related to and shall be read in conjunction with this section.
- .2 This section is related to and shall be read in conjunction with all other Division 28 sections.
- .3 This section is related to and shall be read in conjunction with the BSS drawings.

PART 2: REQUIREMENTS

- .1 Equipment, materials, devices and facilities shall meet, at minimum, the following requirements:
 - .1 Manufactured by experienced manufacturers of the specific components and facilities.
 - .2 All equipment and materials shall be manufactured using new and high-quality components, without defects. All field devices of each system shall be products of one manufacturer with unified shape, colour, design, function, operation, and markings.
 - .1 Design shall minimize the requirement for field repair or maintenance.
 - .2 Modular design to allow expansion without substantial modification of existing installed components.
 - .3 Internal or self-diagnostics for component failures.
 - .4 Maintainable on a unit basis without affecting the ongoing operation of the balance of other systems.
 - .5 Modular components, test ports and cable terminations shall be accessible.
 - .6 Damage caused by the failure of one component will be limited to the component that has failed without affecting the ongoing operation of the systems.
 - .3 Equipment and materials shall be provided with an Underwriters Laboratories, Inc. (U.L.) and Canadian Standards Association C.S.A label wherever applicable.
 - .4 Hazardous Materials Notification: In the event that a product or material that does not contain asbestos, PCB, or other hazardous materials as determined by the Owner is not available, a "Material Safety Data Sheet" (MSDS) equivalent to OHSA Form shall be submitted for the proposed product or material prior to installation.
 - .1 Asbestos and PCB Certification: After completion of installation, but prior to Substantial Performance, the BSS Contractor shall certify in writing that products and materials installed, and processes used, do not contain asbestos or polychlorinated biphenyls (PCB).

2.2 EQUIPMENT - MOUNTING AND FINISHES

- .1 Fire rated or U.L. /U.L.C. listed doors and frames shall not be drilled, cut or modified in any way without prior approval from the Architect. Doors or frames that require modification to meet the Contract

Document requirements shall be brought to the attention of the Architect. Replace any door or frame that has been modified without the approval from the Architect.

- .2 Visible panel and instruction labels shall be in compliance with the CSA Barrier Free Design Standards as approved by the Architect. Graphics for all equipment in areas accessible by the public shall be approved by the Architect.
- .3 Visible security BSS contractor identification logos, trademarks, or evidence of their removal are not permitted on any equipment, or devices, etc. that are located in publicly-accessible, and viewable spaces. Equipment, devices or enclosures accessible to the public shall utilize tamper proof fasteners or manufacturer-installed locks.
- .4 Final mounting locations shall be verified with the Architect prior to installation. Notify the Architect if a particular location is not acceptable for the application.

2.3 AMBIENT CONDITIONS

- .1 Provide equipment, devices and materials for interior applications that shall be capable of withstanding and operate satisfactorily in, at minimum, the following ambient conditions:
 - .1 10 to 45 Deg. Celsius temperatures.
 - .2 10-90 percent relative humidity (non-condensing).
 - .3 Electrical power service of single phase, 85-110 percent of 120 Vac, 60 Hz nominal.
- .2 Provide equipment, devices and materials for exterior applications that shall be capable of withstanding and operate satisfactorily in, at minimum, the following ambient conditions:
 - .1 -40 to 50 Deg. Celsius temperatures.
 - .2 10 - 100 percent relative humidity.
 - .3 Electrical power service of single phase, 85-110 percent of 120 Vac, 60 Hz nominal.

PART 3: PRODUCTS

3.1 PANELS

- .1 Provide panels and enclosures for all components of the BSS which are susceptible to physical or environmental damage. Equipment or devices that are not equipped with enclosures, as a specified unit shall be mounted within panels or enclosures that meet, at minimum, the following requirements:
 - .1 NEMA 1 rated painted steel panels with locking door.
 - .2 Ventilated to prevent excessive heat build-up, where required.
 - .3 Field cabling shall be terminated on a terminal strip or directly on the component PCB fixed within the enclosure. Provide strain relief as necessary.
 - .4 Internal components shall be installed to allow easy access for diagnostics, maintenance, removal or replacement of any component within the enclosure.
 - .5 Cabling shall be neatly installed within wire guides with removable covers for easy access.
- .2 Interior panels and enclosures within plenum areas shall meet, at minimum, the following requirements:

- .1 Approved plenum rated panel with locking door and gasketing as required.
 - .2 Field cabling shall be terminated on a terminal strip or directly on the component PCB fixed within the enclosure. Provide strain relief as necessary.
 - .3 Internal components shall be installed to allow easy access for diagnostics, maintenance, removal or replacement of any component within the enclosure.
 - .4 Cabling shall be neatly installed within wire guides with removable covers for easy access and additional service-loop spare cabling common in best industry installation practices.
- .3 Exterior and garage mounted panels and enclosures shall meet, at minimum, the following requirements:
- .1 NEMA 4 painted steel panels with locking door.
 - .2 Field cabling shall be terminated on a terminal strip or directly on the component PCB fixed within the enclosure. Provide strain relief as necessary.
 - .3 Internal components shall be installed to allow easy access for diagnostics, maintenance, removal or replacement of any component within the enclosure.
 - .4 Cabling shall be within wire guides with removable covers for easy access.
- .4 All panels shall be lockable with the same key, which shall be unique to the building. Provide the Owner with ten keys.
- .5 Panels and enclosures are only allowed at the ACAMS RFP locations as indicated on the Security Drawings.
- .6 Provide cabling diagrams laminated in clear plastic at each field panel enclosure showing all cable terminations, relays, interlocks, power supplies, etc.
- .7 Provide heat output and space conditioning requirements to the Owner and Architect for all BSS components.

3.2 LABELLING

- .1 Provide labelling for all ICP's, RFP's, other panels and enclosures. Labelling shall meet, at minimum, the following requirements:
 - .1 Plastic laminated label, which shall be affixed to the panel or enclosure with rivets or permanent adhesive.
 - .2 Lettering .25 inch high which sharply contrasts with the background.
 - .3 Coordinated with the approved project labelling scheme and consistent throughout the project.
 - .4 Indicated on the record documentation.

PART 4: EXECUTION

4.1 BORING AND PATCHING

- .1 Provide boring and patching of work as required for a complete BSS. Boring and patching shall meet, at minimum, the following requirements:
 - .1 Before boring any structural or fire rated components, obtain the Architects' approval.

- .2 Make boring with clean, square and smooth edges. Patches shall be inconspicuous in the final installation.
- .3 Restore fire ratings if boring has violated the fire rated assemblies.

4.2 SLEEVES, CUTTING, PATCHING AND FIRE STOPPING

- .1 The Contractor shall be responsible for the timely placing of sleeves as detailed on the Drawings and the Coordination Drawings for all piping and conduit through walls and partitions, beams, floors and roofs as noted below, while the same are under construction:
 - .1 All concrete or masonry construction.
 - .2 Wall constructions where the penetration must be sealed air tight. Patches for penetrations through walls for Work installed prior to finish application shall be provided by others. 13mm (1/2")
 - .3 Fire rated wall construction.
- .2 Sleeves shall be at least one size larger than the size of conduit or pipe, including the insulation where applicable; it serves except where "Link Seal" casing seals are used in sleeves through walls below grade. Sleeves shall be sized such that the annular space between the sleeve and the conduit will not be less than 13mm (1/2"). All conduits passing through concrete or masonry walls above grade shall be at least 18 gauge galvanized steel sleeves. Sleeves shall be set flush with finished wall. All sleeves in floors shall extend a minimum of 50mm (2") above the finished floor. Sleeves installed in fire rated construction shall be of suitable length and diameter to accommodate the firesafing system used. Sleeves set in concrete floor construction shall be at least 16 gauge, galvanized steel. Where the conduit passes through a sleeve, no point of the conduit shall touch the sleeve and the conduit shall be centred in the sleeve.
- .3 Seal all penetrations in fire rated construction with factory built devices or with manufactured fill, void or cavity materials "Classified" by Underwriters Laboratories, Inc. for use as a Through Penetration Firestop. All firestop devices and systems shall be approved for such use by the authorities having jurisdiction. The firestop system used shall maintain the fire resistance rating of the building component that is penetrated. Firestop systems and devices shall comply with ASTM E 814 (UL 1479) for all types of penetrations being sealed. Submittal data for firestop systems shall include the applicable UL System Numbers. Excessive shrinkage of the firestop materials, which would permit the transmission of smoke or water prior to exposure to a fire condition, is unacceptable. Where a mastic coating is used to seal the surface of the firestop, the mastic shall be non-hardening. The firestop manufacturer's representatives shall instruct the Contractor's representatives in the proper installation procedures so that the penetrations on the Project will be installed in accordance with the UL listing and the manufacturer's recommendations. If it complies with these Specifications, firestop-sealing component/system as manufactured by one of the following manufacturers will be acceptable:
 - .1 Tremco Fire Resistive Joint System using Dymeric sealant and Cerablanket-FS mineral filler or,
 - .2 Specified Technologies, Inc. SpecSeal Systems or,
 - .3 3M Fire Barrier Penetration Sealing Systems or,
 - .4 GE Pensil Firestop Sealant by General Electric or,
 - .5 International Protective Coatings Corp. Flame Safe Systems or,
 - .6 Thermal Ceramics Fire Master Firestop Fire Protection Systems or,
 - .7 Hilti FS-601 Systems.

- .4 Sleeves penetrating walls below grade shall be standard weight black steel pipe with 1/4" thick steel plate waterseal secured to the pipe with continuous fillet weld. The waterseal plate shall be located in the middle of the wall and shall be 50mm (2") wider all around than the sleeve it encircles. The entire assembly shall be hot dipped galvanized after fabrication. Seal off annular opening between pipe and sleeve with "Link Seal" type casing seal as manufactured by Thunderline Corporation or Innerlynx. The pipe sleeve shall be sized to accommodate the Thunderline casing seal. Casing seals shall be Series 300 for pipe size 20mm (3/4") through 100mm (4") and Series 400 for pipe sizes 125mm (5") and larger. If holes and/or sleeves are not properly installed and cutting and patching becomes necessary, it shall be done at no additional expense to the Owner. The Contractor shall undertake no cutting or patching without first securing the Architect's written approval.
- .5 All unused sleeves shall be sealed with firestop devices and systems to maintain the fire rating of the construction penetrated.

4.3 HANGING AND SUPPORTING

- .1 Install all equipment, devices, materials and components in compliance with the manufacturer's recommendations. Supports shall be suitable for the environment within which the component is to be installed. Coordinate all hanging and supporting of components with all trades.
- .2 Structural support members shall be galvanized.

***** END OF SECTION *****

PART 1: GENERAL**1.1 WORK OF THIS SECTION**

- .1 This section of the specifications details the requirements for the testing and inspecting of the BSS.

1.2 RELATED REQUIREMENTS

- .1 The requirements of the Project Manual are related to and shall be read in conjunction with this section.
- .2 This section is related to and shall be read in conjunction with all other Division 28 sections.
- .3 This section is related to and shall be read in conjunction with the BSS drawings.

PART 2: REQUIREMENTS**2.1 SCHEDULING**

- .1 Acceptance testing shall comply with the Construction Contract schedule. Corrections or alterations, which have been noted during the acceptance tests, shall be completed prior to the end date called for in the Construction Contract. Retests of deficient items shall be taken into consideration in the scheduling.

2.2 TESTING AND INSPECTIONS - GENERAL

- .1 All components shall be tested by the BSS Contractor to ensure compliance with the Specifications before they leave the BSS Contractor's premises and shall be tested again on-site by the BSS Contractor before the commencement of acceptance testing. The BSS Contractor shall not ship components to the project site until they have been found to be fully compliant with the specifications and the BSS Contractor shall not request the commencement of acceptance testing until such time as the BSS Contractor has made a complete and thorough checkout of all equipment.
- .2 Any piece of equipment, device, or material shall be made available for inspections or tests, as deemed necessary by the Owner and Consultant. Use of the equipment, devices or material shall not imply acceptance of the system or acceptability of any component. Availability and demonstration of the systems shall not be withheld and the use of components shall not imply the start of the Warranty Period.
- .3 Costs associated with the required inspections and testing shall be included in this scope of work. Additional charges shall not be accepted.

PART 3: PRODUCTS**3.1 FACTORY TESTS**

- .1 Components shall be factory tested prior to their delivery to the project. Document test results and submit copies of the testing within the Final Documentation.
- .2 Deficiencies shall be remedied and testing shall be repeated at no additional cost to the Owner prior to the shipping of the components to the project site.

PART 4: EXECUTION**4.1 INSPECTION DURING INSTALLATION**

- .1 Prior to acceptance testing, the BSS shall be available for the use by the Owner. Use by the Owner shall not imply acceptance of the BSS or any components or the commencement of the Warranty Period.

- .2 Provide staff to assist the Consultant in the inspections made during the installation period to review the progress and quality of the ongoing work. The Consultant will generate Field Observation Reports in the findings of the inspection. The Consultant shall advise the BSS Contractor during the inspection of any concerns noted with respect to the installation and shall repeat the concerns in writing as soon as possible after the inspection is completed. The BSS Contractor shall take corrective action to meet the requirement of the specifications.
- .3 Failure to identify any error or omission during inspections made in the installation phase shall not relieve the Contractor of any of the specification requirements.

4.2 ACCEPTANCE TESTING

- .1 Prior to the scheduling of the acceptance testing with the Consultant, perform a complete and detailed operational check of each BSS component. Test results shall be documented using test sheets. The test sheets shall be prepared in an appropriate format for the various categories of component to be tested and shall be submitted for approval during the shop drawing phase of the project.
- .2 Completed test sheets indicating the test results for each BSS component within the system shall be submitted to the Consultant, together with a proposed schedule for acceptance testing, at least two weeks prior to the proposed acceptance testing. The Owner and Consultant shall determine on the basis of the BSS Contractor's testing, whether or not it is appropriate to commence acceptance testing. It shall be their decision as to whether the acceptance testing can proceed as proposed by the BSS Contractor or whether deficiencies have to be remedied before the acceptance testing can proceed.
- .3 The entire installation shall go through final acceptance testing at the completion of the project. Installation, engineering, software and system personnel shall be available on-site during the acceptance test. These personnel shall be familiar with the installation and shall undertake all tests as requested by the Owner and Consultant in order to verify that the BSS components individually and in total meet the specifications. The BSS Contractor shall provide wireless radios to allow communication among the testers in the field.
- .4 Deficiencies shall be indicated on a "punch-list". The deficiencies shall be corrected and a time of follow-up testing shall be scheduled. If there are deficiencies remaining after the follow-up testing that required further testing by the Consultant, then the expenses of the Owner and Consultant incurred in providing the additional follow-up tests to verify compliance with the specifications, including travel, subsistence, accommodation and normal consulting fees, shall be paid by this Contractor at no additional cost to the Owner.

4.3 TEST SHEET FORMAT

- .1 Provide ACAMS test sheets for each ACAMS monitored and controlled device. Include, at minimum, the following categories on the test sheet.
 - .1 Point number - as identified on the security drawings.
 - .2 Card reader - test using valid and invalid card.
 - .3 Electric Lock - test release upon valid card and ACAMS operator command, and non-release upon invalid card.
 - .4 Door Status - test each door leaf independently for held open door status.
 - .5 Forced door - test each door leaf independently by removing power to the electric lock (if applicable) and then opening the door.
 - .6 REX devices - test each device independently for activation status.

- .7 Alarm devices – generate appropriate alarm condition, and test each device for alarm status (visibility, audibility, etc.).

- .2 Provide CCTV test sheets for each CCTV camera. Include, at minimum as applicable, the following categories on the test sheet.
 - .1 Point number - as identified on the security drawings.
 - .2 Image Quality - visually verify each cameras image quality.
 - .3 For coordination with the Owner/Consultant, provide preliminary test sheet displaying a colour snap shot image of the maximum field of view (FOV) for each camera in the system. Once markup drawings of the desired field of view of each camera are provided by the Owner/Consultant, point and focus the respective camera to the desired FOV for final test sheet.
 - .4 Confirmation of optimal FOV with a colour snap shot image (minimum 2" x 2") recorded on the test sheet
 - .5 Motion - test each camera independently for motion detection alarm, and that appropriate recording actions have been initiated.

- .3 Provide SIS test sheets for each intercom station. Include, at minimum as applicable, the following categories on the test sheet.
 - .1 Point number - as identified on the security drawings.
 - .2 Call quality – confirm audibility and intelligibility of communication between substation and master station are sufficient to suit the location of the substation.
 - .3 Call sequencing – confirm that the ring sequences are in compliance with Section 28 26 00.

***** END OF SECTION *****

PART 1: GENERAL**1.1 WORK OF THIS SECTION**

- .1 This section details the requirements for those components of the BSS relating to BSS documentation.

1.2 RELATED REQUIREMENTS

- .1 The requirements of the Project Manual are related to and shall be read in conjunction with this section.
- .2 This section is related to and shall be read in conjunction with all other Division 28 sections.
- .3 This section is related to and shall be read in conjunction with the BSS drawings.

PART 2: REQUIREMENTS**2.1 DOCUMENTATION - GENERAL**

- .1 The primary purpose of the shop drawing and equipment documentation submittals is to give instruction and information to those responsible for providing a turnkey BSS which is compliant with the BSS specifications in all respects. The Consultant shall review the shop drawings and equipment documentation submittals with the intent of identifying as many potential areas of non-compliance as possible, but the review of shop drawings and equipment documentation submittals by the Architect, Engineer and Consultant, shall not relieve the Contractor of the responsibility for complete compliance with the specifications. Identification of some errors by the Architect, Engineer and Consultant but overlooking others does not relieve the Contractor of his responsibilities nor does it allow him to proceed based on erroneous shop drawings and equipment documentation submittals.
- .2 Approval of shop drawings or submittal data by the Architect, Engineer or Consultant shall not constitute an order to fabricate, purchase, ship to the site or undertake any other action. The sole responsibility for the timely purchase and/or fabrication of components, obtaining approval on shop drawings and equipment documentation submittals, and delivery of components to the project to comply with the requirements of the project schedule is that of the Contractor.
- .3 The intent of the record documentation is to provide the Owner with complete information on the BSS provided such that a person familiar with installations of this nature shall be able to perform any operating, maintenance or engineering functions with respect to this BSS without having to contact the BSS Contractor or obtain any additional documentation.

PART 3: PRODUCTS**3.1 SHOP DRAWING AND EQUIPMENT DOCUMENTATION**

- .1 Prepare all shop drawings, diagrams, equipment and device schedules, equipment technical data sheets and software information necessary for the Consultant to determine compliance with the specifications. Submit all shop drawings and equipment documentation data together as one submittal within four (4) weeks after notice to proceed.
- .2 The following information shall be included on the cover page for each shop drawing and equipment documentation sheets:
 - .1 Project name.
 - .2 Date.
 - .3 Submittal number and re-submittal number as appropriate.

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- .4 Name and address of Consultant.
 - .5 Name and address of General Contractor.
 - .6 Name and address of BSS Contractor.
 - .7 Name and address of supplier or vendor if appropriate.
 - .8 Name of manufacturer.
 - .9 Reference to the applicable Specification Section by name and number.
 - .10 Stamped and signed coordination certification stamp.
 - .11 Compliance certification as required in Section 28 00 01.
- .3 Shop drawings shall be CAD generated and be clearly referenced to each other and shall include diagrams, mounting instructions, installation procedures, equipment details and software descriptions for all components of the system. AutoCAD floor plan drawings shall be provided to the Contractor. Shop drawings shall be in this order and at a minimum include:
- .1 Cover page with required information identified above.
 - .2 Floor plan drawings in same order and format as architectural drawings. Floor plans shall indicate each BSS field device location. Uniquely identify each cable type for each field device. Identify desired cable routing from each device to termination location. Update these drawings to reflect actual routing location on as-built submittals. Provide a chart based schedule on each floor plan drawing or on a separate drawing sheet prior to the floor plans with, at minimum, the following columns for:
 - .1 ACAMS:
 - .1 Point reference.
 - .2 Device type (card reader, door contact, local alarm, etc. with manufacturer/model number).
 - .3 Lock/control type (manufacturer/model number) if appropriate.
 - .4 Request to exit device type (manufacturer/model number) if appropriate.
 - .5 Special accessories.
 - .6 Cable type (manufacturer/model number).
 - .7 Cable colour and labelling scheme.
 - .2 CCTV system:
 - .1 Fixed or PTZ.
 - .2 Camera and Lens type (manufacturer/model number).
 - .3 Housing type (manufacturer/model number).
 - .4 Mount type (manufacturer/model number).
 - .5 Special accessories.

- .6 Cable type (manufacturer/model number).
- .7 Cable colour and labelling scheme.
- .3 Floor plan drawings in same order and format as architectural drawings. Floor plans shall indicate each BSS field device location. Uniquely identify each cable type for each field device. Identify desired cable routing from each device to termination location. Update these drawings to reflect actual routing location on as-built submittals. Provide a chart based schedule on each floor plan drawing or on a separate drawing sheet prior to the floor plans with, at minimum, the following columns for:
 - .4 Separate wiring schematic diagram for each system. Include all types of controllers, panels, interfaces, and interconnection locations to head-end equipment.
 - .5 Separate Riser diagrams for each system including general layout and configuration of each system indicating major component locations and relationships.
 - .6 Detail installation diagrams of all monitoring and control equipment for each monitoring and control equipment location. Include routing of wiring.
 - .7 Wiring diagrams and installation drawings for each component.
 - .8 BSS data communications network architecture diagram indicating all NDS's, OIW's, SAN devices, ICP's, video encoder/decoder units, CIS's, other network connected devices, network switch and network interface connection points.
- .4 Equipment documentation submittals shall include design, performance and installation details for all aspects of the system to be installed. At minimum, the submittals shall include:
 - .1 Bill of Quantities with name and address of supplier or vendor for each device.
 - .2 Equipment technical data sheets.
 - .3 Central monitoring and control equipment.
 - .4 Operator workstation specifications and data sheets.
 - .5 Software specifications and descriptions.
 - .6 Training outline.
- .5 Literature pertaining to a particular item, piece of equipment or installation shall be submitted at one time and shall be specifically prepared for this project. Each submittal shall be properly marked with service or function, any options available that are not to be provided shall be crossed out or options that will be provided shall be highlighted.
- .6 Comply with the requirements of the Contract Documents. Any deviations from the Contract Documents will not be allowed. Submittals not in accordance with the Contract Document requirements shall be rejected. Before equipment, devices and materials are installed; they shall have submittals that are stamped "Approved" or "Approved as Noted". "Approved" or "Approved as Noted" submittals containing errors and/or omissions shall not relieve the Contractor from the requirements to comply with the complete requirements of the specifications. Corrections or modifications to the work because of errors and/or omissions shall be at the Contractors expense.
- .7 Each submittal shall be reviewed, and electronically stamped and certified by all applicable parent contractors prior to submission to the Consultant. The certification shall be in the form of a rubber stamp,

which states:

I hereby certify that the equipment shown on this shop drawing, product data and or sample, complies in all respects with the requirements of the Contract Documents for this Project. I further certify that all data shown hereon as to performance, dimensions, construction, materials and other pertinent items is true and correct.

(Name of the BSS contractor)

Signed:

Position:

Date:

- .8 Submit electronic copies of all shop-drawing submittals to the Architect, Owner, Consultant, General Contractor, General Contractor Project Manager, and Electrical Sub-Contractor.
- .9 Shop drawings or equipment documentation submittals returned that are noted "Approved" on "Approved as Noted", do not require additional review.
- .10 Shop drawings or equipment documentation submittal data that are noted "Revise and Resubmit", will require additional review. Resubmit all shop drawings and equipment documentation submittals noted "Revise and Resubmit" within two weeks of receipt of the rejected shop drawing or equipment documentation submittal. If more than two reviews are required for any shop drawing or equipment documentation submittals, the Contractor shall reimburse the Owner for any additional fees and expenses required from the Architect, Engineer or Consultant in performing the additional reviews.]

PART 4: RECORD DOCUMENTATION

- .1 At minimum, the record documentation shall include all submittals (shop drawings and equipment documentation) made at the shop drawing stage up-dated to reflect the actual installation and the manuals outlined below.
- .2 A draft version of the record documentation shall be submitted to the Consultant at the time of the request for acceptance testing. Following the acceptance testing and, if necessary, the subsequent rechecking of deficiencies, the BSS Contractor shall re-submit the record documentation incorporating all changes resulting from the acceptance testing and any other changes requested by the Consultant as a result of the consultant's review of the draft version of the record documentation. The Certificate of Substantial Performance shall not be granted until the final approved record documentation has been received.
- .3 Update all documentation to indicate any changes made during the Warranty Period.
- .4 Provide record documentation in manuals as indicated below:
 - .1 Operators' Manuals (PDF format).
 - .2 Managers' Manuals (which includes the Operators' Manuals (PDF format).
 - .3 Hardware Manuals (PDF format).
 - .4 Security shop drawings (PDF format)
- .5 Provide Operators' and Managers' Manuals with, at minimum, the following information:
 - .1 Details of all features and functions available to the Operators and Managers.
 - .2 Details of all alarm, diagnostic, error and other messages. Detail the Operator action to be taken for each instance.
 - .3 Detail special programs provided and provide a complete programming instruction manual. Detail operations of all software applications.
 - .4 Detailed listing of the database for all installed devices.

- .5 Details of all data base management functions and features.
- .6 All details and descriptions shall be in a step-by-step format such that an Operator or Manager shall be able to respond to and undertake the respective actions on the basis of information provided in the manuals and drawings.
- .7 Provide hardware manuals that shall include, at minimum, the following:
 - .1 Details of all specifications including maintenance and installation requirements for all computers, field panels, equipment, devices, interfaces and facilities provided.
 - .2 Record drawings and schedules of the completed installation including location of devices, mounting details, and wiring details.
 - .3 Operating sequences and interlocks.
 - .4 Names and addresses of spare parts suppliers.
- .6 Record drawings shall be CAD generated, pdf printed, based on the latest version of AutoCAD and shall include, at minimum, the following:
 - .1 Details required by the shop drawings.
 - .2 Final locations and point ID for each monitored and controlled device.

***** END OF SECTION *****

PART 1: GENERAL

1.1 WORK OF THIS SECTION

- .1 This section of the specifications details the components to be provided by the BSS Contractor relating to the Access Control and Alarm Monitoring System.

1.2 RELATED REQUIREMENTS

- .1 The requirements of the Project Manual are related to and shall be read in conjunction with this section.
- .2 This section is related to and shall be read in conjunction with all other Division 28 sections.
- .3 This section is related to and shall be read in conjunction with the BSS drawings.

PART 2: REQUIREMENTS

2.1 GENERAL

- .1 The ACAMS system installed to meet the requirements of these Specifications and BSS drawings shall include all software, hardware, field devices, and other components to provide a turn-key operating ACAMS system for the Owner.
- .2 The ACAMS shall be designed in a modular fashion, such that addition and expansion to the ACAMS by adding components shall not require substantial modification of other components such as Server or Client equipment, or other ICP's and RFP's.
- .3 The ACAMS Server/Controller is existing and is off site.
- .4 The ACAMS Client work station shall serve as the monitoring component of the ACAMS. The Client software allows administrators and users to interact with the ACAMS Server/Controller, allowing for system configuration, management, and real-time monitoring of ACAMS events.
- .5 Configuration of all system components shall follow a hierarchical format, where an object which logically belongs to a higher level object is capable of inheriting the property of its "parent" object. This shall apply to, but not be limited to, partitions, logical groupings of system objects, schedules, access levels, card holders, and system users.
- .6 Each field device on the system shall be defined as active/inactive, secure/released, alarmed/suppressed as required by the function, on an as required basis via the operator, or based on a time schedule. Field devices shall be controllable individually, or as part of one or more groups.
 - .1 The system shall be capable of providing email and/or text message alerts for all alarm conditions and threats.
- .7 All equipment and materials comprising the ACAMS system shall be standard components, regularly manufactured, stocked, and utilized in the manufacturer's system.
- .8 All ACAMS components shall have been thoroughly tested and proven in actual installations.
- .9 All ACAMS components shall be provided with a minimum manufacturer warranty of one (1) year.

PART 3: PRODUCTS

3.1 APPROVED SYSTEMS MANUFACTURERS

- .1 Subject to compliance with these specifications, ACAMS equipment, software and related components as manufactured by the following system manufacturing companies shall be considered for the work of this project:

- .1 Software House CCURE 9000 (existing)

3.2 ACAMS HARDWARE

- .1 The ACAMS hardware shall be designed in a modular fashion, such that addition and expansion of an ICP shall not require substantial modification of other components, or cause downtime or operation of other ICP's.
- .2 The main hardware component is the Intelligent Control Panel (ICP). The ICP shall make and manage access control decisions with data provided by the ACAMS Server/Controller, and it shall continuously monitor and manage the communication between the ACAMS Server/Controller and Remote Field Panels (RFP's) connected to the system's inputs, outputs, and card readers.
- .3 The ICP shall be capable of managing access control and store system activity logs during loss of network connectivity. When network connectivity is re-established, the system activity logs are automatically re-synchronized with the ACAMS Server/Controller.
- .4 Failure of any ICP within the ACAMS system shall not affect the operation of the balance of the BSS systems. Failure of any ICP within the ACAMS system shall be annunciated at an OIW.
- .5 The secondary hardware component is the Remote Field Panel (RFP). The RFP shall support a combination of card readers, electronic locks, entry/exit devices, supervised inputs, relay outputs, and be connected directly to the ICP.
- .6 All ICP's and RFP's shall be installed in purpose built enclosures, meeting the specifications in Sections 28 05 00 (Installations – General).
- .7 All enclosures containing ICP's and RFP's shall be equipped with tamper switches connected to the ACAMS, to annunciate at the OIW's when the enclosures are tampered with or opened without authorization.
- .8 All ICP's and RFP's shall be powered from dedicated power supplies, which shall have sufficient battery backup to maintain all intended system operations for a period of eight (8) hours upon main power failure.
- .9 All electronic locks, card readers, annunciation and auxiliary devices which are connected to the ACAMS shall be either powered directly from the ICP or RFP, or from dedicated power supplies which shall have sufficient battery backup to maintain all intended system operations for a period of eight (8) hours upon main power failure.

PART 4: EXECUTION

4.1 SYSTEM PROGRAMMING

- .1 Programming of the database, the Contractor shall provide a proposed device naming standard to the Consultant and Owner for approval. The naming standard shall be based on the naming standard used in the Security drawings, and expanded to accommodate all the components of the ACAMS.
- .2 The Contractor shall provide the initial administration level training, as identified in the training section of these specifications, to familiarize the Owner's staff with the database structure, cardholder file information, access levels, time zones, capabilities etc. The Contractor shall develop the required time zones, access groups, access levels, the cardholder information, database definition, etc. The Contractor shall develop blank forms for all required database and cardholder information and submit them to the Owner. The Contractor shall then enter the information.

4.2 CONTROLLED DOOR/PORTAL OPERATION

- .1 Provide controlled door/portal operating sequences as required. Provide, at minimum, the following operating features:
- .2 As indicated on the electrical drawings, and where there is a ACAMS security controlled door, if the door is equipped with an automatic door operator, provide an output from the ICP and a control relay (if not supplied in the door operator) for each automatic door operator Barrier Free push-button to interrupt the signal between the pushbutton and the controller until the presentation of a valid security card.
- .3 Whenever the door is placed in a non-secure mode (i.e. time scheduled unlocked, operator override unlocked, valid entry/exit request) then the relay shall close, which will connect and complete the pathway of the signal circuit, allowing a signal from the pushbutton (if utilized) to reach the operator. Otherwise the door shall remain in a closed, but unsecured and available for Barrier Free Operation condition.

4.3 BARRIER FREE AUTOMATIC DOOR OPERATION

- .1 During automatic control by the security system, the automatic door operator shall disable (or the security system shall disable) the motion sensor located on the same side of the door as the card reader.
- .2 A valid entry request shall cause the security system to signal the automatic door operator to open the associated door. The automatic door operator shall determine when to close the door after this signal.
- .3 The motion sensor on the non-card reader side of the door shall signal the automatic door operator to open the door anytime movement is detected. The automatic door operator shall determine when to close the door after this signal.

***** END OF SECTION *****

PART 1: GENERAL**1.1 WORK OF THIS SECTION**

- .1 This section of the specifications details the components to be provided by the BSS Contractor relating to the ACAMS field devices.

1.2 RELATED REQUIREMENTS

- .1 The requirements of the Project Manual are related to and shall be read in conjunction with this section.
- .2 This section is related to and shall be read in conjunction with all other Division 28 sections.
- .3 This section is related to and shall be read in conjunction with the BSS drawings.

PART 2: REQUIREMENTS**2.1 FIELD INSTALLATIONS – GENERAL**

- .1 Provide, except where otherwise noted, all associated power supplies, transformers, electronic relays, terminations, cabling, panels, enclosures, housings, interconnections, and equipment required to integrate the field devices into the ACAMS.
- .2 Provide, except where otherwise noted, modifications to doorframes and doors as required for the mounting of the security field door associated devices, to provided manufacturer details, as approved by the Architect and Consultant.
- .3 Electric locks, where required by building and fire codes and except where otherwise noted, will be controlled by both the Fire Alarm System (FAS) and BSS. In these cases, the FAS subcontractor shall provide a signal indicating a fire alarm condition to each Access Control Remote Panel location as shown on the Security Drawings. The FAS subcontractor shall also provide this signal at each code-required electric lock location that has power supplies being located at the door (review electric lock description below and refer to the door hardware specifications). At each Access Control Remote Panel location:
 - .1 The BSS Contractor shall provide a terminal strip within a separate enclosure located adjacent to the electric lock power supply units.
 - .2 The BSS Contractor shall provide an interposing relay in the electric lock control circuits coming from the power supply for each door.
 - .3 The BSS Contractor shall wire between the interposing relay and the terminal strip and provide all facilities as necessary to allow a single FAS signal to unlock all electric locks.
 - .4 The FAS subcontractor shall wire to the other side of the terminal strip to provide automatic override of the electric locks.
 - .5 The BSS operation shall allow for the release of the door upon operator command or on a time scheduled basis while not impeding the automatic override release of the door by the FAS.
 - .6 The FAS shall control (unlock) all electric locking doors.
- .4 Where applicable, the power circuits powering electric locks on elevator lobby doors shall also route through the fire pull station to locally interrupt the power when the pull station is activated. The fire pull station is provided by the FAS subcontractor.
- .5 Immediately after notice to proceed is received, coordinate with the FAS subcontractor to ensure the proper hardware and interfacing noted above (and any code required interfacing) is being provided.

- .6 The BSS Security sub-contractor shall provide interfaces to any automatic – Barrier Free - door operators located on BF doors required to have electronic security ACAMS locks. BF automatic door operator pushbuttons shall be provided by others.
- .7 The BSS Security sub-contractor shall provide a control relay (if not supplied in the BF door operator design) for each automatic door operator pushbutton such that the signal from the operator pushbutton into the controller is interrupted whenever the electric lock is engaged. Review the architectural door hardware section, architectural drawings, and electrical drawings, for automatic door operator locations.

PART 3: PRODUCTS

3.1 CARD READERS - PROXIMITY TYPE

- .1 Provide ACAMS proximity type card readers at locations indicated on the security drawings. Proximity card readers shall meet, at minimum, the following requirements:
 - .1 Manufacturers or supplier's visible identification logo or trademark is not permitted.
 - .2 Multicolour LED displaying green upon a valid read, red upon invalid read.
 - .3 Appropriate colour matching location finish.
 - .4 Environmentally protected on exterior applications.
 - .5 Contactless smart card interactive type.
 - .6 Read range of 5.0cm (2") for building applications.
 - .7 Read range of 38cm (15") for vehicle entry applications.
- .2 Installation of card readers shall meet, at minimum, the following requirements:
 - .1 Tamper resistant.
 - .2 Complete with any faceplates or trim that may be required. Provide standoff non-metallic (½ inch lexan with rounded edges) plates to prevent interference when mounted on metal walls, pedestals or building components.
 - .3 Damage by static electricity or mechanical shock is avoided. Provide grounding as required.
- .3 Provide contactless smart card technology card readers at locations indicated on the Security Drawings. Types are as follows:
 - .1 Card Reader (Mullion mount)– Interior or exterior proximity card technology card reader HID Signo Readers Part number Signo 20 – 20NKS-00-000J2V.
 - .2 Card Reader – Interior or exterior proximity card technology card reader HID Signo Readers Part number Signo 40 – 40NKS-00-000J2V.
 - .3 Card Reader – Interior or exterior proximity card technology card reader HID Signo Readers Part number Signo 40 – 40KNKS-00-000J2V.

3.2 ELECTRIC LOCKS

- .1 Coordinate lock and door hardware with the general contractor and all door hardware subcontractors and review each security device location as shown on the Security Drawings to ensure the proper door hardware is provided at required locations.
- .2 Provide and terminate relay output cabling from the ACAMS ICP/RFP to the electric door locking hardware.

- .3 Specified Product: HES 1006
- .4 Parts showed above are for reference only, additional components/mounting hardware may be required.

3.3 AUTOMATIC DOOR INTERFACE

- .1 Automatic door operators shall be provided under a separate contract. Provide and terminate interface cabling from the ACAMS ICP/RFP to the automatic door operator.

3.4 REQUEST TO EXIT DEVICE (MOTION DETECTOR)

- .1 Provide and terminate request to exit device and signal cabling from the ACAMS ICP/RFP.
- .2 Request to exit motion detectors shall be programmed not to release the electric lock upon motion detection. The request to exit shall act as an door position alarm shunt upon motion detection, in order to eliminate ACAMS alarms on a valid exit.
- .3 Specified Product: Bosch DS160
- .4 Parts showed above are for reference only, additional components/mounting hardware may be required.

3.5 DOOR POSITION SENSORS

- .1 Door position sensors for security doors, with the exception of below noted, shall be provided and terminated to the door connections of the Integration Enclosure door connections under a separate contract.
- .2 Provide and terminate door status monitoring cabling from the ACAMS ICP/RFP to the security connection side of the Integration Enclosure (by others).
- .3 For revolving doors, provide all conduit, cabling, and input connections from monitoring terminals of the revolving door controller to the ACAMS.
- .4 For overhead (roll up) doors, provide all conduit, cabling, and input connections from the overhead door contact to the ACAMS. Overhead door contact shall meet, at minimum, the following requirements:
 - .1 Surface mounted SPDT magnetic contact switch.
 - .2 Cable lead shall be encased in stainless steel armored cable.
 - .3 Gap reading distance of 75mm (3")
 - .4 Specified Product: GE 1078 Series
 - .5 Parts showed above are for reference only, additional components/mounting hardware may be required.

***** END OF SECTION *****

PART 1: GENERAL**1.1 WORK OF THIS SECTION**

- .1 This section of the specifications details the work and components to be provided by the BSS Contractor relating to the Intrusion Detection System (IDS).

1.2 RELATED REQUIREMENTS

- .1 The requirements of the Project Manual are related to and shall be read in conjunction with this section.
- .2 This section is related to and shall be read in conjunction with all other Division 28 sections.
- .3 This section is related to and shall be read in conjunction with the BSS drawings.

PART 2: REQUIREMENTS**2.1 GENERAL**

- .1 The IDS system shall be installed to meet the requirements of these Specifications and BSS drawings shall include all software, hardware, Intelligent Control Panels (ICP), Remote Field Panels (RFP), Remote Modules, field devices, sensors, and other components to provide a turn-key operating IDS system for the Owner.
- .2 The IDS shall be designed in a modular fashion, such that addition and expansion to the IDS by adding components shall not require substantial modification of other components such as other ICP's and RFP's.
- .3 The IDS shall be capable of communicating over multiple methods, including phone line, Internet, and GSM.
- .4 The IDS shall monitor and control intrusion zones, and shall perform alarm monitoring, communications loss monitoring. The system shall also maintain a database of system activity, personnel access information, system user information, user permissions, and other relevant data.
- .5 All logins, alarms, events, actions, commands, and responses shall be completed within two (2) seconds of being triggered. This shall occur across the entire IDS and its components, and shall not be affected by system activity at any given time.
- .6 The system functions shall take place in a touch screen keypad, mounted in locations shown on security drawings and documents. The keypad shall allow for monitoring, control, and alarming functions in a clearly visible, colour display.
- .7 The system shall be capable of being divided into partitions, allowing subsets of the overall system and components to be managed separately. Partitions of the system shall be capable of being assigned different access rights, and have devices zoned to specific partitions. User logins, where restricted, can only view and control partitions for which they are authorized.
- .8 Each field device on the system shall be defined as active/inactive, secure/released, armed/disarmed, alarmed/suppressed as required by the function, on an as required basis via the operator, or based on a time schedule. Field devices shall be controllable individually, or as part of one or more groups.
- .9 All devices in the IDS shall be continuously monitored and supervised, and the IDS shall be capable of detecting faults, shorts, and cuts in the connected equipment. All devices shall be supplied with end of line (EOL) resistors at the device location to supervise the connection. Installation of EOL resistors at the panel location shall not be acceptable.

- .10 All equipment and materials comprising the IDS system shall be standard components, regularly manufactured, stocked, and utilized in the manufacturer's system.
- .11 All IDS components shall have been thoroughly tested and proven in actual installations.
- .12 All IDS components shall be provided with a minimum manufacturer warranty of one (1) year.

PART 3: PRODUCTS

3.1 IDS FIELD DEVICES

- .1 Subject to compliance with these specifications, IDS equipment, software and related components as manufactured by the following system manufacturing companies shall be considered for the work of this project:
 - .2 Motion Detector
 - .1 All devices shall be wired point to point to the nearest controller panel.
 - .2 Motion detectors shall be oriented to minimize nuisance alarms caused by environmental conditions or site conditions.
 - .3 Tamper-proof.
 - .4 Adjustable range as required.
 - .5 Wall or ceiling mount as required.
 - .6 Specified Product: Bosch DS9370 Series
 - .7 Parts showed above are for reference only, additional components/mounting hardware may be required.
 - .3 Glass Break
 - .1 Glass break detectors shall employ microcontroller-based DSP technology with wide-band signal processing to provide accurate glass break detection of plate, laminated, wired and tempered glass, while rejecting common 'bell' or 'ringing' type sounds, and 'white noise'.
 - .2 Glass break detectors shall have a built-in test mode, alarm memory (LED latching), transient/static protection.
 - .3 Specified Product: Acoustic Glass Break Sensor – Sentrol 5812NT
 - .4 Parts showed above are for reference only, additional components/mounting hardware may be required.

PART 4: EXECUTION

4.1 SYSTEM PROGRAMMING

- .1 Implement all software and provide all applicable licenses in order to provide a fully operational system. Where information is required from the Owner in order to implement the software, request such information in writing at least one (1) month prior to the need of such information.
- .2 Programming of the database, the Contractor shall provide a proposed device naming standard to the Consultant and Owner for approval. The naming standard shall be based on the naming standard used in the Security drawings, and expanded to accommodate all the components of the IDS.
- .3 The Contractor shall provide the initial administration level training, as identified in the training section of these specifications, to familiarize the Owner's staff with the IDS capabilities.

***** END OF SECTION *****

PART 1: GENERAL**1.1 WORK OF THIS SECTION**

- .1 This section of the specifications details the components to be provided by the BSS Contractor relating to the Video Surveillance System (VSS).
- .2 This section of the specifications details the components to be provided by the BSS Contractor relating to the Video Surveillance System (VSS).

1.2 RELATED REQUIREMENTS

- .1 The requirements of the Project Manual are related to and shall be read in conjunction with this section.
- .2 This section is related to and shall be read in conjunction with all other Division 28 sections.
- .3 This section is related to and shall be read in conjunction with the BSS drawings.

PART 2: REQUIREMENTS**2.1 GENERAL**

- .1 The NVR is existing.
- .2 Provide all equipment, cameras, bezels, mounting brackets, interconnections, power supplies and other services as required to complete a fully-functional and operational VSS system as contained in the security drawings and performance specifications.
- .3 Provide setup and configuration of the video surveillance system to suit the requirements in these specifications, including alarms and actions, server, workstation and peripherals, camera number and descriptions, camera presets, camera tours, etc.
- .4 All interior ceiling dome cameras, where possible, shall be recess mounted in finished areas. Where indicated by the Architect, provide wall mount brackets with concealed wiring. Surface mounted dome cameras are acceptable in unfinished areas provided they are mounted on a finished back-box, suitable for the installation. Obtain written approval from Owner and Architect prior to finalizing design of the camera mounts in all finished spaces.
- .5 For high finish interiors, coordinate with Architect and Consultant to provide cameras with trim rings, bezels, mounts, etc. to match the surrounding finish. Submit all proposed finishes and configurations to the Architect and Consultant for approval.
- .6 VSS cameras that are required to be mounted on non-structural walls or ceilings shall be provided complete with suitable mounting plates or supporting materials on the reverse side of the wall or ceiling to ensure the devices are securely fastened.
- .7 VSS cameras shall be mounted at heights necessary to maximize the camera field of view. Housings and mounts shall be properly supported from building structure as appropriate. If required, custom mounts and housings shall be provided to allow for maximum use of the cameras. Provide any required miscellaneous materials for bracing and mounting. Conduit shall extend to the housing such that cables are not exposed.
- .8 Internet Protocol (IP) technology based cameras connected to the converged LAN for video signal transmission.

- .9 The BSS Contractor shall ensure proper equipment selection for each application. Consideration shall be given to such criteria as area of coverage, light conditions, etc., consistent with the generally accepted practices for VSS surveillance and to the approval of the Architect, Owner and Consultant.

PART 3: PRODUCTS

3.1 APPROVED SYSTEMS MANUFACTURERS

- .1 Subject to compliance with these specifications, VSS system software and related components as manufactured by the following system manufacturing companies shall be considered for the work of this project: the VSS system is existing and is located off site.
- .2 Subject to compliance with these specifications, VSS cameras, mounts, and related components as manufactured by the following system manufacturing companies shall be considered for the work of this project:
 - .1 Axis Communications (no substitutes)
 - .1 Axis P32 series

3.2 VSS MOUNTS

- .1 All exterior camera mounts, metal tubes, brackets and accessories shall be of sufficient strength and diameter to defeat any detectable camera shake in up to 65 km/h (40 MPH) winds. All components and mounting bolts shall not rust or deteriorate and shall be designed for the surface to which the camera is mounted. All mounts shall allow for complete pan and tilt positioning achieving the required field of view with positive locking position bolts. Cameras mounted over heights greater than 6 meters (20 feet) shall be completely swiveled to a safe location for servicing.
- .2 Additional requirements by mount and camera type:
- .3 Hard-ceiling mounted fixed units shall not be J hook mounted.
- .4 Where electronics do not fit in camera housing coordinate imbedding an IP65 locking electronics box in base of pole or in nearest electrical ground vault. Surface boxes attached to pole are not acceptable.

VSS HOUSING

- .5 Provide VSS cameras complete with protective housings. Protective housings shall meet the following minimum requirements:
 - .1 Complete with all mounting hardware and brackets. Refer to security drawings for mount.
 - .2 Accessible, removable and lockable access doors to allow for maintenance.
 - .3 Allow for the adjustment of the controls without removing the camera.
 - .4 Power and signal cable harnesses and connectors to allow for the removal or replacement of a camera.
 - .5 Tamper resistant.
- .6 Dome with captive shroud to conceal camera position.
- .7 Provide exterior mounted VSS cameras with housings which are non-corroding and weather proof along with integral fans, powered heating elements and controls to maintain the functional operation of the

cameras and controls in the ambient temperatures specified in these contract documents.

PART 4: EXECUTION

4.1 INSTALLATIONS

- .1 Provide all required programming and complete calibration and set-up of all cameras, switching equipment, digital video recording equipment and display devices for a fully functional system.
- .2 Configure the automatic call up of cameras and their associated pre-position settings. Adjust all camera vari-focal lenses to meet the Consultant/Owners requirements.
- .3 Provide a video image snapshot showing the maximum field of view (FOV) of all installed fixed cameras complete with camera software port description. All images shall be provided to the Owner/Consultant on electronic format. The snapshot will be utilized by the Owner/Consultant to select the final desired FOV of the camera.
- .4 Create a hierarchical, interactive facility map which allows operators to manage the facility's cameras using a floor plan with interactive icons to activate live viewing, recording, and other system functions. Provide all programming necessary.
- .5 Coordinate all network configuration and installations with the building IT Services contractor. Provide all installations in compliance with the building IT Services Standards.
- .6 Coordinate IP addresses and all network configuration details with IT Services. Comply with building project IT Services requirements for IP addressing, device naming and documentation.

***** END OF SECTION *****

PART 1: GENERAL**1.1 WORK OF THIS SECTION**

- .1 This section of the specifications details the components to be provided by the BSS Contractor relating to the Security Intercom System (SIS).

1.2 RELATED REQUIREMENTS

- .1 The requirements of the Project Manual are related to and shall be read in conjunction with this section.
- .2 This section is related to and shall be read in conjunction with all other Division 28 sections.
- .3 This section is related to and shall be read in conjunction with the BSS drawings.

PART 2: REQUIREMENTS**2.1 GENERAL**

- .1 Provide a complete Security Intercom System (SIS) including all components as detailed within the BSS drawings and specifications and as required for a fully functional system.
 - .1 Installed separately from conventional general-purpose internal communications systems, the IS system shall be used as a door entry system, emergency announcement system, parking assistance system, urgent call system, public announcement system, and access control system as scheduled, indicated or required.
 - .2 The system shall be comprised of multiple IP-based control units, IP direct masters and/or door stations. Sub stations shall be installed in multiple locations as scheduled, indicated, or required for complete installation.
 - .3 A full range of control unit functions, including basic conversation, shall be capable: call forwarding, scan monitoring, emergency call, priority call, video audio recording, paging, and zone paging as scheduled, indicated or required.
 - .4 All SIS components shall utilize the BSS LAN for connectivity and transmission. All SIS stations shall be powered by Power over Ethernet (PoE) capable switches.
 - .5 Parking Assistance stations shall be installed in a purpose-built enclosure by the same manufacturer, with an integral indicator light, high visibility paint options on the enclosure, and lettering on each side of the enclosure which denotes its function. The integral indicator light shall latch on when the Parking Assistance station is activated, and may be released after the call is complete via local key switch or via the master station.
 - .6 Unless otherwise noted, Door stations shall be flush mounted with a back box, with no protrusions. Refer to security details or coordinate with Architect for elevation.
 - .7 Door stations shall be capable of releasing the associated door via the master station, either through a hardwired interface to the door lock, or through a software interface to the ACAMS.
 - .8 Provide master station at the locations shown on the BSS drawings. The dial/transfer sequence shall be coordinated with the Owner prior to programming.
- .2 The BSS Contractor shall ensure proper equipment selection for each application. Consideration shall be given to such criteria as area of noise level, environmental condition, and shall be subject to the approval of the Owner and Consultant.

PART 3: PRODUCTS

3.1 APPROVED SYSTEMS MANUFACTURERS

- .1 Subject to compliance with these specifications, SIS equipment, software and related components as manufactured by the following system manufacturing companies shall be considered for the work of this project:
 - .1 Aiphone. No Substitutions
- .2 Master Station:
 - .1 Master stations to include direct programmable key for release of door locking hardware at door of calling substation.
 - .2 Specified Product: JP-4MED Video Master Station
 - .3 Parts showed above are for reference only; additional components/mounting hardware may be required.
- .3 Sub Stations
 - .1 Specified Product: JP-DV Video Perimeter Door Station
 - .2 Specified Product: JP-4HD Video inside Room Station
 - .3 Parts showed above are for reference only; additional components/mounting hardware may be required.

3.2 ANCILLARY DEVICES

- .1 System to include:
 - .1 system software and programming by manufacturer's authorized and trained technician;
 - .2 system modules, boards, relay modules, mounting kits, flush and surface mount boxes and mounting hardware;
- .2 Ancillary devices to be of type in accordance with equipment manufacturer's requirements. Wiring to also be in accordance with applicable local governing codes and standards.

PART 4: EXECUTION

4.1 INSTALLATION

- .1 Prepare matrix of masters and substations and interconnections proposed and submit with shop drawings. Provide specified system components and connect complete.
- .2 Confirm exact type of substations with Consultant and Owner prior to ordering. Confirm station finishes, wall mounting/desk top arrangements, strobe colours, handset/hands-free arrangements and specific area applications, prior to ordering. Submit detailed shop drawings of each type of station, station features, and location of installation. Provide drawing identifying system layout and connected stations.
- .3 Install equipment enclosures in accordance with manufacturer's specifications ensuring that proper installation techniques are observed. Brackets, pedestals, and fixed in place housings to be mechanically fastened to building structure independent of other support systems. Under no circumstances are enclosures be fastened to suspended ceiling support systems. Exact enclosure type to suit installation location, and such location to be confirmed with Consultant prior to roughing-in. Enclosures to be permanently tagged with identification properly noted and cross-referenced on "As Built" drawings.
- .4 Install devices in accordance with system manufacturer's instructions.
- .5 Include for and arrange for system manufacturers authorized representative to program system. Provide servers in locations as required to provide best system performance as per manufacturer's recommendations.

- .6 Backbone of the system to be IP based Ethernet LAN network structured cabling infrastructure based on requirements as specified in Communications drawings and specifications. System network to include use of fibre optic cabling, UTP copper horizontal network cabling and components, and network switches. System integrator to coordinate with the telecommunications system integrator responsible for the IT network structured cabling system, and provide network cabling structure to serve the intercom system, consisting of but not limited to providing the following:
 - .1 system components to match requirements of other Sections;
 - .2 dedicated enclosed equipment racks for mounting of required network switches, patch panels and UPS unit;
 - .3 dedicated system of fibre optic cabling and horizontal UTP copper cabling and jacks;
- .7 Confirm and coordinate exact requirements with system supplier. Electrical provisions (conduits and wiring) shown on drawings are assumptions and are only to be used for pricing purposes. Include for power transformers as required and installed to suit specific applications.
- .8 Verify with system vendor, exact power, control, communications, and conduit requirements for specific system(s) being installed. Coordinate requirements with shop drawing submissions. Be present for system testing and make any necessary power or control wiring revisions.
- .9 Installed cabling, connectors and equipment to meet or exceed minimum manufacturer specifications. Any cabling, connectors or equipment failing to meet those specifications to be promptly replaced at no additional cost to Contract. In finished areas, run conductors and conduits concealed.
- .10 Cable and equipment installation to be permanently tagged with identification properly noted and cross-referenced on "As Built" drawings to be provided to Consultant, upon completion, verification, and acceptance of installed systems.
- .11 Verify with Consultant, exact installation height of devices, prior to roughing in. Wall mounted units typically to be recessed mounted. Provide suitable back box. Coordinate installation with Consultant and trades responsible for wall construction.
- .12 Provide integration per the General Requirements and other Division 28 specifications. Confirm integrations and exact sequence of calling with Consultant and Owner prior to start of Work.
- .13 Confirm station finishes and colours, identification nameplates and nomenclature with Consultant prior to ordering.
- .14 Ground and bond system to code and manufacturer's requirements.
- .15 After installation work is complete, coordinate with and work with system vendor to test, adjust, and certify operation of system.

***** END OF SECTION *****

PART 1 GENERAL

1.1 General

- .1 All existing features, weeds, shrubs, trees, roots, and stumps shall be cleared and grubbed as shown on the Drawings.
- .2 Contractor to install and maintain Terrafix Terrafence sediment control filter fabric fence (or approved equivalent), as illustrated in the drawings. Contractor to remove fence following project completion.

1.2 Scope of Work

- .1 Furnish all labor, materials, equipment and related items required to complete the work indicated on the Drawings and/or as specified in the Specifications. The items of work, shall include, but not be limited to:
 - .1 Removal, disposal or transplant of vegetative materials from work area to onsite stockpile;
 - .2 Install and maintain appropriate erosion control and protection fencing.

1.3 Related Work

- .1 Related work in other sections of these Specifications include but is not limited to:
 - .1 Topsoil & Finish Grading
 - .2 Poured in Place Concrete Paving
 - .3 Trees, Shrubs & Groundcovers

1.4 Utilities

- .1 The contractor is responsible to confirm location of all utilities prior to the commencement of work. If unexpected conditions arise, stop work and immediately notify the landscape architect.

1.5 Measure for Payment

- .1 Payment will be made as per the Form of Tender line items identified. Payment includes removal and disposal of materials.

PART 2 PRODUCTS

2.1 Products and Equipment

- .1 Sediment control fencing to be Terrafix Terrafence, or approved equivalent.
- .2 Construction fencing to be Moduloc or approved equivalent.

PART 3 EXECUTION

3.1 Weed and Grass Removal

- .1 Strip existing vegetative cover.
- .3 No herbicides are to be used.

3.2 Clearing and Grubbing

- .1 Remove all imperishable debris that would be unsuitable for bearing including, but not limited to rocks, concrete pipe, residential waste and existing construction.

3.4 Protection

- .1 Protect benchmarks, iron bars and other reference points, and existing work from damage or displacement. If disturbed or destroyed, replace at Contractor's expense. Any benchmarks or survey control points that are disturbed by the work shall be re-surveyed by a Licensed Ontario Land Surveyor. Said benchmark or control point shall be restored by said Licensed Ontario Land Surveyor in accordance with professional standards of practice.
- .2 Construction access is to be off of Bowden Drive. Contractor to repair and restore any damage to silt fence, curbs, sidewalk or sod upon completion of project.

3.5 Protection Fencing

- .1 Contractor to install sediment control fence and replace as required, maintain existing as required. Erect Terrafix Terrafence (or approved equivalent) as illustrated on drawing.
- .2 Sediment control fence to be erected and maintained for the full duration of construction, inspected after every major rain event, and inspected, at a minimum, once every three weeks. Refer to detail on drawing.
- .3 Install and maintain construction fencing for the duration of construction, Moduloc or approved equivalent, as illustrated. Construction fencing surrounding play area to be installed once play equipment is installed until a successful CSA audit (by others) is achieved.

3.7 Disposal

- .1 Remove and dispose of all materials off site unless otherwise noted on the Drawings.
- .2 No on-site burning will be permitted.

1 GENERAL

1.1 Related Sections

- .1 Section 31 23 33.01 - Excavation, Trenching and Backfilling.

1.2 Measurement for Payment

- .1 Site grading will be paid in lump sum based on the estimated volumes listed.

1.3 References

- .1 American Society for Testing and Materials (ASTM)
 - .1 Current ASTM D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m³).

1.4 Existing Conditions

- .1 Verify underground and surface utility lines and buried objects that are indicated on drawings.

1.5 Protection

- .1 Protect existing fencing, trees, landscaping, natural features, bench marks, buildings, pavement, surface or underground utility lines which are to remain as indicated on drawings. If damaged, restore to original or better condition.
- .2 Protect newly graded and filled areas from washouts and settlement caused by rain and water drainage. Correct any damage as necessary.
- .3 Maintain access roads to prevent accumulation of construction related debris on roads.
- .4 Place filter fabric over catch basins and manholes to prevent clogging with sediment during the rough and fine grading operations.

2 PRODUCTS

2.1 Materials

- .1 Excavated or graded material existing on site may be suitable to use as fill for grading work with the approval of the Owner.
- .2 Fill material: Type in accordance with Section 31 21 33.01 - Excavating, Trenching and Backfilling.
- .3 Silt Fencing in accordance with Section 31 10 13 – Site Preparation.

3 EXECUTION

3.1 Stripping of Topsoil

- .1 Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected as determined by the City.
- .2 Commence topsoil stripping of areas as indicated on drawings after site has been cleared and temporary silt protection fencing has been properly installed.
- .3 Strip topsoil to depths noted on the drawings.
- .4 Do not mix topsoil with subsoil.
- .5 Stockpile on site.

3.2 Rough Grading

- .1 Rough grade to levels, profiles, and contours allowing for surface treatment as indicated on drawings.
- .2 Rough grade to specific depths below finish grades as per applicable details.
- .3 Grading shall be completed with a Laser Grading System or GPS based system.
- .4 Place fill material in maximum 250mm lifts.
- .5 Slope rough grade away from buildings.
- .6 Grade slopes for landscape areas to a maximum of 3:1 unless otherwise specified on drawings.
- .7 Grade ditches and swales to depths indicated on drawings. Ensure gradient transitions are smooth and drain in the direction indicated on drawings.
- .8 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.
- .9 Compact filled and disturbed areas to maximum dry density to ASTM D698, as follows:
 - .1 85% under landscaped areas.
 - .2 Refer to appropriate specifications for pavement areas.
- .10 Do not disturb soil within dripline of trees and shrubs to remain.
- .11 Finished subgrade surface to be free of debris or stones larger than 50mm diameter.

- .12 Remove surplus material and material unsuitable for fill, grading or landscaping off site at Contractor's expense.

3.3 Verification of Constructed Rough Grade

- .1 Provide grade control, and verify that grades are correct. If discrepancies occur, notify the City and do not commence work until instructed by the City.
- .2 Remove debris, roots, branches, stones in excess of 50 mm diameter and other deleterious materials.
- .3 Obtain approval from City of subgrade before commencing with placement of topsoil.

END OF SECTION

1 General

1.1 **RELATED SECTIONS**

- .1 Section 32 92 23 Sodding
- .2 Section 32 93 10 Trees, Shrubs and Ground Covers

1.2 **MATERIALS**

- .1 Contract will use native topsoil, amended as directed. Fertilizer is to be delivered to the job site with manufacturer's labels intact. All material to be approved by the project co-ordinator.

1.3 **SCHEDULE OF WORK**

- .1 Schedule placing of topsoil and finish grading to permit sodding or seeding operations under optimum soil moisture and weather conditions.

1.4 **MEASUREMENT FOR PAYMENT**

- .1 Payment for rough grading will be paid by lump sum based on estimated volumes. Payment for fine grading and amendments will be paid on a per square meter basis included into the cost of other items, including sodding.

2 Products

2.1 **MATERIALS**

- .1 Topsoil shall be: friable, neither heavy clay nor of very light sandy nature containing minimum of 4% organic matter to a maximum of 20% by volume. Free from subsoil, roots, grass, weeds, toxic materials, stones, foreign objects and with an acidity range (pH) of 5.5 to 7.5.
- .2 Planting soil for planting trees and shrubs: mix 9 parts topsoil with 1 part peatmoss. Incorporate bonemeal into planting soil at rate of 3 kg/m³ of soil mixture.
- .3 Peatmoss:
 - .1 Derived from partially decomposed fibrous or cellular stems and leaves of species of Sphagnum Mosses.
 - .2 Elastic and homogeneous, brown in colour.
 - .3 Free of wood and deleterious material which could prohibit growth.
 - .4 Shredded particle minimum size: 5mm.
- .4 Fertilizer:
 - .1 Complete commercial synthetic slow release fertilizer with minimum 35% water soluble nitrogen.
 - .2 Formulation ratio: 6-14-14 at 10lbs per 1000 sq feet incorporated into the rootzone.
- .5 Bonemeal:
Raw, steamed bonemeal, finely ground with a minimum analysis of 3% nitrogen and 20% phosphoric acid.

3 Execution

3.1 **SPREADING OF NATIVE/IMPORTED TOPSOIL/PLANTING SOIL**

- .1 Spread topsoil after Landscape Architect has inspected and approved subgrade.
- .2 Spread topsoil with adequate moisture in uniform layers over approved, unfrozen subgrade, where sodding and planting is indicated.

- .3 Apply topsoil to following depths:
 - 100 mm of topsoil for sodded areas
 - Min 850mm of topsoil (mounded) for planters
- .4 Manually spread topsoil/planting soil around trees, shrubs and obstacles.

3.2 **APPLICATION OF FERTILIZER**

- .1 Mix fertilizer thoroughly to full depth of topsoil.

3.3 **FINISH GRADING**

- .1 Fine grade and loosen top soil. Eliminate rough spots and low areas to ensure positive drainage. Prepare loose friable bed for sodding and planting areas, by means of cultivation and subsequent raking.
- .2 Roll with 50 kg roller, minimum 900 mm wide, to consolidate leaving surface smooth, uniform, firm against deep foot printing, and with a fine loose texture to approval of Landscape Architect.

3.4 **RESOTRATION OF STOCKPILE SITES**

- .1 Restoration of stockpile sites to include grading, seeding and sodding where required to match proposed surface treatment.

3.5 **SURPLUS MATERIAL**

- .1 Dispose of materials not required off site.

END OF SECTION

PART 1 GENERAL

1.1 Related Work

- a) Section 32 05 19 - Geotextiles.
- b) Section 31 22 13 - Rough Grading
- c) Section 31 22 19 - Topsoil and Finish Grading

1.2 References

- a) Canadian General Standards Board (CGSB)
 - i) Current CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.
 - ii) Current CAN/CGSB-8.2, Sieves, Testing, Woven Wire, Metric.
- b) Canadian Standards Association (CSA)
 - i) Current CAN/CSA-A23.1, Concrete Materials and Methods of Concrete Construction.
- c) Ontario Provincial Standard Details:
 - i) OPSD 600.110
 - ii) OPSD 310.010

1.3 Definitions

- a) Excavation classes: two classes of excavation will be recognized; common excavation, and rock excavation.
 - i) Rock: any solid material in excess of 0.25 m³ and which cannot be removed by means of mechanical excavating equipment having a 0.95 to 1.15 m³ bucket. Frozen material not classified as rock.
 - ii) Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.
- b) Unclassified excavation: excavation of deposits of whatever character encountered in Work.
- c) Topsoil: material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
- d) Waste material: excavated material unsuitable for use in Work or surplus to requirements.
- e) Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.
- f) Unsuitable materials:
 - i) Weak and compressible materials under excavated areas.
 - ii) Frost susceptible materials under excavated areas: coarse grained soils containing more than 20% by mass passing 0.075 mm sieve.
- g) Unshrinkable fill: very weak mixture of Portland cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

1.4 Protection of Existing Features

- a) Existing buried utilities and structures:
 - i) Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
 - ii) Prior to commencing excavation work, notify applicable owner or authorities having jurisdiction, establish location and state of use of buried utilities and structures. Owners or authorities having jurisdiction to clearly mark such locations to prevent disturbance during work.

- iii) Confirm locations of buried utilities by obtaining a certified utility stakeout.
- iv) Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.
- v) Where utility lines or structures exist in area of excavation, obtain direction of The Owner's Representative before removing or re-routing.
- vi) Record location of maintained, re-routed and abandoned underground lines.
- vii) Protect surface features from damage while work is in progress. In event of damage, immediately make repair to approval of The Owner's Representative.

1.5 Measurement of Payment

- a) Measurement for excavation, trenching and backfill will be included with the specific item of installed work or furnishing as noted in the contract unit price schedule.

1.6 Shoring, Bracing and Underpinning

- a) Protect existing features in accordance with applicable local regulations and as specified by a qualified professional engineer.

PART 2 PRODUCTS

2.1 Materials

- a) Type 1 and Type 2 fill: properties to the following requirements:
 - i) Crushed, pit run or screened stone, gravel or sand.
 - ii) Gradations to be within limits specified when tested to current ASTM C 136 and ASTM C 117. Sieve sizes to current CAN/CGSB-8.1.
- b) Type 3 fill: selected material from excavation or other sources, approved by The Owner's Representative for use intended, unfrozen and free from rocks larger than 75 mm, cinders, ashes, sods, refuse or other deleterious materials.
- c) 19mm diameter clear stone
- d) Clean sand
- e) Granular topping (limestone screenings):
 - i) Screenings: hard, durable, crushed stone particles, free from clay lumps, cementation, organic material, frozen material and other deleterious materials.
 - ii) Gradations:

Sieve Designation	% Passing
9.5 mm	100
4.75 mm	50-100
2.00 mm	30-65
0.425 mm	10-30
0.075 mm	5-10

- f) Topsoil per Section 02312 - Topsoil and Finish Grading
- g) Impervious fill
- h) Unshrinkable fill: proportioned and mixed to provide:
 - i) Maximum compressive strength of 0.4 MPa at 28 days.
 - ii) Maximum Portland cement content of 25 kg/m³

- iii) Minimum strength of 0.07 MPa at 24 h.
- iv) Concrete aggregates: to CAN/CSA-A23.1.
- v) Portland cement: Type 10.
- vi) Slump: 200 mm.

PART 3 EXECUTION

3.1 Site Preparation

- a) Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.
- b) Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly

3.2 Stockpiling

- a) Stockpile fill materials in designated areas. Stockpile granular materials in manner to prevent segregation.
- b) Protect fill materials from contamination.

3.3 Excavation

- a) ***All excavating to be carried out in accordance with the Occupational Health & Safety regulations under the Ontario Labour Act.***
- b) Excavate to lines, grades, elevations and dimensions as indicated.
- c) Remove asphalt, concrete, masonry, paving, walks, demolished foundations and rubble and other obstructions encountered during excavation.
- d) Excavation must not interfere with normal 45d splay of bearing from bottom of any footing.
- e) 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.
- f) For trench excavation, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 5 m at end of day's operation.
- g) Dispose of surplus and unsuitable excavated material off site.
- h) Do not obstruct flow of surface drainage or natural watercourses.
- i) Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
- j) Notify The Owner's Representative when bottom of excavation is reached.
- k) Remove unsuitable material from trench bottom to extent and depth as directed by The Owner's Representative.
- l) Obtain The Owner's Representative approval of completed excavation.
- m) Correct unauthorized over-excavation with no additional cost to The Owner's Representative as follows:
 - i) Fill under bearing surfaces and footings with concrete specified for footings.
 - ii) Fill under other areas with Type 2 fill compacted to not less than 98 % of corrected maximum dry density.
- n) Hand trim, make firm and remove loose material and debris from excavations. Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil. Clean out rock seams and fill with concrete mortar or grout to approval of The Owner's Representative.

3.4 Fill Types and Compaction

- a) Use fill of types as indicated or specified. Compaction densities are percentages of maximum densities obtained from corrected maximum dry density.

3.5 Backfilling

- a) Use suitable vibratory compaction equipment.
- b) Do not proceed with backfilling operations until The Owner's Representative has inspected and approved installations.
- c) Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
- d) Do not use backfill material which is frozen or contains ice, snow or debris.
- e) Place backfill material in uniform layers not exceeding 150 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.
- f) Backfill around installations.
- g) Place unshrinkable fill in areas as indicated. Consolidate and level unshrinkable fill with internal vibrators.
 - i) Place bedding and surround material per specific details.
 - ii) Do not backfill around or over cast-in-place concrete within 48 hours after placing of concrete.
 - iii) Place layers simultaneously on both sides of installed work to equalize loading.
 - iv) Where temporary unbalanced earth pressures are liable to develop on walls or other structures:
 - 1. Permit concrete to cure for minimum 28 days or until it has sufficient strength to withstand earth and compaction pressure and approval obtained from The Owner's Representative; or
 - 2. If approved by The Owner's Representative, erect bracing or shoring to counteract unbalance, and leave in place until removal is approved The Owner's Representative.
- h) Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.

3.6 Restoration

- a) Upon completion of work, remove waste materials and debris, trim slopes, and correct defects as indicated.
- b) Replace topsoil as indicated.
- c) Clean and reinstate areas affected by work to condition existing before excavation.
- d) Reinstate prescribed surface materials to elevation existing before excavation.
- e) Reinstate road pavement, sidewalks, lawns and plantings to condition existing before excavation.
- f) Comply with Detail OPSD 600.110 to reinstate concrete curbs.
- g) Comply with Detail OPSD 310.010 to reinstate concrete sidewalks.
- h) Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.

END OF SECTION

1 GENERAL

1.1 Related Work

- .1 Section 31 22 13 – Rough Grading
- .2 Section 31 22 19 - Topsoil and Finish Grading
- .3 Section 31 23 33.01 - Excavating, Trenching and Backfilling.

1.2 References

- .1 American Society for Testing and Materials (ASTM)
 - .1 Current ASTM D 4491, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
 - .2 Current ASTM D 4595, Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
 - .3 Current ASTM D 4716, Standard Test Method for Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.
 - .4 Current ASTM D 4751, Standard Test Method for Determining Apparent Opening Size of a Geotextile.
- .2 Canadian General Standards Board (CGSB)
 - .1 Current CAN/CGSB-4.2, Textile Test Methods.
 - .2 Current CAN/CGSB-148.1, Methods of Testing Geotextiles and Geomembranes.
 - .1 No.2, Mass per Unit Area.
 - .2 No.3, Thickness of Geotextiles.
 - .3 No.7.3, Grab Tensile Test for Geotextiles.
 - .4 No.6.1, Bursting Strength of Geotextiles Under No Compressive Load.
- .3 Canadian Standards Association (CSA)
 - .1 Current CAN/CSA-G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel.
 - .2 Current CAN/CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.

1.3 Samples

- .1 Submit samples for City approval in advance of installation.
- .2 Submit a 1 m length sample from full roll width of geotextile material to City for approval prior to installation.
- .3 Indicate manufacturer and source of geotextile material.

1.4 Delivery and Storage

- .1 During delivery and storage, protect geotextiles from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust, debris and rodents.

1.5 Measurement for Payment

- .1 Geotextiles will be paid as part of the applicable surfacing, including but not limited to drainage, rock work, planting, granular bases and subbases and wall installations. Refer to applicable specification sections for inclusion of this item into the measurement for payment.

1.6 Waste Management and Disposal

- .1 Separate and recycle waste materials.

2 PRODUCTS

2.1 Materials

- .1 Geotextile materials to conform to applicable detail:

SILT FENCING

- .2 Geotextile: woven or non-woven synthetic fibre fabric, supplied in rolls.
.3 Generic specifications including physical properties, roll width, roll length, thickness, tensile strength, mass, bursting strength and hydraulic properties as per approved manufacturer's specifications.
.4 Securing pins and washers or seams: in accordance with manufacturer's recommendations.
.5 Thread for sewn seams: equal or better resistance to chemical and biological degradation than geotextile.

3 EXECUTION

3.1 Installation

- .1 Place geotextile material by unrolling onto graded surface in orientation, manner and locations indicated.
.2 Place geotextile material smooth and free of tension stress, folds, wrinkles and creases.
.3 Place geotextile material on sloping surfaces in one continuous length from toe of slope to upper extent of geotextile.
.4 Overlap each successive strip of geotextile 450 mm over previously laid strip.
.5 Join successive strips of geotextile as recommended by approved manufacturer.
.6 Protect installed geotextile material from displacement, damage or deterioration before, during and after placement of material layers.
.7 After installation, cover with overlying layer within 4 hours of placement.
.8 Replace damaged or deteriorated geotextile to approval of the City.

3.2 Protection

- .1 No vehicles permitted directly on geotextile.

END OF SECTION

1 GENERAL

1.1 Comply with all the requirements of the General Conditions.

1.2 Related Work

.1 Section 31 22 19 Topsoil & Finish Grading

1.3 Work Included

- .1 Supply and place and compact granular base courses.
- .2 Supply and erect forming to levels and layout indicated on Grading Plan.
- .3 Supply and place reinforcing materials.
- .4 Supply, place and finish concrete within forming.

1.4 Delivery, Storage and Handling

- .1 Deliver materials as required for immediate installation.
- .2 Protect reinforcing from dirt and damage at all phases of the operation.

1.5 Sample

- .1 The Contractor shall provide a job site sample of 2 square metres (one for each colour and pattern) to be approved by the Contract Administrator prior to the start of construction. Said sample shall be the standard for the balance of the work installed and shall be protected against damage until final approval from the Contract Administrator. The Tendered Item is to include all supply of all required material, placing, finishing, and disposal upon approval.

1.5 Testing and Inspection

- .1 The Owner shall retain the services of a Geotechnical Engineer to test and confirm in writing the suitability of the sub base, including bearing capacity and compaction PRIOR to the installation of concrete. The contractor will coordinate all testing.
- .2 The City shall retain the services of an Agency to provide the following written test results to determine conformance with the specifications:
 - .1 A standard strength test for concrete placed but not less than one test for concrete placed each day - each strength test sample will consist of three cylinders with proper identification and field data - one specimen will be tested at 7 days and 28 days - cylinders will be field cured prior to shipping to the test laboratory;
 - .2 One standard air entrainment test for each standard strength test;
 - .3 One or more standard slump tests with each standard strength test.Additional testing for each truckload placed may be required, as deemed necessary.

1.6 Job Conditions

- .1 Existing Conditions:
The Contractor shall make himself aware of all factors which shall affect the work including existing installations, underground services, use and access of adjoining property by the Owners and the general public. Failure to take note of any factor will not be a cause for a claim for additional payment by the contractor over and above the amount quoted in the tender.

- .2 Protection:
The Contractor shall comply with requirements of the latest issue National Building Code, the Ontario Occupational Health and Safety Act and the applicable by-laws of the governing municipality related to safety of the public and workers.

1.7 Measure for Payment

- .1 Payment will be made based on the areas listed in the Unit Schedule. Unit price shall include excavation and concrete base.

2 PRODUCTS

2.1 Materials

- .1 Concrete:
Ready mix design based on the Canadian Safety Association (CSA) specification A-23. Course aggregate shall have maximum size 20 mm. Air Content by volume at time of placing shall be 5 to 7 percent. Minimum compression strength after twenty eight days shall be twenty eight megapascals. (Mpa).
- .2 Air entrainment admixtures to conform to the latest issue of American Society for Testing Materials (ASTM) Standard C-260).
- .3 Water should be clean and potable.
- .4 Reinforcements 10 mm diameter, 150 x 150 welded wire mesh to be made discontinuous at all expansion joints, to current CSAG30.5.
- .5 Expansion joint to be pre-moulded joint filler: bituminous impregnated fibreboard to current ASTM D 1751.
- .6 Other materials shall be as specified by CSA specification A-23.
- .7 Concrete walkways shall be 150mm thick.

3 EXECUTION

3.1 Inspection

- .1 Examine surfaces on which the work of this section is to be installed. Report any defects to the Landscape Architect before commencing work.

3.2 Installation

- .1 Sub Grade:
Blade sub grade to conform to lines, grades and sections as shown on the drawings. Compact sub grade to a uniform density at optimum moisture content. Remove all soft or yielding material,

replace with Class "B" materials. Compact to density of surrounding material - abrupt variations in density are not acceptable.

.2 Base Course:

Place granular base course of Class "A" material to depth shown on the drawings. Place and spread base course in layers not to exceed 200 mm., compacting layer at its optimum moisture content to a density of not less than 98 percent as measured by the Standard Proctor Test. Finished surfaces of granular base course shall be smooth and conform to the lines, grades and cross sections shown on the drawings. Tolerance of the cross section or longitudinal profile shall not exceed 13 mm. when measured with a 3000 mm. straight edge.

.3 Joints:

Expansion joint filler to be cut to full cross sectional shape of structure leaving 10 mm. below finished surface of concrete:

1. At generally 5500 mm. intervals and not more than 8000 mm. intervals but not in front of driveways.
2. At the beginning and end of curved sections.
3. Where the concrete paving abuts curbing or other rigid structures.

Install control joints at 2000 mm. intervals with present tool or post set masonry saw.

.4 Layout and Drainage:

Consult dimensions, angles and elevations indicated on Site, Landscape and Grading Plan. Sidewalk slopes - ideal 2.0 percent, minimum 1.5 percent, maximum 2.0 percent. Cross slopes - ideal 2 percent, minimum 1.5 percent, maximum 5 percent.

6. Placing Concrete:

Place concrete in uniform layers of continuous lengths between expansion joints. An expansion joint is required where placing has been suspended for 30 minutes.

7. Finishing:

Wood float and broom finish with a 300mm rough brush edge on all sides.

8. Curing:

Cure concrete by keeping exposed surfaces continually moist for not less than seven consecutive days after placing for normal Portland Cement. Cure for not less than three consecutive days when High Early Strength Portland Cement is used. Apply proprietary membrane after concrete has set to inhibit water leaching during curing. Remove curing agent at end of curing period.

3.3 Clean Up

- .1 Upon completion of the work, clean up and remove from the site all surplus materials and debris resulting from this work.
- .2 Restore any disturbed areas to its original condition.

END OF SECTION

Synthetic Turf Surfacing System

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - 1. Labour, Products, equipment and services necessary for synthetic turf system.
 - 2. The General Conditions, Supplementary Conditions and the Requirements of Division 1, are part of this Section and shall apply as if written here.

1.2 Quality Assurance

- 1. Provide a qualified Subcontractor's site supervisor to coordinate and review the component parts of the synthetic turf system.
- 2. The Contractor shall submit its Manufacturer's Warranty, which warrants the usability and playability of the synthetic turf system for its intended uses for a minimum of an 8-year period commencing with the date of substantial completion. The warranty coverage shall not be prorated nor place limits on the amount of the products usage.

1.3 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - 1. Labour, materials, and workmanship for work of this section:
 - 2. Duration: 2 years.

PART 2 - PRODUCTS

2.1 Acceptable Products

- .1 Triblend 70 Landcape Turf by Ryamar Grass
- .2 SYN Lawn Play Platinum Playground System.
- .3 GTR turf or approved equal.

2.2 Materials

- .1 All components and their installation methods to be designed and manufactured for use on daycare playgrounds. The materials shall withstand full climate exposure, be resistant to insect infestation, rot, fungus and mildew and be UV tolerant and fire resistant.
- .2 Synthetic Grass:

Synthetic Turf Surfacing System

1. Grass Blades: To be nylon monofilament surface blades (or approved equal).
 2. Colour: to be approved by the Consultant.
 3. Thatch Zone: Beige and green
 4. Construction: Broadloom tufted
 5. Yarn thickness: 100 microns
 6. Pile height (grass): 38 mm minimum
 7. Pile height (Thatch): 38 mm minimum
 8. Permeability: 20" per hour minimum
 9. Primary backing: The primary backing shall consist of 3 woven and nonwoven component fabrics of polypropylene, polyester and fibre backing. The primary backing shall weigh a minimum of 0.33 kg per square metre (10 ounces per square yard).
 10. Secondary Backing: The secondary backing shall consist of a heat activated polyurethane coating weighing approximately 0.86 kg per square metre (26 ounces per square yard). The backing shall be heat punched to create a staggered grid of drainage perforations on 75 x 100mm centers. Non-perforated backing shall not be accepted.
- .3 Stone Base Courses:
1. The free draining base aggregate base layer shall consist of a consistent depth of open graded material. Base drainage aggregate used must achieve a 95% minimum overall compaction rate.
 2. The open graded aggregate material shall conform to the following criteria:
- Base Aggregate: Open Graded Stone (OGS)
- Weight Passing Approximate Percentage Passing
- | 2" Sieve | 36.99 | 100.0% |
|------------|-------------|--------|
| 3/4" Sieve | 34.04 | 92.0% |
| 3/8" Sieve | 21.5 | 58.0% |
| #4 Sieve | 9.34 | 25.0% |
| #16 Sieve | 203.3 grams | 9.2% |
- .4 Choker:
1. The choker material (stone dust) shall be a layer of porous, free draining material, number 1 stone sand material or similar, that will provide a 95% minimum overall compaction rate.

Synthetic Turf Surfacing System

2. Choker Material: (Porous Stone Sand)

Weight Passing Approximate Percentage Passing

3/8" Sieve	579.3 grams	100.0%
#4 Sieve	561.5 grams	96.8%
#8 Sieve	420.0 grams	72.0%
#16 Sieve	260.1 grams	45.0%
#30 Sieve	148.8 grams	25.0%
#50 Sieve	74.9 grams	13.0%
#100 Sieve	29.9 grams	5.0%
#200 Sieve	14.7 grams	2.0%

.5 Adhesive:

1. Adhesives for bonding tufted synthetic turf shall be one part moisture cure polyurethane obtained from a single manufacturer. Tape for securing seams shall be high quality coated tape made with a minimum roll width 300mm (12 inches). If seams are to be sewn, they must be sewn with high quality cord/thread as recommended by synthetic turf manufacturer and approved by Project Manager.

PART 3 - EXECUTION

3.1 Preparation

- .1 Base drainage systems requirements for proprietary systems of approved suppliers shall override paragraphs 2 to 4 below as required to ensure the drainage system functions and that guarantees are maintained.
- .2 The installation of the base drainage aggregate shall only begin after the drainage pipe installation has been inspected and approved by Owner's Representative. Installation of the Free-Draining Base Aggregate shall follow procedures that protect the base grade soils and drainage pipe. The drainage pipe network and its existing elevations shall not be disrupted through ground pressures from trucks, dozers or by any other means.
- .3 The base grade subsoil shall be dry before undertaking the placement of base aggregate.
- .4 The base drainage stone final elevations shall mirror the proposed choker layer final grade material. Care shall be taken not to allow the coarser aggregate to surface into the profile or finished grade of the choker layer.

3.2 Choker Aggregate

- .1 System requirements for proprietary systems of approved suppliers shall override paragraphs 2 to 5 below as required to ensure the drainage system functions and that guarantees are maintained.
- .2 The choker layer shall be applied using high flotation grading equipment. The choker material shall be evenly spread throughout the proposed field surface to the final pre-pad or pre-turf elevations.

Synthetic Turf Surfacing System

- .3 After the choker material has been uniformly spread throughout the surface by the described method, the surface shall receive a final laser finish grade. This process shall be accomplished using a turf-type tractor, or lightweight grader, equipped with high flotation tires and a hydraulically controlled laser blade.
- .4 Care shall be taken throughout the installation not to force the choker material into the porosity of the base aggregate below.
- .5 Final layer of stone must be installed at a depth of 38mm (1.5 inches). Finished aggregate base must be proof rolled by means of 2 ton roller. The finished aggregate base must achieve an overall compaction rate of 95% proctor. It shall also be flush with top of pressure treated wood nailer.
- .6 Base Acceptance: The Architect and/or Owner's Representative must jointly approve the base before turf installation can begin.

3.3 Synthetic Turf

- .1 After a final inspection of the base by the Contractor and the Owner's Representative, the synthetic turf installation shall begin. No head seams shall be permitted in the inbound surface.
- .2 The rolls of turf shall be rolled out a minimum of four hours prior to starting seaming procedures and allowed to relax/expand.
 1. All visible wrinkles shall be stretched out before seaming.
 2. Seams shall be flat, tight and permanent with no separation or fraying.
 3. Synthetic turf yarn fabric that is trapped or glued between seams shall be freed from the seams by hand or other approved method to an upright position prior to the commencement of brushing and top dressing procedures.
 4. All synthetic turf seams shall be assembled as follows: The full width rolls shall be laid out across the yard. Utilizing standard state of the art adhering or sewing procedures, each roll shall be attached to the next.
 5. After final trimming of the turf, the turf shall be secured into the edging system as per the turf manufacturers recommendations.

3.4 Maintenance

- .1 Prior to final acceptance, the Contractor shall submit to the Owner 3 copies of their maintenance manuals. These manuals will include all necessary instructions for the proper care and maintenance of the newly installed synthetic turf system.

END OF SECTION

Playground Protective Surfacing

PART 1 - GENERAL

1.1 General:

- .1 Section includes:
 1. Work and materials associated with the installation of protective rubber surfacing and engineered wood fibre, wood cellulose within the playground environment.
 2. Labour, materials and equipment necessary to construct playground safety surfaces in accordance with the lines, grades, levels and dimensions shown on the drawings and in accordance with the construction details and specifications herein.

1.2 References

- .1 CAN/CSA-Z614-03 Children's Playspaces and Equipment.
- .2 CAN/CSA-B651-04 Accessible Design for the Built Environment.
- .3 ASTM F-1292-09 Standard Specification for Impact Attenuation of Surfacing Materials within the Use Zone of Playground Equipment.
- .4 ASTM F1951 Standard Specification for Determination of Accessibility of Surface Systems Under and Around Play Equipment.
- .5 CPSC - U.S. Consumer Product Safety Commission - A Handbook for Public Playground Safety, Volume II: Technical Guidelines for Equipment and Surfacing.
- .6 UL 94 Standard for Safety of Flammability of Plastic Materials for Parts in Devices and Appliances Testing, Underwriters Laboratories.
- .7 Consumer Products Safety Commission (CPSC)
- .8 Material Specifications for Aggregates - Miscellaneous OPSS 1004
- .9 Material Specifications for Aggregates - OPSS 1010

1.3 Submittals

- .1 Samples of the following for approval by the Project Manager.
 1. 150mm x 150mm (6" inch x 6" inch) beveled samples of the 600mm (2-1/2") safety surface.
 2. 300mm long section of rubber curbing.
- .2 Certified Test Data that Safety Surfacing meets or exceeds the following:
 1. ASTM F-1292 Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment.

Playground Protective Surfacing

- .3 Submit written statement, signed by safety surfacing installer stating that Drawings and Specifications have been reviewed by qualified representatives of materials manufacturer, and that they are in agreement that materials and system to be used for safety surfacing are proper and adequate for applications shown.
- .4 Substrate Acceptability: Submit a certified statement issued by manufacturer of Safety Surfacing materials and countersigned by applicator, attesting that areas and surfaced designated to receive safety surfacing have been inspected and found satisfactory for reception of work covered under this Section: and are not in conflict with "Warranty" requirements. Application of materials will be constructed as acceptance of surfaces.
- .5 Statement of Supervision: Upon completion of Work, submit a written statement signed by manufacturer stating that field supervision of manufacturer's representative was sufficient to ensure proper application of materials, which Work was installed in accordance with Contract Documents, and that installation is acceptable to manufacturer.

1.4 Delivery, Storage, and Handling

- .1 All materials for the work of this Section shall be delivered, stored and handled so as to preclude damage of any sort. Materials showing evidence of damage shall not be used and shall be removed from the site.
- .2 Materials in manufacturer's unopened containers or bundles must be fully identified with brand, type, grade, date of manufacture, class, lot number, and other qualifying information.
- .3 Store materials in original tightly sealed containers or unopened packages. Materials shall be stores out of weather, off the ground, in dry area, in compliance with manufacturer's maximum storage temperature range.
- .4 Materials must be delivered and off-loaded by installation personnel.

1.5 Protection

- .1 Protect the safety surface from damage, resulting from spillage, dripping, and dropping of mater. Prevent materials from entering and clogging drains. Repair, restore or replace work, which is soiled or damaged in connection with the performance of the work.

1.6 Closeout Submittals

- .1 Submit closeout submittals in accordance with Section 01 77 00.
 - 1. .1 Include manufacturer's warranties.
- .2 .2 Maintenance instructions:
 - 1. .1 Submit maintenance instructions for all items for incorporation into the operation and maintenance manuals.

Playground Protective Surfacing

1.7 Quality Assurance

- .1 The installation of the Safety Surfacing specified herein and indicated on the Drawings shall be performed by firm who can furnish supporting evidence of installation experience to perform this work and who has regularly been engaged in this work on a full time basis for a period of not less than 5 years.
- .2 Installer shall be approved by the product manufacturer.
- .3 The installation of the Safety Surfacing shall be performed by an applicator that can furnish evidence of direct employment by the manufacturer.
- .4 The installation of the Safety Surface shall be overseen by a factory representative.
- .5 Material is used in construction of the Safety Surface System shall be tested for conformance with requirements of ASTM F 1292.

1.8 Field Conditions

- .1 The Contractor shall ensure that the sub-grade and preparatory work in advance of the safety surface has been reviewed by Project Manager before placing the safety surface.
- .2 Inspection and compaction tests of sub-grade, sub-base materials or the supporting base components will be carried out by an independent testing laboratory. Costs of tests will be paid for by the Contractor. Compaction tests of the sub-grade and sub-base materials or the supporting base components must be submitted to Project Manager for approval prior to the installation of the Rubber surface.
- .3 The Contractor must provide a Safety Surface Testing Project Manager for all "Triax" Hic and G-max tests indicated herein.
- .4 Conditions of substrates with respect to structural performance shall be evaluated and approved by the applicator prior to applying the safety surfacing.
- .5 Surfaces are to be installed only when temperatures and weather conditions prior to, during, and after installation will meet manufacturer's requirements.
- .6 Maintain manufacturer's current installation instructions at the job site at all times for safety surface material to be used on the Project.
- .7 Maintain material storage area at temperatures meeting the manufacturer's requirements.
- .8 Proceed with work of this section only after substrate construction and penetrating work have been compacted to 98% of dry density.
- .9 Do not proceed with work during inclement weather. Comply with manufacturer's recommendations for application and curing under specific climatic conditions.

Playground Protective Surfacing

.10 Coordinate application of safety surfacing with work of other trades.

1.9 Warranty

.1 Warrant work of this section in accordance with Section 01 78 36.

.2 Extended warranty:

1. Labour, materials, and workmanship for work of this section:
2. Duration: 2 years.

PART 2 - PRODUCTS

2.1 Performance Requirements

- .1 Shock Absorbency (Where required): When tested in accordance with ASTM F-1292, Test Method F355, Procedure C (Metal Headform), the surface shall not impart to the headform upon impact, a peak deceleration exceeding 200 times the acceleration due to Gravity (200 G's). Drop heights used in this test shall be the heights relevant to the proposed play structures used in conjunction with the safety surfacing areas indicated on the Drawings.
- .2 Weathering: After being subjected to a freeze-thaw cycle in accordance with ASTM C 67 and after being subject 200 Degrees F for seven days in accordance with ASTM D 573, the sample shall be retested in compliance with ASTM F-1292 at 72 Degrees F only. A peak deceleration rereading not exceeding 200 G's shall be maintained.
- .3 Slip Resistance: Wet dynamic reading shall not be less than 40 when tested in accordance with ASTM E 303, using British Portable Skid Resistance Tester.
- .4 Flammability: Minimum Critical radiant flux of 0.22 Watts/CM2 when tested in accordance with ASTM E 648.
- .5 Particulate Rubber Particles must successfully pass ASTM standard CFR 1630 for flammability of carpet and rugs.
- .6 Installed Safety Surface shall meet or exceed CPSC performance guidelines with respect to the Critical Heights of the proposed in-place play equipment.
- .7 Material shall be vandal resistant, firmly secured so that it cannot be pulled away from the playground surface (with the exception of Engineered Wood Fiber).

2.2 Materials

- .1 General:
 1. All material components of the safety surfacing shall be obtained from the same source, Binder type by name must be verified by the Contract Administrator prior to field installation. No substitutions.

Playground Protective Surfacing

2. Safety Surfacing shall be installed in the presence of a factory trained service representative to ensure the highest quality installation.
3. Installation of Safety Surfacing shall be over sub-surface as per manufacturer's instructions and as detailed. The safety surfacing in itself shall not create new hazards; hence all installations shall be done as carefully as possible in a neat and workmanlike manner.
4. Layout of areas of safety surfacing shall be reviewed by the manufacturer's representative to ensure that the proper thickness of safety surface is installed.
5. All work must be protected from vandalism and other damage during the installation.

.2 Materials

1. Surface consisting of recycled rubber tire granules combined together with a polyurethane binder.
2. Binder: A binder, approved by the safety surface manufacturer shall be used.
3. Thinner: A thinner, approved by the safety surface manufacturer shall be used for cleaning tools.
4. Safety Surface System:
5. Shall have been tested for shock attenuation under ASTM F-1292 and HIC.
6. Shall have been tested for non-slip characteristics under ASTM E-303.
7. Shall have been tested for ease of ignition under BS-5696 and ASTM D-2859.
8. Shall have been tested for fire resistance under UL94.
9. Shall contain no latex.

.3 Mixing And Preparation:

1. Mixture of binder and rubber will be determined by the system, which is specified. Verify with manufacturer for specific detailing.

.4 Inspection:

1. Examine areas and conditions where safety surfacing is to be installed and curing of the safety surfaces.

Playground Protective Surfacing

2.3 Cleaning And Protection:

- .1 Clean, repair or replace work of trades soiled or damaged by safety surface installation work.
- .2 The General Contractor shall be responsible for protection of finished surfaces until completion of construction and sign off.

2.4 Acceptable Materials

- .1 Product:
 1. TPV safety surfacing with aliphatic coating.
 - .1 Distributor: Uretech.
 - .2 Colour: four colours to be approved by Consultant.
 2. Fortco Synthetic Safety Surfaces or approved equal.

PART 3 - EXECUTION

3.1 Examination

- .1 Examine areas and conditions where safety surfacing is to be installed and curing of the safety surfaces.
- .2 Verify that the base, drainage system, site conditions, surfaces are ready to receive work and elevations are as indicated on drawings.

3.2 Installation

- .1 Provide safety surface immediately after installing playground equipment.
- .2 Safety Surface shall be installed to thicknesses indicated by the manufacturer/installer. Minimum thicknesses indicated must be based on the performance standards of the approved products.

3.3 Base Preparation

- .1 As specified by manufacturer.
- .2 The granular base can be sloped up to 30 degrees or hills may be incorporated into the installation. Other than obvious undulations, the granular base must be smooth in the direction of the grade.

3.4 Inspection

- .1 Examine areas and conditions where safety surfacing is to be installed and curing of the safety surfaces.

Playground Protective Surfacing

3.5 InSitu Testing

- .1 Certify that installed materials meet the latest CAN/CSA-Z614-07 and ASTM F 1292 Standards and requirements for minimum depths related to most stringent fall heights – to meet 161 G-max / 800 HIC minimum measurements.
- .2 Confirm in writing that the proposed depths shown on the drawings and installed meet the latest edition of safety requirements listed above, and are suitable for the most stringent (highest) play equipment fall heights for the play equipment specified and installed. A minimum of 1 test for each play structure or each stand alone piece of equipment subject to a fall height requirement is required to confirm that play surface meets the requirements for safety as defined in the CSA standard.
- .3 The Contractor will have the product tested by an Independent Testing Project Manager, to determine the average G-max and HIC results of the insitu product. If an average G-max over 161 is registered on site, the Contractor shall be required to have lab testing of insitu samples as per ASTM F 1292 to determine the G-max and HIC at no expense to the Owner.
- .4 All safety surfaces installed in playground applications shall be tested in accordance with the testing requirements of ASTM F1292-99 or the latest version as adopted and endorsed by the CSA Technical Committee related to CAN/CSA-Z614-07. Any safety surface not meeting the requirements of this specification shall be removed in its entirety and replaced by the Contractor at no cost to the Owner.
- .5 Testing of safety surfaces to ensure compliance with this specification shall be completed within 7 days of installation and is required as part of and prior to submission of the City's playground certification form.
- .6 Perform testing in the presence of the Project Manager and submit site testing readings immediately or immediately notify the Project Manager in the event of a failure.
- .7 Submit site testing report including photos of the test locations to the Project Manager within 48 hours of testing.
- .8 Safety Surface testing (Playgrounds) – a minimum of 1 test at 3 locations for each play structure or each stand alone piece of equipment subject to a fall height as defined in the CSA standard CAN/CSA-Z614-07 and the specification herein. Allow for a minimum of 12 tests per site. (Note 1 test = 3 drops at 3 locations for each piece of equipment).
- .9 Failure of the laboratory tests will require replacement of the surface to meet specifications and safety requirements at no cost to the Owner.
- .10 Upon confirming the safety surface compliance the Contractor shall complete and submit the Playground Certification Form and affidavit to the City of Toronto.
- .11 Include a copy of the Playground Certification Form and Warranty in the project operations manual.

Playground Protective Surfacing

- .12 Any installation not tested in accordance with the above or the specifications herein may be subject to removal and reinstallation. All associated costs to correct or to verify the safety surface performance including any removal and reinstallation will be borne by the Contractor.

3.6 Protection

- .1 Protect finished installation in accordance with manufacturer's instructions.

3.7 Cleaning

- .1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Wire Fence and Gates

PART 1 - GENERAL

1.1 Summary

- .1 Section Includes
 - 1. Requirements for wire fencing, gates, and steel posts used in the construction of wire fences

1.2 Measurement Procedures

- .1 Measure supply and erection of wire fence in metres erected including gates.
- .2 Measure supply and erection of wire gates in units of each size erected.

1.3 References

- .1 American Society for Testing and Materials International, (ASTM).ASTM A53/A53M-02, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 1. ASTM A121-99, Specification for Zinc-Coated (Galvanized) Steel Barbed Wire.
 - 2. ASTM D5116-97, Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions From Indoor Materials/Products.
- .2 Canadian General Standards Board (CGSB).
 - 1. CAN/CGSB-1.28-98, Alkyd, Exterior House Paint.
 - 2. CAN/CGSB-1.69-98, Aluminum Paint.
 - 3. CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
 - 4. CAN/CGSB-1-GP-138M-97, Paint Exterior Latex Type Flat.
- .3 Canadian Standards Association (CSA International).
 - 1. CAN/CSA-A23.1-00/A23.2-F00, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.
 - 2. CSA G42-1964(R1998), Galvanized (Zinc-Coated) Steel Farm-Field Wire Fencing.
 - 3. CSA-O80 Series-97, Wood Preservation.
- .4 Environmental Choice Program (ECP).
 - 1. CCD-047a-98, Paints, Surface Coatings.

Wire Fence and Gates

2. CCD-47b-98, Stains, Surface Coatings.
3. CCD-47c-98, Varnishes, Surface Coatings.
4. CCD-048-95, Surface Coatings -Recycled Water-Borne.

1.4 Submittals

.1 Product Data:

1. Submit manufacturer's printed product literature, specifications, and data sheet in accordance with Section 01 33 00 - Submittals, including:
 - .1 Fence and gate posts, rails, and fittings.
 - .2 Gates and hardware.
 - .3 Gate operators, including operating instructions.
2. Shop Drawings:
 - .1 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittals
 - .2 Show locations of fence, each gate, posts, rails, and details of gate swing, or other operation, hardware, and accessories. Indicate materials, dimensions, sizes, weights, and finishes of components. Include plans, elevations, sections, gate swing and other required installation and operational clearances, and details of post anchorage, attachment and bracing. Installation procedures and instructions by manufacturer describing all details for a typical fence and gates.
3. Samples for Verification:
 - .1 Provide a colour chip from the manufacturer.
4. Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions.

1.5 Quality Assurance

- .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.

Wire Fence and Gates

- .3 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

1.6 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 and with Waste Reduction Workplan.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.
- .4 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .5 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material on-site, for recycling in accordance with Waste Management Plan.
- .6 Divert unused metal materials from landfill to metal recycling facility approved by Project Manager.
- .7 Do not dispose of preservative treated wood through incineration.
- .8 Do not dispose of preservative treated wood with other materials destined for recycling or reuse.
- .9 Dispose of treated wood, end pieces, wood scraps and sawdust at sanitary landfill approved by Project Manager.
- .10 Unused wood preservative material must be disposed of at an official hazardous material collections site as approved by the Project Manager. Unused preservative material may not be disposed of into the sewer system, into streams, lakes, onto the ground or in other locations where they will pose a health or environmental hazard.

1.7 Warranty

- .1 Warrant work of this section in accordance with Section 01 78 36.
- .2 Extended warranty:
 - 1. Labour, materials, and workmanship for work of this section:
 - 2. Duration: 2 years.

PART 2 - PRODUCTS

2.1 Products

- .1 Steel mesh fence panels, "Architectural," as manufactured by Omega Fence.
 - .1 Nominal panel height: 1247mm.
 - .2 2354 mm wide, welded by resistance using 6 gauge (4.9 mm) pre-galvanized steel wire, welded at each crossing to form rectangles 1-50.0 x 152.4 mm.
 - .3 Cold rolled annealed wire made of AISI Grade 1018 steel with tensile strength of at least 75 000 psi (515 Mpa) in accordance with ASTM A853.
 - .4 One end of the vertical wires of the panel shall extend 25.4 mm from the last or the first horizontal wire to create a spiked top or bottom depending on installed position. The other end is cut flush.
 - .5 Panels shall have the following number of folds based on the panel height:
 1. 1247mm high nominal panels: 2 folds.
 - .6 Panel Camber may not exceed 2.5mm.
2. Coatings:
 - .1 Zinc coating:
 1. Wire meshes are coated with 150 g/m² zinc in conformity with ASTM A641 Class 1.
 2. Square fence posts, swing gate frame and posts:
 - .1 Thickness of 11GA (3.0 mm) or less: Zinc coated (pre-galvanized process) with a minimum of 275 g/m² as per ASTM A653 Grade 90.
 - .2 Thickness over 1/8 in (3.2 mm): Coated with a minimum of 2.3 oz/ft² (705 g/m²) zinc (hot-dip galvanizing) in conformity with ASTM A123 Grade 100.
 - .2 Polyester Coating:
 1. Polyester coating to be minimum 4 mils applied by an electrostatic process. Coating shall cover all surfaces of the wire and post sections. Coating shall be capable of withstanding the following tests:

Wire Fence and Gates

- .1 Mechanical adhesion test as per ASTM D3359 - Method B.
 - .2 Shock resistance tests as per ASTM D2794.
 - .3 Salt spray testing with a minimum of 1 000 hours without red rust appearance, as per ASTM B117.
 - .4 Humidity resistance in a weather meter chamber as per ASTM D2247.
 - .5 Exposure to ultraviolet light with exposure of 1 000 hours using app
2. Gloss coating colour: silver grey, RAL 7001.
- .2 Posts:
- 1. Cold rolled 1008 grade steel to meet ASTM A500 and ASTM A787 and maximum horizontal loads as indicated by manufacturer.
 - 2. Length: as required for installation type.
 - 3. Installation type: surface-mounted, flanged.
- .3 Post brackets:
- 1. Universal collar bracket kit: universal bracket for standard use on line or end posts 50.8 mm or 76.2 mm. Includes the following: 14 gauge (1.9 mm) steel collar and wire retaining plate 6.4 mm x 25.4 mm, nut, washer and carriage bolt 7.9 mm x 38.1 mm, all galvanized steel.
 - .1 For 90° turn, use the same bracket.
 - .2 Provide 4 brackets per panel.
- .4 Post caps:
- 1. Aluminum alloy: For dimension posts 2 in x 2 in (50.8 mm x 50.8 mm), 3 in x 3 in (76.2 mm x 76.2 mm) and 4 in x 4 in (101.6 mm x 101.6 mm).
 - 2. Finish: polyester powder coating.

2.2 Single / Double Swing Gates

- .1 Configuration
 - 1. Swing as shown on drawings.
- .2 Gate frames:

Wire Fence and Gates

1. Two (2) 38.1 mm x 38.1 mm horizontal tubes and two (2) 50.8 x 50.8 mm vertical tubes, all 16 gauge (1.6 mm) tubes, welded at intersections to create a rigid frame, in accordance with ASTM F900.
- .3 Gate posts:
 1. Cold rolled from 1008 grade steel to meet ASTM A500 and ASTM A787. Posts are to include cap and SPF-W Kit for adjacent panel.
 2. Surface mounted, flanged.
- .4 Gate hardware:
 1. Standard Hardware: Hot-dip galvanized steel in conformity with ASTM F900, sized to assure proper gate operation. Non-moving parts shall be powder coated.
 - .1 Hinge: structurally designed to support all gates without deformation during opening and closing.
 - .2 Latch: clamp-on gravity system that is self latching. Includes the following:
 - .3 - Self-locking Device:
 1. With padlock eyes as an integral part of latch.
- .5 Finish: polyester coating.
- .6 Accessories
 1. Provide mounting kit including pedestal.

PART 3 - EXECUTION

3.1 Examination

- .1 Examine areas and conditions, with Installer present, for compliance with requirements for a verified survey of property lines and legal boundaries, site clearing, earthwork, pavement work, and other conditions affecting performance.
- .2 Do not begin installation before final grading is completed, unless otherwise permitted by Architect.
- .3 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Preparation

- .1 Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 ft (152.5 m) or line of sight between.

Wire Fence and Gates

3.3 Installation

- .1 Install the fence along the specified layout according to the drawings. The fence panel shall be installed to maintain a clear minimum distance of 1-1/4 in (31.8 mm) and a maximum distance of 2 in (50.8 mm) from the ground surface. Holes for posts shall be at least 8 in (200 mm) in diameter and at least 42 in (1 070 mm) deep.
- .2 Posts shall be adequately supported within the concrete forms to maintain the required positioning and prescribed level until concrete has set. All necessary anchors and posts shall be at a minimum depth of 36 in (914 mm) into the ground.
- .3 Square Post Installation: Once the concrete is set, the fence sections are fastened to the posts with the desired bracket type.
- .4 Step fence sections to follow slopes. Slide bracket on square posts to the desired height. Always install flush with horizontal wire (no gap). At steep slopes, provide longer posts and panels cut in half as to keep the gap under the panel to a minimum.
- .5 Upon cutting or trimming a post or a wire mesh section, apply a zinc rich primer to the exposed ends and finish with the matching touch-up paint supplied by the manufacturer.
- .6 Gate:
 1. Install gate posts in accordance with manufacturer's instructions.
 2. Concrete Set Gate Posts: Drill holes in firm, undisturbed or compacted soil. Holes shall have a diameter 4 times greater than outside dimension of post, and depths approximately 6 in (150 mm) deeper than frost level. Excavate deeper as required for adequate support in soft and loose soils, and for posts with heavy lateral loads. Set post bottom 36 in (914 mm) below surface when in firm, undisturbed soil. Place concrete around posts in a continuous pour, tamp for consolidation. Trowel finish around post and slope to direct water away from posts. Check each post for vertical and top alignment and maintain in position during placement and finishing operations.
 3. Install gates perfectly horizontal and levelled (at junction), plumb, and secure for full opening without interference.
 4. Attach hardware so to have the nuts inside the property thus making the assembly tamper-proof which will prevent unauthorized removal. Install ground-set items in concrete for anchorage.
 5. Adjust hardware for smooth operation and lubricate where necessary to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

Wire Fence and Gates

3.4 CLEANING

- .1 Perform cleaning as soon as possible after installation.
- .2 Clean and trim areas disturbed by operations. Dispose of surplus material and waste per requirements of Section 01 74 19.
- .3 Clean damaged painted metal surfaces with wire brush removing loose and cracked coatings. Apply two coats of same paint to damaged areas.
- .4 Clean damaged galvanized surfaces with wire brush removing loose and cracked coatings. Apply two coats of organic zinc-rich coating.
- .5 Upon completion of installation, remove surplus materials, rubbish, tools, and equipment barriers.

END OF SECTION

- 1 General
 - 1.1 **SECTION INCLUDES**
 - .1 Provision of all labour, materials, equipment and incidental services necessary to supply and install site furnishings.
 - 1.2 **PROTECTION OF EXISTING FEATURES**
 - .1 Building and surface features.
 - .1 Protect surface features which may be affected by work from damage while work is in progress. In the event of damage, immediately make repair to the approval of the landscape architect.
 - 1.3 **MEASUREMENT FOR PAYMENT**
 - .1 Items will be paid for as per the Unit Schedule. Payment includes installation, excavation (as required) and all materials, labour and incidentals required to complete the work.
- 2 Products
 - 2.1 **MATERIALS**
 - .1 Precast concrete bench by Ed's Concrete 519-271-6590.
Model No. CU204820 and CU209420, Custom angles as shown on L2.
Finish: Sandblast
Install as per manufacturer's instructions on granular base.
 - .2 Planter edging by Green Theory c/o Park Street Solutions 1-888-788-7408.
Model No. Join Edging, 700mm height.
Finish: Aluminum Matte Black
Install as per detail on L2, and as per manufacturer's instructions. Provide shop drawings for review.
 - .1 Green roof components by Zinco 905-690-1661 or approved equal.
Model No. Root Barrier – WSB100
 Drainage layer – FD60
Install as per detail on L2 and as per manufacturer's instructions. Provide shop drawings for review.
- 3 Execution
 - 3.1 **INSTALLATION**
 - .1 Install as per the details identified on drawing L2.
 - .2 Prior to installation provide layout to the approval of the landscape architect.

END OF SECTION

- 1 General
- 1.1 **RELATED WORK**
 - .1 Section 31 22 19 Topsoil & Finish Grading
- 1.2 **SOURCE QUALITY CONTROL**
 - .1 Obtain approval from Landscape Architect of sod at source.
 - .2 Notify Landscape Architect of source of material at least 7 days in advance of shipment. No work under this Section is to proceed without approval.
 - .3 Acceptance of plant material at its source does not prevent rejection on site prior to or after planting operations.
- 1.3 **MEASUREMENT FOR PAYMENT**
 - .1 Payment will be unit price for supply and installation of trees and shrubs. Installation includes:
 - .1 Excavations for planting.
 - .2 Supply of peat moss and fertilizer for planting.
 - .3 Tree and shrub placement as shown on planting details.
 - .4 Staking and guying as per specification.
 - .5 Mulching.
- 1.4 **SHIPMENT AND PRE-PLANTING CARE**
 - .1 Coordinate shipping of plants and excavation of holes to ensure minimum time lapse between digging and planting.
 - .2 Tie branches of trees and shrubs securely and protect plant material against abrasion, exposure and extreme temperature change during transit. Avoid binding of plant stock with rope or wire which would damage bark, break branches or destroy natural shape of plant. Give full support to root ball of large trees during lifting.
 - .3 Cover plant foliage with tarpaulin, and protect roots by means of dampened straw, peatmoss, sawdust, or other acceptable material to prevent loss of moisture during transit and storage.
 - .4 Remove broken and damaged roots with sharp pruning shears.
 - .5 Keep roots moist and protected from sun and wind. Heel in trees and shrubs, which cannot be planted immediately, in shaded areas and water well. Heeled in trees and shrubs are to be kept to a minimum on-site. Landscape Architect must be notified prior to any on-site storage of materials.
- 1.5 **GUARANTEE**
 - .1 Provide a written guarantee, signed and issued to the owner stating that the plant material as itemized on the plant list is guaranteed against defects for a period of twelve (12) months from the date of Acceptance.
 - .2 End-of-warranty inspection will be conducted by the Landscape Architect.
 - .3 Landscape Architect reserves the right to extend Contractor's warranty responsibilities for an additional one year if, at end of initial warranty period, leaf development and growth on trees and shrubs is not sufficient to ensure future survival.

1.6

REPLACEMENTS

- .1 If any plant material is found either dead or not in satisfactory health as determined by the Landscape Architect, it will, upon request, be immediately removed from the site and replace as soon as conditions permit during the normal planting season.
- .2 Replace dead plant material immediately.
- .3 Extend warranty on replacement plant material for a period equal to the original warranty period.
- .4 Continue such replacement and warranty until plant material is accepted by the Landscape Architect.

2

Products

2.1

MATERIALS

- .1 Water: potable and free of minerals which may be detrimental to plant growth. use appropriate treegator watering bag as specified in tree planting details.
- .2 Stakes: Wood stakes 40 x 40 x 5 x 2440 mm.
- .3 Guy Wires: steel wire strand at following size.
 - .1 Shrubs and trees under 75 mm caliper use No. 12 galvanized wire (not on podium deck)
- .4 Tree Rings: fabricated from 3 mm galvanized wire encased in two ply reinforced 12 mm diameter rubber garden hose or equivalent.
- .5 Tree Wrapping Material:
Not Applicable
- .6 Mulch: Submit sample prior to shipping to site for approval by Landscape Architect:
 - .1 Shredded bark mulch: free of small branches, leaves and varying in size with no pieces thicker than 12 mm.
- .7 Anti-desiccant: Wax-like emulsion to provide film over plant surfaces reducing evaporation but permeable enough to permit transpiration.
- .8 Fertilizer: 6-24-24 at 12lbs per 1000sq ft incorporated to half rootball depth, and to the dripline of trees.
- .9 Peatmoss:
 - .1 Derived from partially decomposed fibrous or cellular stems and leaves of species of Sphagnum Mosses.
 - .2 Elastic and homogeneous, brown in colour.
 - .3 Free of wood and deleterious material which could prohibit growth.
 - .4 Shredded particle minimum size: 5 mm.

2.2

PLANT MATERIAL

- .1 Quality and Source:
Comply with Guide Specification for Nursery Stock, latest edition of Canadian Nursery

Trades Association referring to size and development of plant material and root ball. Measure plants when branches are in their natural position. Height and spread dimensions refer to main body of plant and not from branch tip to branch tip. Use trees and shrubs of No. 1 grade.

.2 Additional plant material qualifications:

.1 Plant material obtained from areas with milder climatic conditions from those of site acceptable only when moved to site prior to the breaking of buds in their original location and heeled-in, in a protected area until conditions suitable for planting.

.2 Use trees and shrubs with strong fibrous root system free of disease, insects, defects or injuries and structurally sound. Use trees with straight trunks, well and characteristically branched for species. Plants must have been root pruned regularly, but not later than one growing season prior to arrival on site.

.3 Large trees must have been half root pruned during each of two successive growing seasons, the latter at least one growing season prior to arrival on site.

.4 Plant material that has come out of dormant stage and is too far advanced will not be accepted unless prior approval obtained.

.3 Cold Storage:

Approval required by Landscape Architect for plant material which has been held in cold storage.

.4 Container Grown Stock:

.1 Acceptable if containers large enough for root development. Trees and shrubs must have grown in container for a 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 been root bound are not acceptable. Container stock must be fertilized with slow releasing fertilizer.

.5 Balled and Burlapped:

Coniferous and broad-leaved evergreens over 500 mm tall must be dug with soil ball.

Deciduous trees in excess of 3 m height must have been dug with large firm ball. Root balls must include 75% of fibrous and feeder root system. This excludes use of native trees grown in light sandy or rocky soil. Secure root balls with burlap, heavy twine and rope.

For large trees: wrap ball in double layer of burlap and drum lace with minimum 10 mm dia. rope. Protect root balls against sudden changes in temperature and exposure to heavy rainfall.

.6 Substitutions:

Substitutions to plant material as indicated on planting plan are not permitted unless written approval has been obtained from Landscape Architect as to type, variety and size. Plant substitutions must be of similar species and of equal size as those originally specified.

- 3 Execution
 - 3.1 **WORKMANSHIP**
 - .1 Obtain approval prior to excavating.
 - .2 Apply anti-desiccant in accordance with material manufacturer’s instructions.
 - .3 Coordinate operations. Keep site clean and planting holes drained. Immediately remove soil or debris spilled onto pavement.
 - 3.2 **PLANTING TIME**
 - .1 Plant deciduous plant material during dormant period before buds have broken. Plant material noted for spring planting must be planted in dormant period.
 - .2 Plant material imported from region with warmer climatic conditions may only be planted in early spring.
 - .3 When permission has been obtained to plant deciduous plant material after buds have broken, spray plants with anti-desiccant to slow down transpiration prior to transplanting.
 - .4 Plant evergreens in spring before bud break.
 - .5 When permission has been obtained, trees and shrubs, and ground covers growing in containers may be planted throughout growing season.
 - .6 Plant only under conditions that are conducive to health and physical conditions of plants.
 - .7 Provide planting schedule:
Extended planting operations over long period using limited crew will not be accepted.
 - 3.3 **EXCAVATION**
 - .1 Individual shrubs:
excavate planting holes 250 mm deep and at least 250 mm wide.
 - .2 Small trees (up to .30 m):
excavate holes 450 mm deep with diameter of 300 mm greater than root spread or root ball.
 - .3 Large trees:
excavate to depth of 500 mm with width of 750 mm greater than diameter of root ball. In heavy soils, increasing planting holes by 50 mm for each 100 mm of root ball diameter.
 - 3.4 **PLANTING**
 - .1 Plant trees and shrubs vertically with roots placed straight out in hole. Orient plant material to give best appearance.
 - .2 Place plant material to depth equal to depth they were originally growing in nursery.

- .3 With balled and burlapped root balls, loosen burlap and cut away minimum top 1/3 without disturbing root ball. Do not pull burlap or rope from under root ball. With container stock, remove entire container without disturbing root ball. Non-biodegradable wrappings must be removed.
- .4 Tamp planting soil around root system in layers of 150 mm eliminating air voids. Frozen or saturated planting soil is unacceptable. When 1/3 of planting soil has been placed, fill hole with water. After water has completely penetrated into soil, complete backfilling with mixture of planting soil, peatmoss and 1:4:2 slow release fertilizer.
- .5 Build 100 mm deep saucer around outer edge of hole to assist with maintenance watering.
- .6 When planting is completed, give surface of planting saucer dressing of 1:2:2 fertilizer at rate of 12 kg/100 m.2 Mix fertilizer thoroughly with top layer of planting soil and water in well.

3.5 **TREE SUPPORT**

- .1 Tree support is shown on planting details.

3.6 **PRUNING**

- .1 Prune trees and shrubs after planting where damage has occurred during shipping or planting. Postpone pruning, of those trees where heavy bleeding may occur, until in full leaf. Employ clean sharp tools and make cuts flush with main branch, smooth and sloping as to prevent accumulation of water. Remove projecting stubs on trunks or main branches. Remove dead and injured branches and branches that rub causing damage to bark, without changing the plants natural shape. Do not damage lead branches or remove smaller twigs along main branches.

3.7 **MULCHING**

- .1 Obtain approval of planting material installations before mulch is applied. Loosen soil in planting beds and pits and remove debris and weeds. Spread mulch to a minimum thickness of 100 mm. Mulch material susceptible to blowing must be moistened down and mixed with topsoil before applying or will not be acceptable.
- .2 Mulch material sample must be provided to the landscape consultant for approval prior to the successful contractor shipping the material to the site.

3.8 **MAINTENANCE**

- .1 Water twice a week for first 4 weeks and then sufficiently thereafter to maintain optimum growing conditions (assumed to be once every two weeks thereafter from June through to September). Ensure adequate moisture in root zone at freeze-up.
- .2 Spray plants to combat pests and diseases, as required. Do not use DDT or sprays prohibited by Agriculture Canada.
- .3 Keep stakes and guy wires in proper repair.

- .4 Provide adequate protection against winter damage including damage caused by rodents.
- .5 Maintain plant material from date of planting up to end of warranty period.
- .6 Remove trunk wrapping, guy wires and tree stakes at end of warranty period.

3.9

ACCEPTANCE

- .1 Trees, shrubs and ground covers must be healthy and in a vigorous growing condition at the time the final inspection review for the landscape components of the project is requested.
- .2 Trees, shrubs and ground covers planted in the fall will be evaluated for final acceptance in the following spring one month after start of growing season.

END OF SECTION

Subgrade Drainage

PART 1 - GENERAL

1.1 Summary

- .1 Section includes:
 - 1. Materials and installation for constructing sub-drains with granular filter and/or geotextile filter material.

1.2 Measurement Procedures

- .1 Excavation and backfill will be measured under Section 31 23 00 – Excavation and Fill.
- .2 Supply of sub-drain pipe will be measured in metres, of each type and size indicated and in authorized quantities delivered to designated storage area.
- .3 Bedding gravel and filter material will be measured in cubic metres of material incorporated into Work. No deduction to be made for volume occupied by drain pipe.
- .4 Supply and installation of pipe sub-drains will be measured in metres of each type and size installed.
- .5 Horizontal measurement will be made from centre to centre of manholes or catch basins over surface after work has been completed.
- .6 In cases where drain pipe is not connected to manholes or catch basins measurement will be actual length in place.
- .7 Supply and installation of sub-drainage including, trenching, backfill, bedding, granular filter material and geotextile will be measured horizontally from manhole face to manhole face in metres of each pipe size and depth class installed.

1.3 References

- .1 Canadian Standards Association (CSA International)
- .2 CSA B1800-[02], Plastic Non-pressure Pipe Compendium - B1800 Series (Consists of B181.1, B181.2, B181.3, B181.5, B182.1, B182.2, B182.4, B182.6, B182.7, B182.8 and B182.11).
- .3 CSA B182.1-[02], Plastic Drain and Sewer Pipe and Pipe Fittings.
- .4 CSA-G401-[01], Corrugated Steel Pipe Products.

1.4 Submittals

- .1 Submit samples in accordance with Section 01 33 00.

Subgrade Drainage

- .2 Inform the Contract Administrator of proposed source of bedding and filter materials and provide access for sampling at least 4 weeks prior to commencing work.
- .3 Submit manufacturer's test data and certification that drain pipe materials meet requirements of this Section at least 4 weeks prior to beginning Work.
- .4 Certification to be marked on pipe.

1.5 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 74 21.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .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.
- .4 Separate for reuse and/or recycling and place in designated containers: Steel, Metal, Plastic waste in accordance with Waste Management Plan.
- .5 Divert all unused metals, concretes, aggregates, piping materials to appropriate recycling or disposal facilities as approved by the Project Manager.
- .6 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 - PRODUCTS

2.1 Materials

- .1 Catch basins:
 1. All catch basin parts as manufactured by NDS, Vodaland or approved equal:
 2. 227x 227 mm catch basin, NDS #900-4.
- .2 PVC DR28 hard pipe and fittings: Nominal pipe size 152mm diameter.
- .3 Perforated plastic pipe and fittings: to CAN/CSA B 181.2-M85 & CAN/CSAB-182.1-M83. Nominal pipe size 102mm.
 1. Product: Big 'O' with filter sock by Armttec or approved equal.
- .4 Bedding gravel or crushed stone: 10mm diameter clear stone, to completely surround pipe.
- .5 Filter cloth: Geotextile No. P200 as manufactured by Terrafix or approved equal.

Subgrade Drainage

PART 3 - EXECUTION

3.1 Excavation

- .1 Excavate area to depths as indicated. Compact sub grade to 95% S.P.D
- .2 Bedding:
 1. Place 100 mm layer of bedding material over entire excavated area and compact to 95% S.P.D.

3.2 Installation Of Catch Basins

- .1 Assemble units in accordance with details indicated, plumb and true to alignment and grade.
- .2 Dewater excavation to approval of Project Manager and remove soft and foreign material.
- .3 Set base on +/- 300 mm minimum of granular bedding compacted to 100% corrected maximum dry density.
- .4 Compact granular backfill to 95% corrected maximum dry density.
- .5 Place un-shrinkable backfill in accordance with Section 31 32 33.01.
- .6 Place frame and cover on top section to elevation as indicated.
- .7 Clean units of debris and foreign materials.
 1. Remove fins and sharp projections.
 2. Prevent debris from entering system.

3.3 Installation Pipe Sub-Drains

- .1 Lay drains on prepared bed true to line and grade with inverts smooth and free of sags or high points. Ensure barrel of each pipe is in contact with bed throughout full length.
- .2 Commence laying at outlet and proceed in upstream direction. Where perforated pipe is to be installed lay pipe with perforations downward. Make joints tight in accordance with manufacturer's instructions. Do not allow water to flow through pipes during construction except as approved. Perforated pipe plug open upstream end of pipe with approved closure. Surround pipe with filter material and clear stone bedding material compacted to 95%. S.P.D.

END OF SECTION

Metro Hall - Washroom Accessories Schedule

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Room	Accessory	Tag	Description	Quantity	Supply	Install	Other Requirements
C104 Meeting Room	Paper Towel Dispenser	WA3.1	By Client	1	CS	GC	
C104 Meeting Room	Soap Dispenser	WA9.1	By Client	1	CS	GC	
C105 Preschool Activity 1	Paper Towel Dispenser	WA3.1	By Client	1	CS	GC	
C105 Preschool Activity 1	Paper Towel Dispenser (Child-Height)	WA3.2	By Client	1	CS	GC	
C105 Preschool Activity 1	Soap Dispenser	WA9.1	By Client	1	CS	GC	
C106 Preschool Washroom	Paper Towel Dispenser	WA3.2	By Client	4	CS	GC	
C106 Preschool Washroom	Toilet Tissue Dispenser	WA6.2	By Client	4	CS	GC	
C107 Preschool Activity 2	Paper Towel Dispenser	WA3.1	By Client	1	CS	GC	
C107 Preschool Activity 2	Paper Towel Dispenser (Child-Height)	WA3.2	By Client	1	CS	GC	
C107 Preschool Activity 2	Soap Dispenser	WA9.1	By Client	1	CS	GC	
C108C Infant Washroom	Paper Towel Dispenser	WA3.1	By Client	1	CS	GC	
C108C Infant Washroom	Paper Towel Dispenser	WA3.2	By Client	1	CS	GC	
C108C Infant Washroom	Toilet Tissue Dispenser	WA6.2	By Client	1	CS	GC	
C109 Toddler Activity 1	Paper Towel Dispenser	WA3.1	By Client	1	CS	GC	
C109 Toddler Activity 1	Paper Towel Dispenser	WA3.2	By Client	1	CS	GC	
C109 Toddler Activity 1	Soap Dispenser	WA9.1	By Client	1	CS	GC	
C110 Toddler Washroom	Paper Towel Dispenser	WA3.1	By Client	2	CS	GC	
C110 Toddler Washroom	Paper Towel Dispenser	WA3.2	By Client	2	CS	GC	
C110 Toddler Washroom	Toilet Tissue Dispenser	WA6.2	By Client	3	CS	GC	
C109 Toddler Activity 2	Paper Towel Dispenser	WA3.1	By Client	1	CS	GC	
C109 Toddler Activity 2	Paper Towel Dispenser	WA3.2	By Client	1	CS	GC	
C109 Toddler Activity 2	Soap Dispenser	WA9.1	By Client	1	CS	GC	
C113 Laundry & Toy Wash	Paper Towel Dispenser	WA3.1	By Client	1	CS	GC	
C113 Laundry & Toy Wash	Soap Dispenser	WA9.1	By Client	1	CS	GC	
C114 Servery	Paper Towel Dispenser	WA3.1	By Client	2	CS	GC	
C114 Servery	Soap Dispenser	WA9.1	By Client	2	CS	GC	

Metro Hall - Washroom Accessories Schedule

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Room	Accessory	Tag	Description	Quantity	Supply	Install	Other Requirements
C115 Staff Washroom	Grab Bar (Toilet)	WA1.2	Bobrick B-5806.99 × 42	1	GC	GC	
C115 Staff Washroom	Grab Bar (90°)	WA1.5	Bobrick B-5898.99 2583	1	GC	GC	
C115 Staff Washroom	Grab Bar (Drop-down)	WA1.6	Bobrick B-4998.99	1	GC	GC	
C115 Staff Washroom	Hook	WA13.2	Frost 1150-SS	2	GC	GC	
C115 Staff Washroom	Shelf	WA13.4	Frost 950-4	1	GC	GC	
C115 Staff Washroom	Mirror	WA17.1	B-1658 2436	1	GC	GC	
C115 Staff Washroom	Combination Paper Dispenser/Waste Receptor	WA2.1	Bobrick B-369	1	GC	GC	
C115 Staff Washroom	Paper Towel Dispenser	WA3.1	By Client	1	CS	GC	
C115 Staff Washroom	Sanitary Napkin Disposal	WA5.1	By Client	1	CS	GC	
C115 Staff Washroom	Toilet Tissue Dispenser	WA6.1	B-2888	1	GC	GC	
C115 Staff Washroom	Sanitary Napkin Dispenser	WA8.1	By Client	1	CS	GC	
C115 Staff Washroom	Soap Dispenser	WA9.1	By Client	1	CS	GC	
C116 Staff Washroom	Grab Bar (Toilet)	WA1.2	Bobrick B-5806.99 × 42	1	GC	GC	
C116 Staff Washroom	Grab Bar (90°)	WA1.5	Bobrick B-5898.99 2583	1	GC	GC	
C116 Staff Washroom	Hook	WA13.2	Frost 1150-SS	2	GC	GC	
C116 Staff Washroom	Shelf	WA13.4	Frost 950-4	1	GC	GC	
C116 Staff Washroom	Mirror	WA17.1	B-1658 2436	1	GC	GC	
C116 Staff Washroom	Combination Paper Dispenser/Waste Receptor	WA2.1	Bobrick B-369	1	GC	GC	
C116 Staff Washroom	Paper Towel Dispenser	WA3.1	By Client	1	CS	GC	
C116 Staff Washroom	Sanitary Napkin Disposal	WA5.1	By Client	1	CS	GC	
C116 Staff Washroom	Toilet Tissue Dispenser	WA6.1	B-2888	1	GC	GC	
C116 Staff Washroom	Sanitary Napkin Dispenser	WA8.1	By Client	1	CS	GC	
C116 Staff Washroom	Soap Dispenser	WA9.1	By Client	1	CS	GC	
C117 Staff Room	Paper Towel Dispenser	WA3.1	By Client	1	CS	GC	
C117 Staff Room	Soap Dispenser	WA9.1	By Client	1	CS	GC	

Responsibility Matrix Legend

- CS | Toronto Children's Services
- GC | General Contractor

Metro Hall - Furniture, Fixture, & Equipment Responsibility Matrix

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Room	Element	Description	Quantity	Supply	Install	Part of Contract	Blocking	HVAC	Plumbing	Power	Security	Comm.	
C102 Office	Work Station with Adjustable Work Surface	Refer to Furniture Schedule	2	GC	FV	See Note 4				x			
C102 Office	Mobile Storage Pedestal		2	GC	FV	See Note 4							
C102 Office	Lateral File Storage Cabinet		3	GC	FV	See Note 4							
C102 Office	Work Table		1	GC	FV	See Note 4							
C102 Office	Office Seating		2	GC	FV	See Note 4							
C102 Office	Guest Seating		4	GC	FV	See Note 4							
C102 Office	Desk Phone	By TS	3	TS	TS	See Note 1				x		x	
C102 Office	Desktop PC		2	TS	TS	See Note 1				x		x	
C102 Office	Keyboard		2	TS	TS	NIC							
C102 Office	Mouse		2	TS	TS	NIC							
C102 Office	Monitor		2	TS	TS	NIC							
C102 Office	Docking Station		2	TS	TS	NIC							
C102 Office	Printer		1	TS	TS	NIC					x		x
C102 Office	Video Intercom		Aiphone	1	Cor Sec	Cor Sec	See Note 1				x		x
C104 Meeting Room	Conference Table		Refer to Furniture Schedule	1	GC	FV	See Note 4						
C104 Meeting Room	Conference Seating			4	GC	FV	See Note 4						
C104 Meeting Room	Desktop PC	By TS	1	TS	TS	See Note 1				x		x	
C104 Meeting Room	Workstation Mount		1	TS	TS	NIC							
C104 Meeting Room	Keyboard (Wireless)		1	TS	TS	NIC							
C104 Meeting Room	Mouse		1	TS	TS	NIC							
C104 Meeting Room	Monitor		1	TS	TS	NIC				x			
C104 Meeting Room	Conference Camera		1	TS	TS	NIC							x
C104 Meeting Room	Conference Camera Mount		1	TS	TS	NIC							
C104 Meeting Room	Video Conferencing System		1	TS	TS	See Note 1					x		x
C104 Meeting Room	TV		65" By CS	1	CS	GC	See Note 3				x		x
C104 Meeting Room	TV: Wall Mount		By CS	1	CS	GC	See Note 2	x					
C105 Preschool Activity 1	Microwave: Countertop	LG or Equivalent by GE, Whirlpool, Frigidaire Model: NeoChef LMC1575ST Capacity: 1.5 Cubic Feet	1	CS	GC	See Note 3				x			
C105 Preschool Activity 1	Refrigerator: Compact	Danby or Equivalent by GE, Whirlpool, Frigidaire Model: DCR044B1SLM Capacity: 4.4 Cubic Feet	1	CS	GC	See Note 3				x			
C105 Preschool Activity 1	Video Intercom	Aiphone	1	Cor Sec	Cor Sec	See Note 1				x		x	
C107 Preschool Activity 2	Microwave: Countertop	LG or Equivalent by GE, Whirlpool, Frigidaire Model: NeoChef LMC1575ST Capacity: 1.5 Cubic Feet	1	CS	GC	See Note 3				x			
C107 Preschool Activity 2	Refrigerator: Compact	Danby or Equivalent by GE, Whirlpool, Frigidaire Model: DCR044B1SLM Capacity: 4.4 Cubic Feet	1	CS	GC	See Note 3				x			
C107 Preschool Activity 2	Video Intercom	Aiphone	1	Cor Sec	Cor Sec	See Note 1				x		x	

Metro Hall - Furniture, Fixture, & Equipment Responsibility Matrix

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Room	Element	Description	Quantity	Supply	Install	Part of Contract	Blocking	HVAC	Plumbing	Power	Security	Comm.
C108 Infant Activity	Microwave: Countertop	LG or Equivalent by GE, Whirlpool, Frigidaire Model: NeoChef LMC1575ST Capacity: 1.5 Cubic Feet	1	CS	GC	See Note 3				x		
C108 Infant Activity	Refrigerator: All-Refrigerator	Whirlpool or Equivalent by GE, Frigidaire Model: WSR57R18DM Capacity: 18 Cubic Feet, 31" (787 mm)	1	CS	GC	See Note 3				x		
C108B Infant Sleep Room	Work Table	Refer to Furniture Schedule	1	GC	FV	See Note 4						
C108B Infant Sleep Room	Chair		1	GC	FV	See Note 4						
C108B Infant Sleep Room	Video Intercom	Aiphone	1	Cor Sec	Cor Sec	See Note 1				x		
C109 Toddler Activity 1	Microwave: Countertop	LG or Equivalent by GE, Whirlpool, Frigidaire Model: NeoChef LMC1575ST Capacity: 1.5 Cubic Feet	1	CS	GC	See Note 3				x		
C109 Toddler Activity 1	Refrigerator: Compact	Danby or Equivalent by GE, Whirlpool, Frigidaire Model: DCR044B1SLM Capacity: 4.4 Cubic Feet	1	CS	GC	See Note 3				x		
C111 Toddler Activity 2	Video Intercom	Aiphone	1	Cor Sec	Cor Sec	See Note 1				x		
C111 Toddler Activity 2	Microwave: Countertop	LG or Equivalent by GE, Whirlpool, Frigidaire Model: NeoChef LMC1575ST Capacity: 1.5 Cubic Feet	1	CS	GC	See Note 3				x		
C111 Toddler Activity 2	Refrigerator: Compact	Danby or Equivalent by GE, Whirlpool, Frigidaire Model: DCR044B1SLM Capacity: 4.4 Cubic Feet	1	CS	GC	See Note 3				x		
C111 Toddler Activity 2	Video Intercom	Aiphone	1	Cor Sec	Cor Sec	See Note 1				x		
C113 Laundry & Toy Wash	Washer: Stackable Front-Loading	General Electric or Equivalent by Whirlpool, Frigidaire Capacity: 5.5 Cubic Feet Model: GFW550SMNWW	2	CS	GC	See Note 3			x	x		
C113 Laundry & Toy Wash	Dryer: Stackable Front-Loading	General Electric or Equivalent by Whirlpool, Frigidaire Capacity: 7.8 Cubic Feet Model: GFD55ESMNWW	1	CS	GC	See Note 3		x		x		
C113 Laundry & Toy Wash	Washer/Dryer Pedestal	Compatible with Washer Model	1	CS	GC	See Note 3						
C113 Laundry & Toy Wash	Washer/Dryer Stack Bracket Kit	Compatible with Washer & Dryer Model	1	CS	GC	See Note 3						

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Room	Element	Description	Quantity	Supply	Install	Part of Contract	Blocking	HVAC	Plumbing	Power	Security	Comm.
C114 Servery	Freezer: Reach-in, Solid Swing Door	True Manufacturing Company Inc. Model: TS-23F-HC or Equivalent	1	CS	GC	See Note 3				x		
C114 Servery	Refrigerator: Reach-in Solid-Swing Door	True Manufacturing Company Inc. Model: T-23-HC or Equivalent	1	CS	GC	See Note 3				x		
C114 Servery	Refrigerator: Top-Freezer	General Electric or Equivalent by Whirlpool, Frigidaire 30" (762 mm) 18 Cubic Feet Model: GTS18FTLKWW or Equivalent	1	CS	GC	See Note 3				x		
C114 Servery	Food Warmer	By CS	2	CS	CS	NIC				x		
C114 Servery	Dishwasher: High Temperature, Ventless	Hobart Model: LXeR Advansys or Equivalent	1	CS	GC	See Note 3			x	x		
C114 Servery	Dishwasher: Stand	Hobart Model: 17" (432 mm) with Detergent Compartment	1	CS	GC	See Note 3						
C114 Servery	Electric Oven & Range: Freestanding	General Electric or Equivalent by Whirlpool, Frigidaire 30" (762 mm) 5.0 Cubic Feet, Self-Cleaning Model: JCB630SVSS	1	CS	GC	See Note 3				x		
C114 Servery	Microwave: Over-the-Range with Hood	General Electric or Equivalent by Whirlpool, Frigidaire Capacity: 1.6 Cubic Feet, 300 CFM Model: JCM635SFC	1	CS	GC	See Note 3	x	x		x		
C114 Servery	Video Intercom	Aiphone	1	Cor Sec	Cor Sec	See Note 1				x		x
C117 Staff Room	Lunch Table	Refer to Furniture Schedule	1	GC	FV	See Note 4						
C117 Staff Room	Sofa		1	GC	FV	See Note 4						
C117 Staff Room	Lunch Seating		4	GC	FV	See Note 4						
C117 Staff Room	Lockers, 3-Tier Stacks		8	GC	FV	See Note 4	x					
C117 Staff Room	Microwave: Countertop	LG or Equivalent by GE, Whirlpool, Frigidaire Model: NeoChef LMC1575ST Capacity: 1.5 Cubic Feet	1	CS	GC	See Note 3				x		
C117 Staff Room	Refrigerator: Top-Freezer	General Electric or Equivalent by Whirlpool, Frigidaire 24" (610 mm) 11.55 Cubic Feet Model: GPE12FGKWW	1	CS	GC	See Note 3				x		
C117 Staff Room	TV	40" By CS	1	CS	GC	See Note 3				x		x
C117 Staff Room	TV: Wall Mount	To Suit TV By CS	1	CS	GC	See Note 2	x					
C117 Staff Room	Video Intercom	Aiphone	1	Cor Sec	Cor Sec	See Note 1				x		
Infant Outdoor Storage	Wall Standards & Melamine Shelving	Knappe and Vogt FAST-MOUNT BK-100 Hang-Trak 0111 Shelf Bracket BK-0103	Ref to Drawings	GC	GC	Y	x					
Toddler Outdoor Storage	Wall Standards & Melamine Shelving	Knappe and Vogt FAST-MOUNT BK-100 Hang-Trak 0111 Shelf Bracket BK-0103	Ref to Drawings	GC	GC	Y	x					
Preschool Outdoor Storage	Wall Standards & Melamine Shelving	Knappe and Vogt FAST-MOUNT BK-100 Hang-Trak 0111 Shelf Bracket BK-0103	Ref to Drawings	GC	GC	Y	x					

Responsibility Matrix Legend

- CS|City of Toronto Children's Services
- Cor Sec|City of Toronto Corporate Security Vendor
- FV|City of Toronto Furniture Vendor
- GC|General Contractor
- TS|City of Toronto Technology Services

Metro Hall Early Learning Child Care Centre - Material / Equipment / Product Schedule

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Reference / Tag	Material / Equipment / Product Description	Finish / Colour	Acceptable Manufacturer/Distributor	Size / Configuration / Performance	Scope of Application	General Locations	Project Manual Section	Or Approved Equal
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Exterior Wood Types

WDE1A	Kebony Clear Dressed	NA	Kebony/North on Sixty	22mm x 98mm	Fence	Outdoor Play Areas	06 20 00 Exterior Woodwork	Ref to Specification
WDE1B	Kebony Clear Dressed	NA		22mm x 148mm	Fence			
WDE1C	Kebony Clear Dressed	NA		22mm x 198mm	Fence			
WDE2	Kebony Deck Board 2637 & 2638	NA		22mm x 140mm	Deck			
WDE3A	Kebony Clear Dressed	NA		38mm x 85mm	Furniture			
WDE3B	Kebony Clear Dressed	NA		38mm x 140mm	Furniture			

Roofing Membrane Types

AVBMC1	Henry LowSlope One-Ply Self-Adhered Waterproof Roll Roofing	NA	Henry	Ref to Specifications	Storage	Outdoor Play Areas	06 20 00 Exterior Woodwork	Ref to Specification
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Air Barrier Membrane Types

ABMC1	AirOutshield UV	Top: Black Coated Bottom: Black Textured	SRP Canada	Ref to Specifications	Storage	Outdoor Play Areas	06 20 00 Exterior Woodwork	Ref to Specification
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Wood Types

WD1	White Oak Veneer on Particle Board Core	Quarter Cut	NA	Panel: 19 mm & 25 mm Thick	Willwork	Activity Servery Corridor Children's Washrooms	06 40 00 Architectural Woodwork	NA
WD1A	Solid White Oak Edging	Quarter Cut	NA	Ref to Drawings	Millwork	Activity Servery Corridor Children's Washrooms		
WD2	Post-Catalyzed MDF	NA	NA	Ref to Drawings	Millwork	Corridor		

Solid Surface Types

SSM1	Avonite, Nordic	Colour: Nordic 9119	Trinseo	12 mm Thick	Millwork	Activity Adult Washrooms Children's Washrooms Servery Staff Laundry & Toy Wash Meeting	06 40 00 Architectural Woodwork	DuPont Corian
SSM2	Avonite	Colour: Custom	Trinseo	12 mm Thick	Millwork	Servery		

Plastic Laminate Types

PLam1	Plastic Laminate, Colour 1	TBD	Abet Laminati		Millwork	Meeting Staff Laundry & Toy Wash	06 40 00 Architectural Woodwork	Formica Wilsonart
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Change Table Types

MCT1a	Toddler Changing Table with Sink, SKU TM8543A S2222	Maple	Totmate	1511mm x 952mm x 597mm Stair at Left	Floor	Children's Washrooms	06 40 00 Architectural Woodwork	NA
MCT1b	Toddler Changing Table with Sink, SKU TM8520A S2222	Maple	Totmate	1511mm x 952mm x 597mm Stair at Right	Floor	Children's Washrooms		

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Air Grill Types

FLGR1A	Extruded Aluminum Linear Grille, Pressed Core, 4900 Series	Anodized Clear, "SA"	Nailor	49-480, 6.35mm Blade Spacing, 3 mm Bars, 152mm Wide, Type 'F' Frame, Countersunk Mounting Bracket, Mitered Corners	Walls	Activity Vestibule Sleep	06 40 00 Architectural Woodwork	As Indicated in This Schedule
	Extruded Aluminum Linear Grille, Pressed Core, LBP	Anodized Clear, "AC"	EH Price	15A, 6.35mm Blade Spacing, 2.38mm Bars, 152mm Wide, 1000 Frame & 'A' Type Countersunk Mounting Bracket, Mitered Corners				

Display Types

TBD1	Frame: Series 9100, Radius Corner Surface: Forbo Bulletin Board	Frame: Clear, Anodized Alum Surface: Oyster Shell 2206	ASI Group	Horizontal 1220mm x 1220mm	Wall	Activity	06 40 00 Architectural Woodwork	Ref to Specification
TBD2	Frame: Series 9100, Radius Corner Surface: Forbo Bulletin Board	Frame: Clear, Anodized Alum Surface: Oyster Shell 2206	ASI Group	Horizontal 1220mm x 1830mm	Wall	Activity		
TBD3	Frame: Series 9100, Radius Corner Surface: Forbo Bulletin Board	Frame: Clear, Anodized Alum Surface: Oyster Shell 2206	ASI Group	Horizontal 1220mm x 2440mm	Wall	Activity		

Waterproofing Membrane Types

WPMC1	Pumadeq Flex 31MV		Henry	Ref to Specifications	Plaza Deck	Outdoor Play Areas	Fluid Applied Waterproofing	Ref to Specification
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Corner Guard Types

CG1	Curved Outside Corner, DRMC-OS-75	White	Fry-Reglet	76mm Radius	Wall	Ref to Drawings	09 29 00 Gypsum & Cement Board	Ref to Specification
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Tiling Types

TLC1	Micro Joint	Colour: Azure Finish: Matte	Terratinta Group Micro/Stone Tile Canada	70 x 280 mm	Backsplash	Activity Children's Washrooms	09 31 00 Tiling	Centura, OlympiaTile
TLC2	Micro Joint	Colour: White Finish: Matte		70 x 280 mm	Backsplash	Servery Adult Washrooms Children's Washrooms		
TLC3	Cementum	Colour: Sand Finish: Matte	Stone Tile Canada	300 x 600 x 10 mm	Floor	Adult Washrooms Children's Washrooms		

Acoustic Panel Types

APN1	Techstyle Acoustic Ceiling Panel, Swing-Down	White, Coated Fibreglass Mat	CertainTeed	610 x 1830 x 28.6 mm	Ceiling	Refer to RCP	09 51 13 Acoustic Panel Ceiling Systems	Armstrong CGC
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Acoustic Tile Types

ACT1	Dune, 1773 HRC	White	Armstrong	610 x 1220 x 16 mm	Ceiling	Refer to RCP	09 51 23 Acoustic Tile Ceiling Systems	As Indicated in This Schedule
	Sand Micro, SHM197	White	CertainTeed					
	Astro, 8241	Flat White	CGC					

Resilient Base Types

BTC1	Pinnacle Cove Wall Base	Colour: Lunar Dust	Roppe	100 mm High x 3.125 mm Thick	Wall Base	Ref to Drawings	09 65 13 Resilient Base and Accessories	As Indicated in This Schedule
	Johnsonite Baseworks, Traditional Thermoplastic Rubber Wall Base Covered	Colour 1	Tarkett					
	Burkbase Thermoplastic Rubber Base Type TP Covered	Colour 1	Mannington					
BTC2	Pinnacle Cove Wall Base	Colour 2	Roppe					
	Burkbase Thermoplastic Rubber Base Type TP Covered	Colour 2	Mannington					
	Burkbase Thermoplastic Rubber Base Type TP Covered	Colour 2	Mannington					

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Resilient Floor Types

RSFC1	DLW Arabesque	Colour: Arabesue, Antico 0302	Gerflor	2.5 mm Thick	Floor Finish	Activity Sleep	09 65 43 Linoleum	Tarkett Forbo
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Wall Panel

AWP1	Arcus, ARC-3D-x-118-118	Colour: Castle Rock	Akustus/Sound Solutions	2100 x 756 x 65 mm	Walls	Activity		Artofix Sonus
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Fluid Applied Floor Types

EPX	Sikafloor 261CA	TBC (Manufacturer's Standard Range)	Sika	Ref to Specifications	Floor	Seryer Janitor	09 67 00 Fluid Applied Floor & Wall Coatings	As Indicated in This Schedule
	StonKote GS4	TBC (Manufacturer's Standard Range)	Stonhard					

Paint Types

PT1	OC-65 "Chantilly Lace"	Benjamin Moore Dulux	Semi-gloss	Walls: Background	Ref to Drawings	09 91 00 Painting	Benjamin Moore Dulux PPG Paints Sherwin-Williams
PT2	DLX1022 "Rock Slide"		Semi-gloss	Walls: Accent (Dark Green)	Ref to Drawings		
PT3	Colour 3		Semi-gloss	Walls, Ceilings: (White)	Ref to Drawings		
PT4	Colour 4		Semi-gloss	Walls	Ref to Drawings		
PT5	Colour 5		Semi-gloss	Walls	Ref to Drawings		
PT6	Colour 6		Semi-gloss	Walls	Ref to Drawings		
PT7	Colour 7		Semi-gloss	Walls	Ref to Drawings		
PT8	Colour 8		Semi-gloss	Walls	Ref to Drawings		
PT9	Colour 9		Semi-gloss	Walls	Ref to Drawings		
PT10	Colour 10		Semi-gloss	Ceilings, Metal: (Black)	Ref to Drawings		

Window Shade Fabric Types

WS	Fabric Basis of Design: E Screen	Basis of Design: Mermet	3% Openness, Conventional Basketweave	Curtain Wall	Activity Sleep	12 24 13 Roller Window Shades	Ref to Specification
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Applied Film

FILMC1	3M Film	TBC			Ref to Drawings	Applied Films	Ref to Specification
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Plastic Mirror

PLMir	Fabback Acrylic Mirror Sheet	Machine & Edge Relief	Plastokite	3mm Thick		Ref to Drawings	Ref to Specification
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Turf

TRF	Play Platinum Artificial Turf	NA	SYNLawn	Per Manufacturer's Requirements	Pavement	Outdoor Play Areas	32 18 13 Synthetic Turf Surfacing	As Indicated in This Schedule
	Triblend 70 Landscape Turf	NA	Rymar Grass					

Rubber Safety Surfacing

RSS1	Playsoft TPV Safety Surfacing with Aliphatic Coating	Colour 1	Uretech	19mm on Minimum 25mm Buffer	Pavement	Outdoor Play Areas	32 18 16 Playground Protective Surfacing	TBD
RSS2	Playsoft TPV Safety Surfacing with Aliphatic Coating	Colour 2	Uretech	19mm on Mimum 25mm Buffer	Pavement	Outdoor Play Areas		
RSS3	Playsoft TPV Safety Surfacing with Aliphatic Coating	Colour 3	Uretech	19mm on Mimum 25mm Buffer	Pavement	Outdoor Play Areas		
RSS4	Playsoft TPV Safety Surfacing with Aliphatic Coating	Colour 4	Uretech	19mm on Mimum 25mm Buffer	Pavement	Outdoor Play Areas		